



EUROPEAN CENTRAL BANK

EUROSYSTEM



**ECB FORUM**  
**ON CENTRAL BANKING**

16-18 June 2018 · Sintra Portugal

# Price and wage-setting in advanced economies

Conference proceedings

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# Programme

Monday, 18 June

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18:30 **Opening reception and dinner**

Opening remarks

**Mario Draghi**, President, European Central Bank

Dinner hosted by the Executive Board of the European Central Bank

**Dinner speech**

Monetary policy in a low inflation, low interest rate world

**Lawrence H. Summers**, Professor and President Emeritus of Harvard University, former US Secretary of the Treasury

Speech

Tuesday, 19 June

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9:00 **Introductory speech**

**Mario Draghi**, President, European Central Bank

Speech

9:30 **Session 1**

**Macroeconomics of price and wage-setting**

Chair: **Peter Praet**, Member of the Executive Board, European Central Bank

**Slack and cyclically sensitive inflation**

**James H. Stock**, Professor, Harvard University

(with **Mark Watson**, Professor, Princeton University)

Paper/Presentation

Discussant: **Lucrezia Reichlin**, Professor, London Business School

Paper/Presentation

**Inflation expectations – a policy tool?**

**Yuriy Gorodnichenko**, Professor, University of California, Berkeley

(with **Olivier Coibion**, Associate Professor, University of Texas at Austin;

**Saten Kumar**, Associate Professor, Auckland University of Technology; and

**Mathieu Pedemonte**, Graduate Student, University of California, Berkeley)

Paper/Presentation

Discussant: **Ricardo Reis**, Professor, London School of Economics

Paper/Presentation

11:30 Coffee break

12:00 **Panel: Macroeconomics of price and wage-setting**

Chair: **Peter Praet**, Member of the Executive Board, European Central Bank

**Jim Bullard**, President, Federal Reserve Bank of St. Louis

Paper/Presentation

**Kristin J. Forbes**, Professor, Massachusetts Institute of Technology

Paper/Presentation

**Philip R. Lane**, Governor, Central Bank of Ireland

**Charles Wyplosz**, Professor, Graduate Institute of International and Development Studies, Geneva

Paper/Presentation

13:30 Lunch

18:30 **Reception and dinner**

Wednesday, 20 June

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9:00 **Session 2**

**Microeconomics of price and wage-setting**

Chair: **Sabine Lautenschläger**, Member of the Executive Board and Vice-Chair of the Supervisory Board, European Central Bank

**Measuring inflation in the modern economy – a micro price-setting view**

**Aviv Nevo**, Professor, University of Pennsylvania

(with **Arlene Wong**, Assistant Professor, Princeton University)

Paper/Presentation

Discussant: **Michael Weber**, Assistant Professor, University of Chicago

Paper/Presentation

**Productivity growth, wage growth and unions**

**Uta Schönberg**, Professor, University College London (UCL)

(with **Alice Kügler and Ragnhild Schreiner**, both Postdoctoral Research Fellows, CReAM/UCL)

Paper/Presentation

Discussant: **Michael C. Burda**, Professor, Humboldt University Berlin

Paper/Presentation

11:00 Coffee break

11:30 **Panel: Microeconomics of price and wage-setting**

Chair: **Benoît Cœuré**, Member of the Executive Board, European Central Bank

**Erica L. Groshen**, Visiting Professor, Cornell University

Paper/Presentation

**Philippe Marcadent**, Chief of the Inclusive Labour Markets, Labour Relations and Working Conditions Branch, ILO

Paper/Presentation

**Tommaso Valletti**, Chief Competition Economist, European Commission

Paper/Presentation

**Klaus F. Zimmermann**, President, Global Labor Organization, and Maastricht University

13:00 Lunch

14:30 **Policy panel**

**Mario Draghi**, President, European Central Bank

**Haruhiko Kuroda**, Governor, Bank of Japan

**Philip Lowe**, Governor, Reserve Bank of Australia

**Jerome H. Powell**, Chairman, Board of Governors of the Federal Reserve System

Moderator: **Stephanie Flanders**, Bloomberg Economics

16:00 Award ceremony – Young economists' posters

**Closing remarks**

Group photo

18:30 Reception and dinner hosted by the Banco de Portugal

# Price and wage-setting in advanced economies: takeaways from the ECB's 2018 Sintra Forum

By Philipp Hartmann and Peter McAdam<sup>1</sup>

## Abstract

The origins and implications of the low inflation dynamics that characterised the post-crisis recoveries in many advanced economies were at the heart of the ECB's 2018 Sintra Forum on Central Banking. In this article, two of the organisers highlight some of the main points from the papers and discussions, including why measured economic slack did not translate into more vivid price and wage growth, which role inflation expectations play in the conduct of monetary policy as well as where the challenges lie in reconciling changes in firms' micro price-setting with aggregate inflation dynamics.

This year's ECB Forum on Central Banking focused on the core issue for monetary policy of why inflation accelerated so moderately in the recoveries that followed the crises in advanced economies. Policymakers, academics and market economists debated price and wage-setting from both macroeconomic and microeconomic perspectives. In this introductory chapter we summarise four of the main themes that were keenly debated in Sintra in June 2018: explanations as to why the Phillips curve has flattened and its implications; the sources and implications of low real wage growth; central bank communication with respect to inflation expectations; and key challenges in reconciling changes in micro price-setting behaviour with macroeconomic inflation developments. The full set of papers, discussions and speeches can be found in the other chapters of these proceedings and video recordings of all sessions on the [Sintra Forum website](#).<sup>2</sup>

## 1 Slack and the flat Phillips curve: international factors, regime switches, slow adjustment or mismeasurement?

The vanishing slope of the Phillips curve over the last few decades raises major questions about how the low-inflation phenomenon should be understood (see the previous discussion on this at the 2015 Sintra Forum; Constâncio et al. 2015). Put

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<sup>1</sup> Both European Central Bank. We are grateful to Benoît Cœuré, Luca Dedola, Martin Eiglspurger and Peter Praet for comments and discussions. All views expressed are summarised to the best of the authors' understanding from the various Sintra participants' Forum contributions and should not be interpreted as the views of the ECB or the Eurosystem. Any errors are our own.

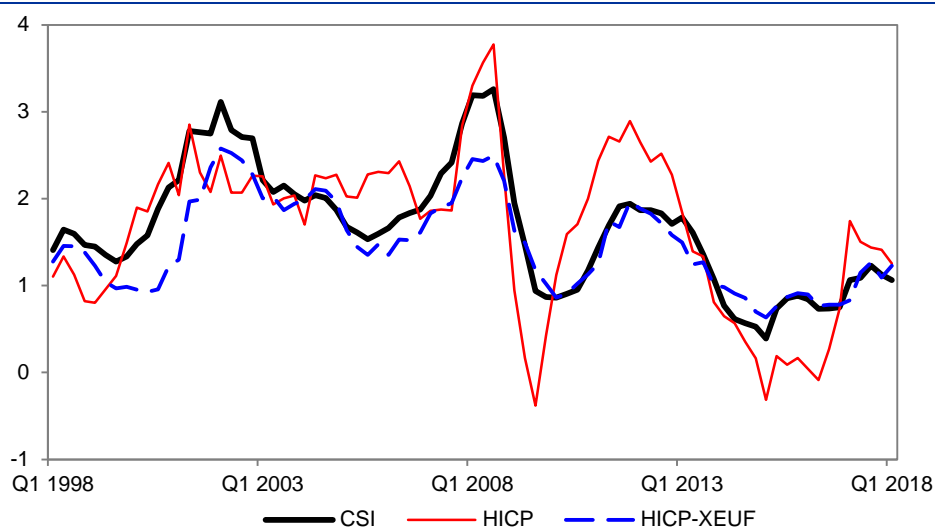
<sup>2</sup> A shorter version of this chapter is available on [VoxEU](#).

another way, the empirical relationship between economic slack and wage and price developments seems to have weakened considerably in many advanced economies. Participants put forward many arguments that could explain why the Phillips curve is flat.

In the opening paper, Jim Stock and Mark Watson (2018) argue that mismeasurement of inflation may be one culprit. Once price index components that do not react to the business cycle (or that are badly measured) as well as trends are taken out, the negative relationship between different measures of slack and the resulting indicator of “cyclically sensitive inflation” (CSI) in the United States remains stable and statistically significant over the last few decades. Chart 1 shows that the CSI indicator estimated by Stock and Watson for the euro area (black solid line) increased only very gradually in the last few years (see ECB 2014 for a similar methodology). This would suggest that the observed low inflation in the euro area is not a measurement artefact. In contrast to the US CSI, it is also quite close to the Harmonised Index of Consumer Prices (HICP) excluding energy and food (dashed blue line), a more standard measure of “core inflation” (which takes the most volatile components out of the index).

### Chart 1

Different inflation measures for the euro area



Source: Reproduced from Stock and Watson (2018), Chart 4.4.

Note: CSI is the cyclically adjusted inflation measure estimated by Stock and Watson (2018), HICP is the Harmonised Index of Consumer Prices and HICPexEUF is the HICP excluding energy and food.

Based on a different approach, namely estimating cyclical components and trends of US and euro area inflation together (rather than cleaning the data of the latter; see Hasenzagl et al. 2018), the discussant, Lucrezia Reichlin (2018), agrees with Stock and Watson that the Phillips curve can be re-established. But it tends to constitute a relatively small part of the inflation process as opposed to a dominating trend (plus cyclical effects of global commodity prices). Moreover, her trend-cycle approach shows greater upward pressure on inflation in both the United States and the euro area in recent years compared with the CSI. Another reason for the different results



could be that the CSI is based on only a small number of sufficiently cyclical price index components, including a large weight on rents.

Jim Bullard (2018) also agrees that the Phillips curve has not disappeared. In fact, it is the “theoretical” relationship that is at work, as for example included in New Keynesian macroeconomic models. In his view, the slope of the curve can no longer be seen in the data, because central banks have become more active and more successful in fighting inflation deviations from their policy targets. In these New Keynesian models aggressive reactions of monetary policy to inflation deviations are optimal. Bullard shows that the more aggressive the central bank becomes, the more the Phillips curve coefficient converges to 0 in a curve estimated from model-simulated data. So, we may be experiencing a case of the Lucas critique or Goodhart’s law at work.

Kristin Forbes (2018b) argues that the difficulty in identifying the Phillips curve in the data can be explained by the fact that standard approaches for doing so neglect international factors. Using another type of trend-cycle model which is applied to 43 countries over the last 30 years, she not only confirms the importance of trends in inflation but also shows that including variables like the real exchange rate, the world output gap or commodity prices materially reduces errors in estimating inflation. Which of them are relevant, however, varies across countries and over time (hinting also at the possibility of regime changes; see below). These international factors may reduce the importance of domestic variables but not necessarily replace them. Taking Forbes’ regression in which all countries are pooled, Table 1 illustrates how the relative importance of domestic and international factors changed after the break-out of the financial crisis compared with the full-sample estimates. For example, the world output gap and non-oil commodities moved from insignificant to significant inflation factors.

**Table 1**

Estimation of time-varying domestic and international inflation determinants

	CPI Inflation
<i>Inflation Expectations</i>	0.592***
<i>Lagged Inflation</i>	0.682***
<i>Domestic Output Gap</i>	0.115***
<i>Real Exchange Rate</i>	-0.025***
<i>World Output Gap</i>	0.027
<i>World Oil Prices</i>	0.002***
<i>World Commodity Prices</i>	0.002
<i>World PPI Dispersion</i>	0.301***
<i>Post * Inflation Expectations</i>	0.188**
<i>Post * Lagged Inflation</i>	-0.116
<i>Post * Domestic Output Gap</i>	-0.052
<i>Post * Real ER</i>	0.008
<i>Post * World Output Gap</i>	0.122**
<i>Post * World Oil</i>	0.000
<i>Post * World Commodities</i>	0.014***
<i>Post * World PPI Dispersion</i>	-0.322***
<i>Adj. R2</i>	0.56
<i># observations</i>	3002
<b><i>Global variables jointly signif?</i></b>	<b>154.3***</b>

Source: Reproduced from Forbes (2018a), Table 1.

Notes: The table shows the parameter estimates of an enhanced Phillips curve regression for quarterly inflation (as measured by consumer price indexes – CPIs) for 43 countries between 1990 and 2017 according to equation (1) in Forbes (2018a). “ER” stands for exchange rate and “PPI” for producer price inflation. “Post” is a dummy variable equal to 1 for the years 2007 to 2017. The estimation uses random effects with robust standard errors clustered by country.

\*\*\*, \*\*, \* indicate statistical significance at 1, 5 and 10 percent levels.

Several other Sintra speakers, such as Charles Wyplosz, Philip Lane, Philip Lowe, Aviv Nevo and Jim Stock, also supported the point about the importance of international factors. For example, Nevo and Wong (2018) mention that since firms’ pass-through from marginal costs to prices is smaller than 1 for most sectors, the more global and complex supply chains that emerged should further reduce the overall pass-through rate. Luigi Zingales linked international factors to Jim Stock’s contribution. The price index components that figure prominently in the CSI are housing, restaurant meals and entertainment, which are all very local. The prices of goods that are more closely subject to international competition do not receive much weight.

John Muellbauer, based on his joint work with Janine Aron (2018), pointed out that a stable empirical relationship between US unemployment and core inflation can also be found when a number of “non-standard” domestic factors are added to the explanatory

variables for inflation. These include, inter alia, longer lags in the autocorrelation of inflation (along the lines of Sargan 1964, reflecting the fact that periods of low inflation are followed after some time by periods of higher inflation through some form of equilibrium adjustment mechanism). A particularly strong case of this may have happened after the crisis of 2008-09, which affected major economies like a “heart attack”. Inflation would just take a very long time to recover after such a “stroke”. Philip Lane agreed that the euro area experienced such a large shock. It was therefore understandable that euro area inflation would take much more time to get to normal levels than for a regular business cycle. Philip Lowe pointed out that, based on its broad mandate, the Reserve Bank of Australia was able to be patient until inflation would ultimately come up. This meant that it did not risk side-effects on financial stability that a more forceful monetary expansion could cause. On the basis of the Swiss experience, Charles Wyplosz thought that low inflation did not always have to be a problem. Philip Lane, however, warned about yielding to the temptation of “nihilism”. In the case of the ECB, action was taken and it proved to be successful. Frank Smets and Michael Burda referred to previous literature that suggested non-linearities in and regime dependence of the Phillips curve. It could well be that at a more advanced stage of the cycle, the curve would steepen again.

In this context it may be interesting to note that in an online poll conducted among the Sintra participants, more than half of the voters felt that the Phillips curve was not “alive and well”. A third of Sintra participants agreed with the statement that it was well but non-linear and, hence, inflation reacts with a lag when slack is large. Only a minority thought that the Phillips curve is hidden by mis-measured inflation or slack.

Jay Powell wondered whether there were some lessons to be learnt from history. The last time that US unemployment had been as low as it is today was in the second half of the 1960s. During these five years, inflation increased from below 2% to around 5%. Powell concluded, however, that one cannot learn from this episode for today as much as one would have hoped for, because the US economy and central bank practices have changed in many ways over the past 50 years. For example, the natural rate of interest at the time was estimated around 5%, whereas today it is often estimated about 4 percentage points lower. An important factor in this reduction is that levels of education are significantly higher, making it less likely that people will become (and remain) unemployed. Moreover, after many years of low and stable inflation today’s inflation expectations are well anchored and central banks have a better appreciation of the importance of these expectations. So, the lack of useful historical precedent leaves us with some uncertainties regarding important questions faced today.

Perhaps we can draw a few conclusions from this debate. First, the simple traditional Phillips curve – where the output gap or other slack measures explain inflation in a linear way – is too primitive to work reliably in all circumstances. It needs to be enhanced by many more determinants of inflation, the possibility of regime changes and the correction of measurement biases in some variables. Second, the fact that the simple variant of it is flat does not mean that slack in goods or labour markets (or other domestic or international variables) are not acting as inflation determinants. Third, there were a variety of reasons – acting together or at different points in time – why

inflation in the euro area recovered so slowly. It would be wrong to pinpoint one or two of these reasons. But in any case they are fading away now.

## 2 Low real wage growth, employment and inequality

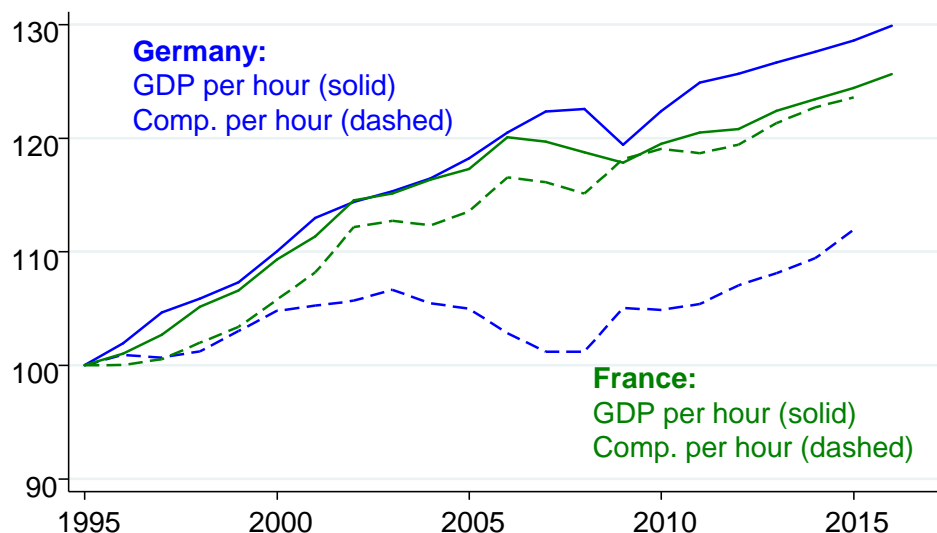
Many observers seem to agree that one of the key explanatory variables for low inflation has until recently been wages, i.e. that the cost of labour grew at an unusually slow rate during the recovery. There are multiple possible explanations for this, the importance of which can also vary significantly across countries. Uta Schönberg reviewed the divergences of productivity, wage and (un)employment developments in nine advanced economies for the period 1995-2016, covering the main Anglo-Saxon, Nordic and euro area countries. This allowed her to then focus on how the uneven roles of trade unions in the wage-setting process of the two largest euro area countries – France and Germany – can explain their widely differing labour market outcomes (Kügler et al. 2018).

As can be seen from the left-hand panel of Chart 2, labour productivity grew at relatively similar rates in France and Germany (green and blue solid lines, respectively). But labour compensation started to diverge in the early 2000s, with French wages rising broadly in line with productivity and German wages stagnating until relatively recently (green and blue dashed lines). As Philippe Marcadent (2018) pointed out, wage decoupling from productivity over the last 20 years among a number of advanced economies has been particularly driven by large countries such as Germany, Japan and the United States. Shortly after the start of the wage divergence, Germany's unemployment peaked at around 11% and an unprecedented period of employment creation started, lasting until the present day. In contrast, French unemployment stagnated at first but with the European crises moved up to around 10%, as shown in the right-hand panel of Chart 2. At the same time, however, wage inequality went in opposite directions in the two countries. Whereas in Germany the 10% lowest wage earners lost out over many years and the 10% highest earners increased their compensation relative to others, in France the 10% lowest somewhat gained in relative terms and the 10% highest lost out.

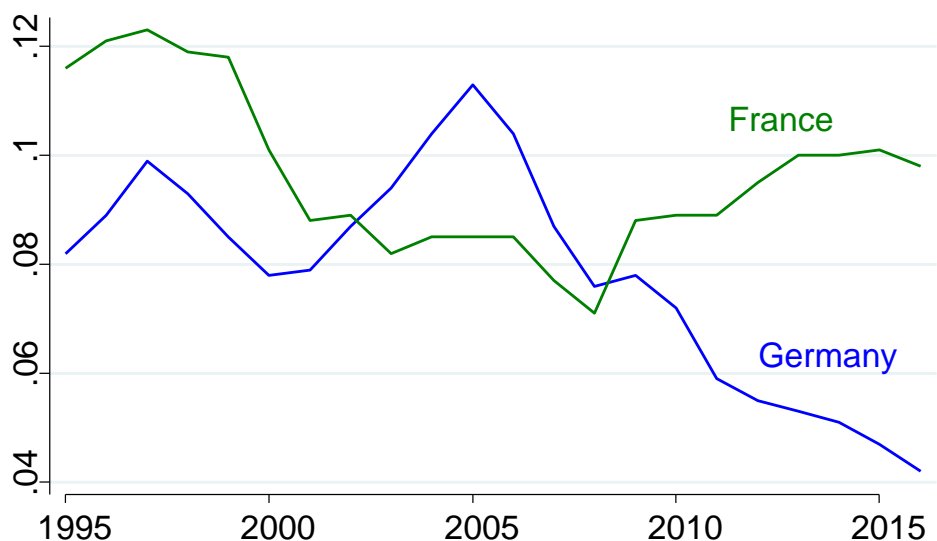
**Chart 2**

Labour productivity, wages and unemployment in France and Germany

Panel A: Productivity and compensation



Panel B: Unemployment



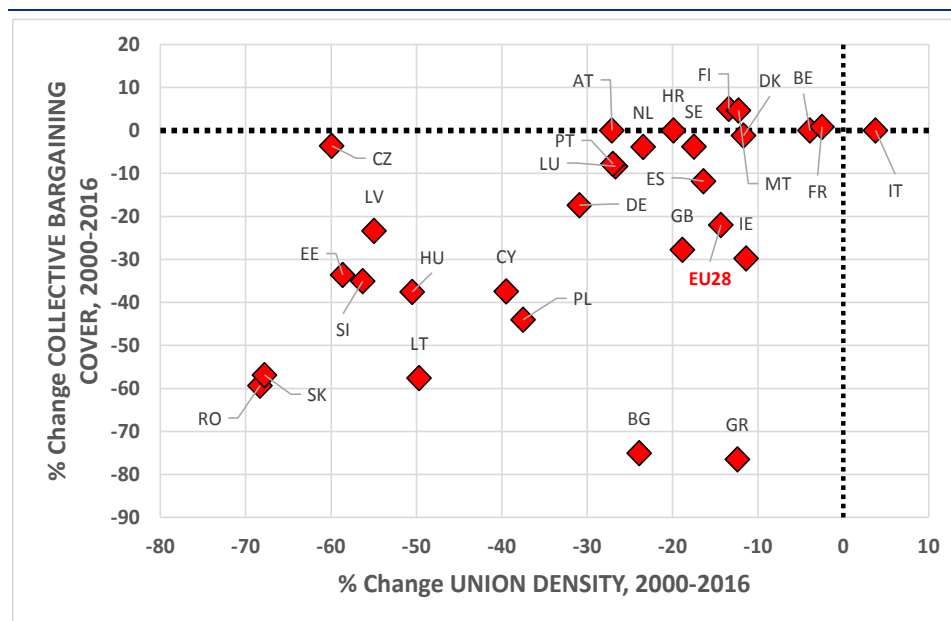
Source: Chart A from Kügler, Schönberg and Schreiner (2018) Panel A, Chart 2. Chart B derived from Kügler, Schönberg and Schreiner (2018) Chart 3.

Notes: Data for France are in green and for Germany in blue. Labour productivity is measured as GDP at fixed prices (using the GDP deflator) divided by total hours worked by all employees (solid lines in Panel A). Compensation (abbreviated as "Comp.") per hour worked is defined as total labour costs (gross wages and salaries, plus employers' social security contributions) divided by total hours worked by all employees (dashed lines in Panel A). Data in Panel A are normalised to 100 in 1995. Unemployment is defined as the share of unemployed people in the total labour force and measured in fractions (Panel B). The latest observation is for 2016 (GDP per hour 2015).

Schönberg argued that a major factor in these divergent developments was the decentralisation of the wage-setting process from the level of industry to the firm or even individual level that had started in Germany around the mid-1990s. After the fall of the Iron Curtain, Germany was burdened with reunification (including uncompetitive firms in eastern Germany), and the outsourcing of production to central and eastern European countries became a credible threat. Given high union wages, German firms started to opt out of union agreements or increasingly used "opening clauses" (which

allow individual firms to pay salaries below the agreements). De-unionisation has been a more general phenomenon in many, albeit not all, countries. Philippe Marcadent (2018) illustrated this with Chart 3, which shows the change in both union density (the share of workers with union membership – horizontal axis) and in collective bargaining cover (the share of wage agreements resulting from collective bargaining – vertical axis) for EU Member States since the turn of the millennium. German unions responded by making wage concessions in exchange for job security and job creation, basing wage demands more on inflation than on productivity developments. Updating Dustmann, Ludsteck and Schönberg (2009), Schönberg presented counterfactual simulations suggesting that, without de-unionisation, cumulative real wage growth in Germany between 1996 and 2012 would have been between 3 percentage points (for high wages) and 6 percentage points (for low wages) higher than was actually the case. While these only amount to small annual differences for each wage group, they could be multiplied if de-unionisation progressed further (as is the case for the countries in the lower left-hand part of Chart 3, for example). In Schönberg's view, the decentralisation of wage-setting in Germany happened without intervention by the government.

**Chart 3**  
De-unionisation in EU Member States



Source: Reproduced from Marcadent (2018), Chart 4.  
Notes: Union density is the share of workers that are union members. Collective bargaining cover is the share of wage agreements that are the result of collective bargaining.

The same flexible adjustment would not be possible in the French system of industrial relations. There, the state extended union agreements to virtually all firms in a sector, downward deviations in wages at firm level were not possible and a relatively high, inflation-adjusted minimum wage existed. Moreover, whereas the German wage moderation proceeded in a relatively consensual way, industrial relations in France (and some other European countries) tend to be more confrontational. All these differences seem to explain quite well the stronger creation of jobs in Germany and the greater wage equality in France. More recently, however, wage growth has picked up

again in Germany and a minimum wage was introduced. Together with the French labour market reforms under President Hollande and President Macron, this has led to the two countries becoming slightly more similar again.

The discussant, Michael Burda (2018), concluded that Schönberg and co-authors make a convincing case that nominal wage behaviour was crucial for the diverging employment and wage inequality developments in France and Germany. By decomposing the gradually declining labour share into three components – consumption wage, productivity and terms of trade – one can not only exclude differences in productivity as a primary force but also diverging trends in the terms of trade. But the wage “give-backs”, inequality and resulting successful internal devaluation in Germany cannot be understood without reference to the German labour market reforms of the early/mid-2000s. While greater wage disparity started in the mid-to-late 1990s, when unions tried to help firms with concessions, the lowest real wages started only to diverge more from the median than the highest ones, and their growth effectively turned negative, with the implementation of the first Hartz reforms in 2003. Burda stresses that one key additional margin of flexibility was induced by the liberalisation of part-time work through Hartz I. Another resulted from the reduction in unemployment benefits (and in their duration) with Hartz IV (implemented in 2005), which significantly lowered the reservation wage above which people were willing to work. The sharply negative correlation between employment and wages from 2005 to 2010 confirms that the reforms led to increased labour supply (including notably because more women were joining the labour force) combined with flexible wages and better labour-market matching (enabled e.g. by the Hartz III reforms). Another source of limited upside wage pressure in Germany may have been a reduction in the non-accelerating inflation rate of unemployment (NAIRU) through some of the reforms. For example, Burda cited estimates that the Hartz III reforms – which in 2004 involved restructuring the Federal Labour Office and making regional employment agencies more efficient – may have knocked 1 to 2 percentage points off the German NAIRU.

Both Schönberg and Burda seemed to share the view that elements of the German approach to the labour market, such as the Hartz reforms, cannot simply be directly applied to other European countries that may have very different set-ups for their industrial relations.

Philippe Marcadent (2018) gave an overview of the “wage penalty” on temporary contracts. Despite legal requirements that pay for the same work has to be equal across employees, estimates suggest that – in practice – temporary workers in EU Member States tend to earn between 10% and 20% less than full-time workers (International Labour Organization 2016). Similar to part-time, on-call or multi-party employees, they are less unionised and generally have less bargaining power. Moreover, the penalty tends to be higher in the lower part of the wage distribution. So, increasing temporary work not only adds downward wage flexibility but may also contribute to wage inequality, as Burda observes for Germany after 2003.

Several people in the audience wondered about the generality of the trade-off between employment and wage equality visible in the Franco-German experience. Is inequality a necessary price to pay for bringing unemployment down or does low-wage

employment tend to become a stepping stone for better jobs over time? Uta Schönberg thought that this was an important area where more research is needed. So far it can be observed that there are countries with low unemployment and low wage inequality, such as the Nordic countries. Moreover, after 2010 Germany experienced decreasing unemployment and decreasing wage inequality at the same time. In other words, the trade-off is not a necessity. But if there is high unemployment to start with, it is probably hard to bring it down without some rise in inequality. Luis de Guindos also emphasised the importance of the initial conditions for labour market reforms to be effective. In 2011 Spain had an unemployment rate of 25%. The government therefore enacted a reform in 2013 that included the decentralisation of wage bargaining. With such initial conditions the priority was to create jobs. Michael Burda held the view that the trade-off is not necessary, but some countries are better equipped than others to avoid it. For example, Nordic countries – such as Denmark or Sweden – do a better job of training low-skilled workers. Finally, both Michael Burda and Federico Fubini clarified that inequality issues in Germany were more pronounced in terms of wealth. Inequality of incomes overall was similar to the average of other advanced economies, because redistribution through Germany's strong welfare system evens out part of the wage inequality.

Klaus Zimmermann (2018) went in a similar direction as Burda, stressing the importance of reforms with the German government's involvement. Without long-term pressure for reform, the considerable level of flexibility internally could not have been achieved. Another example of this flexibility can be found in the "Kurzarbeit" scheme, which is covered under German labour and social law. In this scheme, the public unemployment insurance may subsidise the salaries of employees who work a reduced number of hours. This allows jobs to be shared and avoids the need for mass dismissals in situations such as in the Great Recession. Zimmermann expressed doubts that the call for unions in other countries to be more constructive would be heeded. In his view, a source of subdued wage growth that was not emphasised enough in the Forum discussions was migration. It was particularly important in a monetary union (and for monetary policy), because it helps smooth not only wage but also general macroeconomic adjustment in the case of asymmetric shocks. In addition, he stressed the issue of underutilised labour. As has been suggested in the work of Bell and Blanchflower (2018), many employed people have recently expressed a desire to work more and people who had previously felt that they should work less no longer want to do so as much. In such a context one may not be overly concerned with a coincidence of low unemployment and low wage growth.

Some further discussion also took place about the role of minimum wages. Klaus Zimmermann observed that they not only affect the lowest parts of the wage distribution but their changes can also have a level effect on the whole distribution. For example, the relatively new German minimum wage may become part of a long-term strategy to move wages up. So, central banks should include adjustments to minimum wages in their inflation assessments. Philippe Marcadent recalled the experience of the United Kingdom, where the minimum wage led to an increase in the lowest wages but to a reduction of the next higher wages above the minimum wage, presumably because employers oriented towards the minimum labour costs. Similarly, Erica



Groschen was concerned that a very low minimum wage could become a monopsonistic tool for employers.

Philip Lane, Philip Lowe and Klaus Zimmermann stressed the risk of backward-looking inflation expectations in wage negotiations. Wages could not recover as they should in the post-crisis upturn, if social partners based their agreements on future inflation below central banks' targets. Therefore, information campaigns are being undertaken in euro area countries and in Australia to explain the likely future paths of inflation. But Lowe reported that Australian employers are also reluctant to increase wages because of the fiercely competitive international environment in which their companies operate (e.g. vis-à-vis other Asian countries). Haruhiko Kuroda reported that the Japanese government had asked social partners to increase wages by 3% in this year's "spring offensive". With Japanese labour productivity at around 1%, he regarded this to be an appropriate number for achieving consistency with the Bank of Japan's 2% inflation target.

In sum, the low wage growth of recent times in the euro area and other advanced economies can be explained by a variety of factors.

### 3 Inflation expectations, central bank communication and monetary policy

Inflation expectations are not only important for the social partners' wage negotiations – they are also a key variable for the conduct of monetary policy. Central banks place great importance on the anchoring of inflation expectations, i.e. the fact that they are credible and that expectations do not deviate much from their inflation objective. Yuriy Gorodnichenko notes, however, that central banks tend to focus entirely on the expectations of professional forecasters and of market participants (as embodied in asset prices; Coibion et al. 2018b). Traditionally, they pay little or no attention to the inflation expectations of households or non-financial corporations (NFCs). In fact, measures of these – where collected – tend to show large deviations from the inflation objectives pursued by central banks. Most of the time, the difference from the objective is much larger than the case for inflation expectations by professionals. Over the last one to two decades, differences between the two involving 2 or more percentage points were quite common in the United States and the euro area, for example (see Chart 1 in Coibion et al. 2018b).

Where do these discrepancies come from? Research suggests that households' inflation expectations are particularly influenced by salient prices of frequently purchased, homogeneous goods (such as groceries or gasoline), creating a "veil of inattention" with respect to aggregate inflation and monetary policy announcements. For example, Michael Weber presented some new analysis suggesting that the high inflation expectations are driven by the members of households who do the main grocery shopping (D'Acunto et al. 2018). In emerging market economies or developing countries with histories of high inflation, however, agents' attention to it is much closer.

Notwithstanding the need to improve the measurement of inflation expectations of households and, particularly, of NFCs, Gorodnichenko and co-authors suggest that influencing these expectations more actively has considerable potential for becoming a new “policy tool” for central banks. Convincing households and NFCs to revise their inflation expectations would change real interest rates, potentially by a large amount relative to other policy instruments, and thereby affect consumption and investment. It would also affect firm pricing and actual inflation. The potential for breaking through the “veil of inattention” is based on research that suggests that households and NFCs adjust their beliefs to incoming information and update their consumption and investment accordingly. For example, Coibion et al. (2018a) find that US consumers who are informed of past inflation rates, the Federal Reserve System's inflation target or the inflation forecast of the Federal Reserve System's Federal Open Market Committee (treatment group) revise their inflation expectations towards those levels, but that the consumers who have not been given this additional information (control group) do not (see Table 2). To be successful in this, however, central bankers would need to use simple messages that are regularly repeated and directly targeted at the relevant firm or population subgroups (as is possible in social media or with advertising techniques).

**Table 2**  
Estimation of the scope for influencing household inflation expectations

Dependent variable: Revision of one-year-ahead inflation forecast	
Control group	1.350*** (0.233)
Treatment groups (coefficients are relative to control)	
Irrelevant 2% figure	0.265 (0.343)
Past inflation	-1.954*** (0.366)
Inflation target	-1.411*** (0.341)
FOMC inflation forecast	-2.004*** (0.384)
FOMC statement	-2.272*** (0.335)
USA Today coverage of FOMC statement	-0.950** (0.397)
Observations	1,484
R-squared	0.049

Source: Reproduced from Coibion, Gorodnichenko, Kumar and Pedemonte (2018b), Table 4.

Notes: The table reports estimated effects of providing information (indicated in the left column) to households participating in the Nielsen Homescan panel for the United States. For treatment “Irrelevant 2% figure”, households are informed that the population in the United States grew 2% over the last three years. The dependent variable is equal to (post-treatment one-year-ahead inflation expectations) minus (pre-treatment one-year-ahead inflation expectations). Pre-treatment expectations are computed as the implied mean of expected inflation distribution over the next year. Post-treatment expectations are elicited as point forecasts. Treatment effects tend to be negative, because households typically hold too high inflation expectations (before receiving additional information). Robust standard errors are reported in parentheses.

\*\*\*, \*\*, \* indicate statistical significance at 1, 5 and 10 percent levels.

Today, however, we are not yet ready to apply this new communication approach, according to Gorodnichenko, particularly since more research is needed on how

inflation expectations translate into NFC and household actions and because surveys about NFCs' inflation expectations are unavailable or not of the desired quality. Charles Wyplosz felt that it would be real progress if central banks were to focus their communication more on the "people in the street" and less on financial market experts. If they do not believe the inflation numbers, then they have to be convinced that the figures are honest.

The idea of targeted influencing of households and NFCs via social media was met with scepticism by a number of central bankers. For example, Otmar Issing feared that using tools similar to those used by populist politicians could endanger the credibility of central banks, particularly if attempts were made to influence the expectations of specific groups further away from stated inflation objectives. Mario Draghi agreed and added that inflation expectations should not be getting close to replacing actual inflation as the objective of central banks. There was also some disquiet that delivering different inflationary sentiments to different stakeholders might undermine central bank transparency. Benoît Cœuré and Erica Groshen agreed that households' and NFCs' inattention to inflation and monetary policy is rather likely to be a sign of success of central banks in advanced economies keeping inflation low and stable. Jim Bullard considered that "communicating to the masses" would be an uphill battle. While the ongoing broadening of central banks' outreach to more groups in society was useful, it is not a realistic substitute for talking to professionals and financial markets. Market-based expectations provide a great signal of what monetary policymakers do, taking into account all relevant data and reacting fast. In a similar vein, Philip Lane and Stefan Gerlach argued that much of the monetary transmission mechanism works through the financial system. So, in order to influence financial intermediaries' funding and general financial conditions in the economy (e.g. through long-term bond yields), explaining developments to the market is very important. In another online poll about what central banks should do to better align firm and household inflation expectations with their objective, 43% of voting Sintra participants agreed with pursuing three directions at the same time, namely:

- generally improving financial literacy and awareness of monetary policy;
- shifting the emphasis from financial markets to NFCs and households; and
- targeting specific groups, including via social media.

However, when looking at each individual direction, the first received the most support (28%).

The discussant, Ricardo Reis (2018), observed that the focus on experimental event studies by Gorodnichenko et al.'s survey could miss some longer-term effects of central bank communication. He took the so-called Volker disinflation as one example. The bell-shaped distribution of consumer inflation expectations in the United States in Q1 1979 had a relatively high mean. The distribution then moved slowly over time to a bi-modal pattern before settling in Q4 1982 again to a bell-shaped form with a lower mean (Mankiw et al. 2004). A better approach for capturing these slow-moving expectation effects would be to include monetary policy communication events in vector-autoregression models.

Reis (2018) also discusses three channels through which monetary policy communication may influence inflation expectations:

1. revelation of future monetary policy;
2. revelation of fundamental information about the economy; and
3. moving expectations independently, i.e. influencing “animal spirits”.

Central banks would seem to have a duty to regularly engage in 2. (e.g. by publishing forecasts or commenting on data releases) and to some extent in 1. (e.g. when forward guidance is necessary). 3. seems to be more problematic though. For example, the evidence from hyperinflations suggests that announcements are only successful when they are followed up by solid policy action. In other words, trying to stimulate “animal spirits” via some form of “propaganda” would be a dangerous interpretation of the Coibion et al. paper.

Reis and Reichlin agreed that it was also important to distinguish between permanent and transitory components in inflation expectations. The strong influence of gasoline prices on household expectations, for example, could suggest that their misalignment with central banks’ inflation objectives has significant transitory components. But misalignments of the permanent component or trends would be more worrying. Lastly, Ricardo Reis considered that the role of monetary policy to ensure a stable unit of account (“anchoring” of inflation expectations) tends to be generally regarded as a success. But using it as a countercyclical stabilisation policy is harder. Households’ and firms’ inattention, as reported by Gorodnichenko and co-authors, makes “anchoring” easier. One example of it was the relative stability of expectations during the Great Recession. But it also makes fine-tuning of stabilisation policy even more challenging.

## 4 Do we understand the microeconomic factors influencing inflation well enough?

Against the background of important structural changes in advanced economies, including globalisation, industry concentration, the growth of e-commerce, the emergence of a “sharing economy” and the availability of “big data”, Aviv Nevo (Nevo and Wong 2018) discusses micro aspects of consumer behaviour and firm price-setting that could have a bearing for general inflation developments and measurement. He first asks how substitution biases in price measurement have evolved, adopting the perspective of individual shoppers. With grocery data, scanned by these shoppers, he shows that during the Great Recession US households were using sales, coupons and generic products more actively. In the subsequent recovery this behaviour was reversed, partly, fully or even more, depending on the shopping indicator considered. It might be tempting to infer from this that some part of the “missing disinflation” during the Great Recession was a statistical artefact from standard price indexes not capturing the changed shopping behaviours. Similarly, part of the “missing inflation” in the recovery could be the consequence of the reversals of

those behaviours. But such stark conclusions do not necessarily follow from these facts for a variety of reasons. For example, we do not know whether the shopping behaviour for the many other product categories that are not covered is similar or different. Moreover, it is very hard to establish whether consumers derive the same level of utility when they substitute products or outlets to pay a lower price. Finally, it is not clear whether the substitution cycle fluctuates around a neutral, positive or negative level.

Some of these comparability problems are the reason why statistical offices usually base their standard price indexes on a product perspective. The prices of the same goods are tracked in shops over time. This approach, however, could still be vulnerable to an “upper level” substitution bias if households’ consumption baskets change relative to the ones assumed in the indexes. To check for this bias, the US Bureau of Labor Statistics publishes not only the regular consumer price index (CPI) but also the so-called Chained Consumer Price Index (C-CPI). Whereas the CPI expenditure basket is only adjusted every two years, the C-CPI benefits from baskets that are adjusted monthly. So, the difference between the CPI and C-CPI represents a measure of the over-estimation of prices through this type of bias. Erica Groshen showed this measure in her panel intervention for the period 2000-17. She reckoned that the average aggregate bias tended to be moderate, varying between +80 and -10 basis points. If anything, its average of 22 basis points after the crisis was slightly lower than before. All this does not support the hypothesis that the “missing disinflation” during the Great Recession or the “missing inflation” in the subsequent recovery were statistical artefacts from substitution biases.

The next issue Nevo addresses is whether some micro price developments can be more clearly identified as long-term trends. The first is the growth in online shopping which, according to the US Census Bureau, went from less than 1% of total retail sales in 2000 to almost 10% in 2017. Although not a comparable indicator, the share of euro area citizens ordering goods or services online ranged between about 20% and 70% in 2014, depending on the country considered (ECB 2015). Arguably, online shopping is likely to progress further going forward. Although perhaps different from everybody’s casual shopping impressions, the conventional wisdom from a small but rising literature so far seems to be that online prices are not markedly different from regular shop prices (Cavallo, 2017, or Gorodnichenko et al., 2017). However, one recent paper – using a broad range of product categories – suggests that online inflation could have been 1 percentage point lower than regular CPI inflation in the United States between 2014 and 2017 (Goolsbee and Klenow, 2018). In line with the conventional wisdom, Mario Draghi mentioned internal analytical work by ECB staff that found very little evidence that e-commerce would permanently lower aggregate euro area inflation (ECB 2015). Moreover, Erica Groshen pointed out that the statistical offices calculating price indexes tend to catch up by including an appropriate share of online prices in their sampling. For example, in 2016 more than 8% of prices collected by the US Bureau of Labor Statistics were online prices. So, any measurement bias related to the negligence of e-commerce should be limited.

The second structural change mentioned by Nevo concerned increased industry concentration and market power of firms (see e.g. De Loecker and Eeckhout, 2017

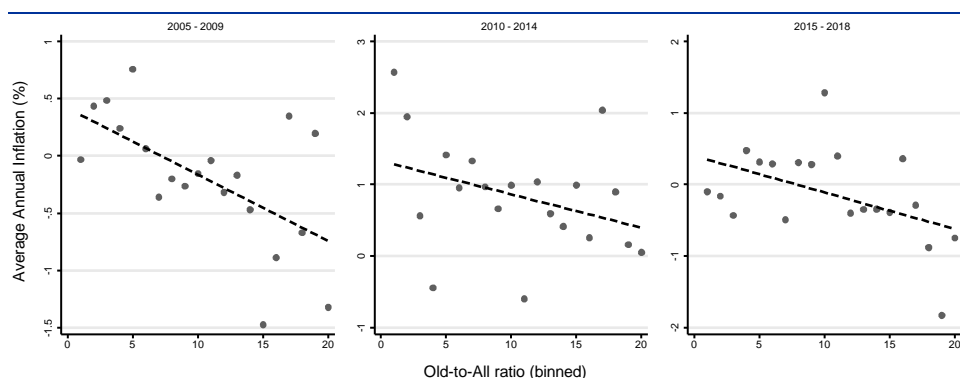
and 2018). As also pointed out by Tommaso Valletti (2018), this could further reduce the pass-through from marginal costs to prices. In such a context, wage increases would have a more limited effect on inflation (potentially making an indirect contribution to low inflation). But marginal cost reductions, say through digitisation, would also not be passed on in full, implying in principle the opposite effect. In contrast to the United States, Valletti (2018) did not find particular changes to industry concentration in the five largest EU Member States (EU5) between 2010 and 2015. Moreover, increases in mark-ups seem to be more muted in the EU5. Firms' profits as a share of GDP in the EU5 are on a similar upward trend as in the United States, but the figures are weaker when excluding the United Kingdom. Generally, caveats about data quality and country heterogeneity have to be kept in mind for Europe. One question that seems to remain unanswered is which of two trends – increasing market power and mark-ups, implying upward pressure on prices, versus technical change expanding low marginal cost industries, implying downward pressure on prices – would dominate in terms of price levels and potential inflation effects. (The growth of global supply chains, the third structural change, and pass-through has already been mentioned in Section 1 above.)

Lastly, Nevo observed that the new availability to firms of “big data” about their clients and greater computing power puts them in a better position for active price discrimination, where prices are set according to individual consumers' willingness to pay rather than as an add-on to marginal costs. It is hard to say whether such “first degree” or “perfect” price discrimination will result in general price increases or not. Even worse though is working out how inflation can be properly measured and interpreted in a world where prices become largely individualised, Nevo asks.

The discussant, Michael Weber (2018), recalled that ageing societies might also have a role in the low inflation observed in advanced economies. An argument put forward in the past is that a growing cohort of elderly or retired people relative to young and middle-aged people would consume less and therefore create less demand. Moreover, older workers typically receive smaller salary increases than do younger workers. Therefore, Weber reported new research on the (cross-sectional) relationship between the age composition and producer price inflation (PPI) of different US industries (Schoefer et al. 2018). He showed that, from an economic and statistical point of view, PPI is significantly lower in industries with higher “senior-to-all ratios” (defined as the share of total hours worked by employees aged between 55 and 64 years in the total hours worked by all employees) than in other industries. Chart 4 visualises the relationship for the three most recent time periods covered. Moreover, this effect is larger in relatively labour-intensive industries. Finally, wage growth is also lower in industries with an older labour-force composition, in line with older workers having less bargaining power in wage negotiations than younger and more recently educated workers (see Section 2 above for a more general discussion of sources for low real wage growth).

## Chart 4

### Workforce age structure and producer price inflation in the United States



Source: Reproduced from Weber (2018), Chart 8.

Notes: The charts show the relationship between the share of total hours worked by senior employees (aged between 55 and 64 years) in the total hours worked by all employees ("Old-to-All ratio") and producer price inflation for average US industry data over the time periods indicated above the three panels, as estimated by Schoefer et al. (2018). The total number of points is much lower than the total number of industries covered in the underlying estimations, because a "binning" technique is used for ensuring clarity of exposition. The plots are conditional, i.e. effects of other variables included in the underlying regression are taken out (see column 6 of Table 1 in Weber 2018).

Some macroeconomists wondered about the relevance of the discussed competition and micro price developments for central banks and monetary policy. For example, Charles Wyplosz pointed out that mark-up changes have natural limits upwards or downwards and their effects may only be temporary. Jan Eeckhout responded that the phenomenon of increasing mark-ups has been observed for about the last 40 years, with an average annual growth rate of about 1% and the pick-up being steepest in the last 6 to 7 years. John Muellbauer added that his recent research suggests that industry concentration is one of the "non-standard" variables that help improve the modelling and forecasting of US inflation (Aron and Muellbauer 2018). He thinks that the relative adjustment between input and output prices as well as of different output prices across industries with changing concentrations likely plays a role in the equilibrium adjustment mechanism for inflation. In response to a question by Ricardo Reis and Benoît Cœuré, Aviv Nevo speculated that greater price discrimination could make consumers' extraction of the general inflation component in price changes more difficult thereby enhancing nominal rigidities in macroeconomic adjustment. Finally, Tommaso Valletti (2018) argued that lower cost pass-through should reduce the transmission of central bank interest rate policy via NFCs, particularly the more they pursue first degree price discrimination. Benoît Cœuré commented that other monetary policy transmission channels would still remain active.

All in all, the Sintra discussion on this theme, particularly including the call by Aviv Nevo, seems strongly to suggest that research into micro price developments and macro inflation developments needs to be much more integrated. The question whether the changes in firms' individual price-setting behaviour make a net contribution to the low-inflation phenomenon or go somewhat in the opposite direction can only be answered if scholars from fields such as industrial organisation, marketing and macroeconomics work much closer together than has been the case so far. Finally, there remain great challenges with measurement biases and data availability for this theme and for understanding price and wage-setting in advanced economies more generally.



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**PRICE AND WAGE-SETTING  
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# Monetary policy in a low inflation, low interest rate world

## Dinner speech by Lawrence H. Summers

Mario, thank you for those generous words. As you were saying them, it occurred to me that this evening would be rather more fun if you gave me a full-length, speech-length introduction and I sat and listened! Nothing I say will give me nearly as much pleasure as you just did. It is a great privilege to be here at the ECB's annual conference. This is a remarkable and extraordinary institution. There are countries without central banks, but until now there has never been a bank without a country! It occurred to me as I was thinking – and this is a serious comment – that the ECB is almost certainly the most operational, supranational institution that has ever been invented by human beings in terms of the ongoing work that it does that is central to the lives of citizens of so many countries. It's a privilege also to be introduced by my friend, Mario Draghi, who I first got to know well when we were G7 deputies more than 25 years ago.

I have known people who are consummately effective bureaucratic and political operators. I have known people who stand out for their intellectual capacity, curiosity and creativity. But I have not known anyone who equals Mario Draghi in standing out on those two dimensions and so it is a great privilege for me to be here with him. I think the world has been remarkably fortunate to have him as the head of the ECB through these last challenging years.

I judge that Mario's decision to invite me to speak here was not an act of deft politics. It is unlikely that he thought that inviting me would be a way of forging a successful connection with the Trump administration. I judge it more likely that he thought it appropriate that there be some intellectual provocation on this occasion and at least some attempt to challenge orthodoxy, and so I shall oblige. My remarks are going to build on and extend and revise in some ways the observations I made some years ago about secular stagnation and its importance for thinking about macroeconomic policy and in particular the major structural changes that have affected normal or neutral real interest rates.

In particular, I want to argue five propositions this evening. First: relative to the magnitude of the event and the many respects in which it's a surprise, the financial crisis has led to remarkably little revision in basic monetary theory, as practised by the world's central banks.

Second: the pure neutral real interest rate has declined by substantially more than is generally accepted and is substantially more likely to be trending downwards over time than is generally recognised. Third: the BIS notwithstanding, it is far more plausible to attribute this to deep structural factors in our economies than it is to attribute it to monetary policy choices. Four: of all moments in the last 70 years, we are at one when economically, politically and socially the world is least able to withstand a

recession or a significant economic downturn. Fifth: that the objective of monetary policy should no longer be conceptualised purely in terms of inflation targeting but in terms of achieving the dual goals of price stability and maximum sustainable employment.

Let me take each of these propositions in turn. There have been three epochal monetary events in the last century: the Great Depression, which was followed by the Keynesian Revolution; the great inflation of the 1970s, which was followed by the move to independent central banks, the emphasis on rules rather than discretion, the emphasis on Dynamic Consistency Theory from an academic perspective, the adoption of inflation targeting from a policy perspective and the abandonment of the view that monetary policy could affect the average level of output over time in favour of the view that nominal authorities could affect only nominal things; and the financial crisis of the post-2008 period, which led to a decade of stagnation that, judged in terms of beginning-to-end growth, was comparable to the Great Depression in the United States and Europe, that judged in terms of its impact on economic welfare was almost certainly greater than any costs associated with the inflation of the 1970s, and that judged in terms of the magnitude of the surprise to economic models was at least comparable to those events.

Yet, while there has been extraordinarily skilled improvisation, extraordinarily adept tactics, here I think of the phrase “whatever it takes” among many other examples that I believe literally changed the monetary fate of the world, we leave the financial crisis period with the same paradigm with which we entered it. Central banks explaining that they can’t effect real things, that they can affect inflation and so that needs to be their sole focus, even as their ability to affect inflation is in substantially more doubt than it was some years ago. It’s quite evident that they have had substantial effects on real variables. I leave you first with the thought that there’s something surprising about the fact that the paradigm has changed so little.

Second: neutral real rates. There are a familiar set of calculations. Econometrics would be most prominently associated with Laubach and Williams, though it’s been replicated by many others, suggesting that neutral real rates have declined by two to three percentage points over the last generation or so. There have been calculations that differ between different countries. There have been attempts at calculating this on a global basis. It is hard to escape the conclusion that the neutral real rate has declined by two to three percentage points. What has not been emphasised, however, is that, while the real rate has been declining by two to three percentage points, the ratio of government debt to GDP in the industrial world has increased by 50% or more. The magnitude of prospective budget deficits has increased by two to three percentage points as a share of GDP.

The calculation that I would submit is natural to do is to construct what one might call the pure neutral real interest rate. Imagine that structural fiscal policy had not changed over time. What would then have happened to the real interest rate? Or, to put it slightly more harshly, imagine that central bankers had got their policy preferences with respect to fiscal policy on a consistent basis over the last 25 years. What would then have happened to the real interest rate? There are many ways of doing that calculation. A rough survey of the literature suggests that a 1% of GDP increase in the

deficit raises real interest rates by 50 basis points. A three percentage point increase in prevailing deficits raises real interest rates by 150 basis points.

An alternative, which is probably better in the idiom of the modern economics way of doing the calculation, is to focus on stocks. There, one would conclude that a 1% increase in GDP in the debt-to-GDP ratio raises real interest rates by about 4% – by about four basis points. So the 50% increase in debt-to-GDP ratios that we've seen has raised real interest rates by some 200 basis points or two percentage points. This, of course, is an underestimate of the impact of fiscal policies because it takes no account of the generosity of retirement benefits which have operated to reduce savings and therefore to raise real interest rates. It takes no account of the increased generosity of healthcare benefits which have operated in the same direction.

I would suggest to you that the decline in real interest rates that we have observed and that we usually estimate as the neutral real interest rate is about half as large as the pure market decline in the neutral real interest rate, and that the expansionary fiscal policies that we have seen around the world have obscured what otherwise would be a much more precipitous decline in real interest rates and one that, if observed, would represent a much stronger trend. Therefore, one would be more likely to extrapolate forward.

That this view is correct, or at least plausible, is confirmed by the variety of studies that actually over-explain the 200 basis point decline in neutral real rates. It's not hard to find estimates that attribute 75 basis points to demography. Not hard to find estimates that attribute 50 to 75 basis points to inequality. Not hard to find estimates that attribute at least that to declines in the price of capital goods or increase in the profit share. Not hard to find estimates that attribute a significant amount to rising current account surpluses of emerging markets. I would suggest that the right way to understand the global economy is that there are major structural changes that have led to sharp declines in the neutral real rate that have been significantly obscured by the movements to expansionary fiscal policy that we have seen around the world, and that without the build-up of substantial increases in debt-to-GDP ratios, we either would have had to contrive ways to bring about much larger declines in real interest rates than we have observed – something that quite likely would have been difficult given the zero lower bound – or we would've had to accept significantly more sluggish growth than we have observed.

Next observation: I do not relate to the suggestion that somehow this is all driven by some kind of debt super cycle. I would note that all of the indicia of a debt super cycle would be a predictable and indeed predicted consequence of the kind of structural decline in neutral real rates that I have described. After all if the Maastricht criteria were appropriate when real interest rates were thought to be 2 to 3%, presumably some different criteria is appropriate when real interest rates are thought to be zero or negative 1%. If it makes sense to say that people can take out a mortgage that's equal to six times their income when the interest rate is at a high level, it's presumably appropriate for that ratio to be higher when interest rates are at a low level. Or equivalently, when debt service costs are reduced, if debt service costs are linked in any way to income then one would expect to see substantial increases in the ratio of debt to income.

Similarly, when discount factors are reduced, asset prices go up, so increases in asset prices are a natural consequence of a discovery that neutral real rates have declined. Indeed, it is precisely through that mechanism that returns are pulled forward. It seems to me that, on the one hand, what we observe in terms of debt and financial aggregates is exactly what one would expect in the face of an exogenous decline in interest rates. Those who tell us that that is the wrong way to think about it and that it instead reflects the actions of irresponsible central banks creating excess liquidity, owe us an explanation for the counterfactual path. If interest rates were significantly higher, if term premiums were substantially larger, if risk premiums were not distorted downwards, if corporations and households were more effectively discouraged from spending, if governments were more effectively discouraged from running deficits, where would the demand to support even the relatively limited growth that the global economy has observed come from? I do not believe that such an answer has been provided and I have too much faith in the energy and the entrepreneurial capacity of our economies to believe for one second that they are in some sense producing more than they are potentially capable of producing, even if one grants, which I think is somewhat problematic, that that is a meaningful construct.

My fourth observation: the world can ill afford an economic downturn. That is true as an economic observation and it is true as a political observation. As an economic observation, ponder this: there is a playbook for responding to recessions. It is the playbook that has been used in the United States and it has been used in Europe multiple times. It has one central element: the reduction of interest rates by 500 basis points. That has been the elixir that has stopped recessions in the past. When the recession is really serious, as it was in 2008, that's actually been an insufficient elixir for stopping the recession. That's part of why it went on so long.

On the path we are on, it is not envisioned by markets that anytime in Mario's successor's term that we will be anywhere near with room to reduce interest rates by 500 basis points in Europe, in the United States or in Japan. If one reads the papers about inflation expectations and forward guidance, the capacity to supercharge monetary policy starting from a scenario where we have an economic downturn would, I suspect, be rather limited. The ten-year German interest rate is, I believe, under 50 basis points. If there's a downturn, it will of its own volition fall substantially further below its current level. How much further can QE, can manipulating expectations, bring it?

The world will have great difficulty in responding economically if there is a downturn. This is not the forum for an extensive meditation on the forces which brought to power the current President of the United States. Suffice it to say that it is far more troubling that this happened at a moment when the unemployment rate was in the low fours than it would've been if the unemployment had been in the eights and that nothing about an economic downturn will do anything other than magnify the pressures for populism, for protectionism and for systemic breakdown and a return to economic nationalism. I would therefore suggest that it is a matter of the most extraordinary urgency to avoid, in the foreseeable future, for as long as possible, another economic downturn. The consequences of another economic downturn would dwarf and

massively exceed any adverse consequences associated with inflation pushing a bit above 2%.

Indeed, in reflecting on a 2% target, there's a different history of a 2% target in different countries. It seems to me, however, that the story always has to be something like this. We want price stability, so we want inflation to be low, but we want the zero lower bound not to be a serious problem. We want wage flexibility through declines in real wages, without declines in nominal wages to be possible. Whatever the right trade-off was 20 years ago, when we thought the neutral real rate was 2% or 2.5%, it must surely be different when the neutral real rate is a negative 1%. Whatever the right trade-off was when we thought normal productivity growth would give people a 2% a year pay increase, it must surely be different when we no longer expect such a dividend from normal productivity growth. Whatever the case with a symmetric target was for concern about inflation above 2%, it must surely be different when inflation has for a decade been below 2%.

I would conclude, fifth, that it is a demonstrated fact that monetary policies have consequences for real outcomes that last over long periods of time. By the way, anyone who wants this in a more technical and econometric form should just look at the research by Robin Greenwood and Sam Hanson (that's been verified by many others), showing that monetary policy surprises affect forward real rates 15 years in the future, which is entirely inconsistent with the idea that money is just effective in the short run. Reality is that monetary policy does have impacts not just on the variability but also on the level of output. Reality is that responsible monetary policy should recognise those effects. The goal of monetary policy, I submit, should therefore be the goal that all our fellow citizens have for monetary policy, which is price stability – yes – but also maximum sustained full employment.

That is going to be an increased challenge for us in the years ahead because the truth is that the apparent success and function of our economies has not been a reflection of the miracle of the market. It has been a reflection of an extraordinary period in fiscal policy and an extraordinary period in monetary policy. That, I would suggest, is the challenge that is before monetary policy as we look to the future. Thank you very much.



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**ECB  
FORUM  
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18-20 June 2018  
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## PRICE AND WAGE-SETTING IN ADVANCED ECONOMIES



# Monetary policy in the euro area

## Introductory speech by Mario Draghi

### President of the ECB

The euro area's economy continues on a growth path and inflation is gradually returning towards our objective. But uncertainty permeates the economic outlook. Recent data releases have created questions about the durability of the growth outlook. And – as we will discuss over the next two days – the crisis has presented us with new issues and fresh challenges in understanding the wage- and price-setting process.

Regarding the ECB's monetary policy, as outlined at last week's press conference, progress towards a sustained adjustment in inflation has been substantial so far.

With longer-term inflation expectations well anchored, the underlying strength of the euro area economy and the continuing ample degree of monetary accommodation provide grounds to be confident that the sustained convergence of inflation towards our aim will continue in the period ahead, and will be maintained even after a gradual winding-down of our net asset purchases. But this requires monetary policy in the euro area to remain patient, persistent and prudent.

## 1 Recent economic developments

In 2017, growth in the euro area turned out stronger than we had anticipated: the annual growth rate in the fourth quarter was the fastest for a decade. But in 2018, growth has moderated and, so far, has come in below our expectations. In the latest Eurosystem staff projections, growth for 2018 has been revised down by 0.3 percentage points.

This has prompted some questions about the sustainability of the ongoing expansion, which is unusual at such an early stage of the cycle.

In historical terms, the current growth period is comparatively short in length and small in size. Since 1975, there have been five growth phases in the euro area. The average duration from trough to peak is 31 quarters, with GDP increasing by 21% over that period. The current expansion has to date lasted just 20 quarters and GDP is less than 10% above the trough.<sup>1</sup>

To determine whether the moderation has any bearing on medium-term growth, we need to distinguish between its underlying drivers.

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<sup>1</sup> The GDP series used to compute the euro area "synthetic" aggregate come from the Euro Area Wide Model (AWM) database and Eurostat and covers the period 1970 Q1 – 2018 Q1.

In part, the moderation is related to supply-side factors. Some of these are temporary in nature and have already subsided, such as the cold winter weather in large parts of the euro area. But there may also be broader supply factors at play.

In particular, there are increasing signs that capacity constraints are starting to bind in some countries and sectors. Capacity utilisation stands above its long-term average in the euro area and in all large economies. The question is how much, and how quickly, firms will be able to increase supply to relieve these limits.

Adjustment is already taking place in the labour market. The labour force participation rate in the euro area has risen by 1.5 percentage points since the crisis and now stands at an all-time high. And businesses have been actively trying to expand capacity by increasing labour inputs. Employment has risen by 8.4 million since mid-2013, and is growing in nearly every euro area economy.<sup>2</sup>

This has indeed been a job-rich recovery. Compared with the previous growth phases going back to 1975, the contribution of labour to growth has been the highest on record, accounting for almost half of average annual growth.<sup>3</sup>

But the flipside of rising labour utilisation has been a lack of capital deepening. Whereas capital deepening contributed at least 0.6 percentage points to annual growth in all those previous growth phases, its contribution to the current phase is approximately zero. This could explain why signs of capacity constraints are now emerging. Growth has largely been achieved by applying more labour to existing capital.

Firms should increasingly turn to capital to lift capacity – a process that has already begun as business investment has picked up and now stands above its pre-crisis level.

Certainly the conditions are in place to further foster investment, including improving profitability and supportive financial conditions. This is in line with the latest European Commission forecasts for potential output, which project an increase in the contribution from capital and a decrease from labour over the coming years.<sup>4</sup>

All this suggests that the supply-side factors we are currently seeing are likely to slowly unwind over the medium term. Where we need to pay closer attention in the nearer term is to developments on the demand side.

By and large, the underlying fundamentals of the euro area remain solid. Domestic demand is robust, and the main motor of the expansion – the virtuous circle between employment and consumption – is still in place. External demand has been less positive, but this may partly reflect a pullback from the very strong export performance of last year, as well as temporary factors in our main trading partners.

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<sup>2</sup> In annual terms, employment is not growing only in Lithuania.

<sup>3</sup> European Commission data and ECB calculations. As growth accounting exercises are sensitive to the underlying assumptions, exact numbers should be treated with caution.

<sup>4</sup> European Commission (2018), *European Economic Forecast*, Spring 2018.

Yet what is undeniable is that uncertainty surrounding the growth outlook has recently increased.

The downside risks to the outlook come from three main sources: the threat of increased global protectionism prompted by the imposition of steel and aluminium tariffs by the United States; rising oil prices triggered by geopolitical risks in the Middle East; and the possibility for persistent heightened financial market volatility.

Set against this are some risks to the upside, stemming mainly from the fiscal expansion in the United States and, more in the medium term, from likely fiscal expansions in several countries in the euro area.

We will continue to monitor these developments closely. But for now, our growth expectations for the medium term remain essentially unchanged and we view the risks around that outlook as broadly balanced.

## 2 Outlook for wages and inflation

For monetary policy, the key issue is how growth feeds into wages and then inflation. It is well-known that the reaction of inflation dynamics to accelerating growth has been atypically slow in recent years. As I have discussed elsewhere, there are a variety of factors that could explain this, ranging from mismeasurement of slack to a changing relationship between slack and wages.<sup>5</sup>

All this has injected quite some uncertainty into understanding and forecasting wage dynamics, which persists today. But there are signs that slack is now diminishing, and that the relationship between slack and wages is slowly re-asserting itself.

Different measures of slack, such as broad and headline unemployment, appear to give a similar picture of lessening spare capacity, although there is still high unemployment among specific groups and regions.<sup>6</sup>

In keeping with this, the unexplained residuals in the standard wage Phillips curve model for the euro area are gradually reducing, and wage growth is beginning to pick up.

Compensation per employee has lifted from its trough in mid-2016 and is now growing at 1.9%. So far, the increase has been mainly explained by the wage drift component, which tends to react faster to cyclical improvements in the labour market. But annual growth in negotiated wages has also started to move upwards.

Looking ahead, recent wage agreements notably in Germany, but also in other large countries such as France and Spain, point to a continuation of these wages dynamics. There are signs that the restraint in public-sector wage growth, which had in the past dragged on aggregate wage growth, is starting to relax.

<sup>5</sup> See for example Draghi, M (2017), "Accompanying the economic recovery", Speech at the ECB Forum on Central Banking, Sintra, 27 June.

<sup>6</sup> See Szörfi, B. and Tóth, M. (2018): Measures of slack in the euro area, *Economic Bulletin*, Issue 3, ECB.

We are seeing an increase in domestic cost pressures along the pricing chain.<sup>7</sup> Domestic producer price inflation for non-food consumer goods is growing at its highest rate since February 2013. Producer price inflation in the services sector – where wages represent around 40% of costs – has also picked up.

That said, higher wage growth does not mechanically translate into higher inflation. Even if wages continue to rise as we expect, we cannot exclude that structural factors beyond the central bank's control might impede the transmission of wages into consumer prices. For example, more intense competition through globalisation or e-commerce might act to compress margins. At present, we do not see much evidence that such factors have affected inflation in the euro area.

What is key is that inflation expectations remain well anchored. Here we are seeing some positive signs. For example, the latest ECB Survey of Professional Forecasters (SPF) shows longer-term inflation expectations stable at 1.9%.

So, overall, there is growing evidence that broad-based economic growth is beginning to generate positive pricing dynamics. But uncertainty arising from economic developments lingers throughout the various stages of this process.

### 3 Implications for monetary policy

So what does this imply for our current monetary policy?

We have set out three conditions that must be in place for our net asset purchases to end. We need to see the *convergence* of inflation towards our aim over the medium term; we need to have sufficient *confidence* that this convergence will be realised; and the inflation path needs to show *resilience* and be self-sustaining without additional net purchases.

Assessing these conditions is a forward-looking exercise, because the full effects of monetary policy are felt only after long lags. We have to rely on our projections, the probability distributions surrounding them, and the extent to which they are dependent on our own monetary policy actions.

In terms of convergence, the latest projections see headline inflation reaching 1.7% in each of the next three years. Inflation excluding food and energy – a simple measure of underlying price pressures – is expected to climb to even higher levels over the same horizon. These are the latest in a series of projections which foresee inflation converging to our aim over a policy-relevant medium-term horizon. Importantly, over the course of the past year, that convergence path has held firm, and the timing of when we expect to attain our objective does not appear to have receded further into the future.

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<sup>7</sup> See Fabiani, et al. (2006), "What Firms' Surveys Tell Us about Price-Setting Behavior in the Euro Area", *International Journal of Central Banking*, 2(3): 3-47.

Our confidence in the inflation path is also rising, on the basis of two indicators we have been using to assess the probability of inflation convergence.

The first is our own internal estimates of the distribution of future inflation outcomes. ECB staff have constructed a measure that combines the implied inflation distributions from a variety of sources – Eurosystem staff projections, model-based estimates, market-based measures of expectations and surveys such as the SPF. These sources are then weighted by their historical ability to accurately forecast inflation.

That aggregate probability distribution of two-year-ahead inflation expectations has evolved in three dimensions that provide confidence that inflation adjustment is sustainable. The mean of the distribution has increased, the dispersion of the distribution has narrowed, and the downward skew has declined.

Second, we have been monitoring a range of measures of underlying inflation, including model-based statistical measures such as what we refer to as the PCCI,<sup>8</sup> and exclusion-based methods such as inflation excluding food and energy.

Measures of underlying inflation typically provide some early information about the rate at which inflation will stabilise in the future, once all the noise that is affecting current observed headline measures has faded away. Though underlying inflation has not yet shown a clear upward trend, the improvement in wage growth, domestic producer prices and inflation expectations gives us more confidence that, as resource utilisation continues to tighten, underlying inflation will eventually begin to rise.

Finally, market pricing provides some comfort on the resilience of inflation to the anticipated gradual ending of asset purchases.

Inflation expectations are influenced not only by economic fundamentals and the cumulative impact of our past policies, but also by market expectations of *future* policy settings, including net asset purchases. Ahead of our meeting last week, the median market expectations for net purchases beyond September 2018 were small. It follows that the contribution to our inflation outlook from expected future net purchases was also modest.

As a result of this assessment, last week the Governing Council concluded that progress towards a sustained adjustment in inflation has been substantial so far. As we announced, we anticipate that after September 2018, subject to incoming data confirming our medium-term inflation outlook, we will reduce the monthly pace of the net asset purchases to €15 billion until the end of December 2018 and then end net purchases.

That decision, while acknowledging the increase in uncertainty, shows that we are confident that the projected convergence in the path of inflation will occur with sufficient probability without further *net additions* to our stimulus. The economy and the inflation process are developing an underlying strength that was previously

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<sup>8</sup> Persistent and common component of inflation.

absent. As a result, as I described here last year, monetary policy can accompany the economic recovery.<sup>9</sup>

But the projected convergence remains reliant on the substantial cumulative impact of past policies, which are locked into the supportive financial conditions present today. Significant monetary policy accommodation is still needed to support the further build-up of domestic price pressures and headline inflation developments over the medium term.

Our latest, unanimous decision ensures that the necessary monetary policy support remains in place. This support has a number of elements, including the net asset purchases until the end of the year, the sizeable stock of acquired assets and the associated reinvestments, and our enhanced forward guidance on the key ECB interest rates.

Our decisions also reflected the desire of the Governing Council to retain the ability to react to potential future shocks to ensure the sustained convergence of inflation to our medium-term aim. They embed precise elements of state contingency into our forward guidance. By clearly specifying and communicating our reaction function, we are able to act in a consistent and predictable fashion. Acting in this way helps reduce any market uncertainty that might arise concerning our future actions.<sup>10</sup>

Let me restate our recent decisions on our policy instruments.

First, our anticipated ending of asset purchases in December this year is subject to incoming data confirming the medium-term inflation outlook. Moreover, the APP can always be used in case contingencies materialise that we do not currently foresee.

Second, we announced that we intend to maintain our policy of reinvesting the principal payments from maturing securities purchased under the asset purchase programme (APP) for an extended time after the end of net purchases, and in any case for as long as necessary to maintain favourable liquidity conditions and an ample degree of monetary accommodation.

Third, we conveyed our expectation that the key ECB interest rates will remain at their present levels at least through the summer of 2019, and in any case for as long as necessary to ensure that the evolution of inflation remains aligned with our current expectations of a sustained adjustment path.

This enhanced forward guidance clearly signals that we will remain patient in determining the timing of the first rate rise and will take a gradual approach to adjusting policy thereafter. The path of very short-term interest rates that is implicit in the term structure of today's money market interest rates broadly reflects these principles.

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<sup>9</sup> Draghi, M (2017), *op. cit.*

<sup>10</sup> Coenen et al. (2017), "Communication of monetary policy in unconventional times", *Working Paper Series*, No 2080, ECB. The authors find that clearly communicated forward guidance can help reduce market uncertainty.

As indicated at the ECB watchers' conference earlier this year,<sup>11</sup> after the end of net asset purchases, the main tool for shaping our policy stance will become the path of our key policy rates and forward guidance about their likely evolution.

Finally, we have stated that we stand ready to adjust all of our instruments as appropriate to ensure that inflation continues to move towards our medium-term aim of inflation below, but close to, 2%. Adjustments to our instruments will remain predictable, and they will proceed at a gradual pace that is most appropriate for inflation convergence to consolidate, taking into account continued uncertainty in the economy. In short, monetary policy in the euro area will remain patient, persistent and prudent.

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<sup>11</sup> Draghi, M. (2018), "Monetary Policy in the Euro Area", speech at The ECB and Its Watchers XIX Conference organised by the Institute for Monetary and Financial Stability, Frankfurt, 14 March.





# Slack and Cyclically Sensitive Inflation

By James H. Stock and Mark W. Watson<sup>1</sup>

## Abstract

The low rates of price inflation in both the United States and the euro area have been resistant to tightening economic conditions. As measured by the unemployment rate, the US economy in particular is at historically tight levels. One possibility is that the unemployment rate understates slack because of special features of the financial crisis recession and the long recovery, however we find the same puzzling quiescence of inflation in both the United States and the euro area when we look at other slack measures. We therefore turn to the possibility that inflation *is* increasing – but only in those sectors that are historically cyclically sensitive, with prices set not in international markets but locally (such restaurants and hotels). We find that cyclically sensitive inflation has increased slightly in the United States over the past two years, but has been stable in the euro area.

## 1 Introduction

Charts 1 and 2 summarize the low-inflation puzzle confronting the United States and the euro area. In the United States, the unemployment rate has fallen from a peak of 10% in October 2009 to a 48-year low of 3.8% in May 2018, and it has been below the Congressional Budget Office's current estimate of the natural rate of unemployment since February 2017. In Europe, the recovery from the financial crisis recession was slower to take hold, and the euro area (EA) harmonized unemployment rate of 8.5% still exceeds its pre-crisis trough of 7.3% in January 2008. Since mid-2013, however, the EA unemployment rate has been falling steadily and has declined by 0.9 percentage points in the past year alone.

Yet, despite this strong growth, especially over the past several years, both wage and price inflation remain stubbornly below the 2% target. In the United States, core inflation as measured the personal consumption expenditure price index (PCE excluding food and energy, PCE<sub>ExFE</sub>) is currently 1.6% (Q1 to Q1), the same value as in the first quarter of 2013 (it has edged up in the April and May 2018 monthly data). Like prices, the rate of wage inflation, as measured by average hourly earnings (all

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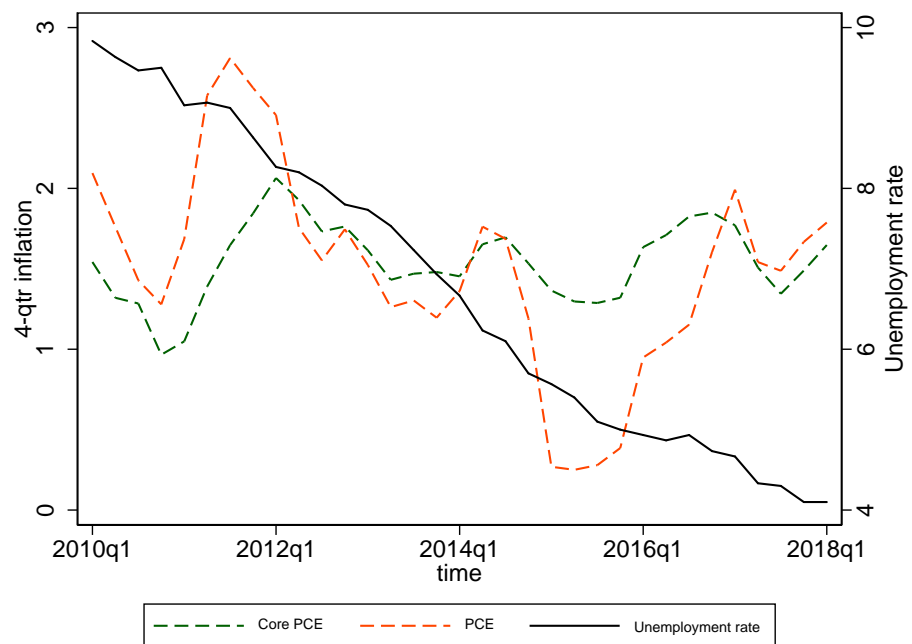
<sup>1</sup> James Stock is the Harold Hitchings Burbank Professor of Political Economy in the Department of Economics at Harvard University. Mark Watson is the Howard Harrison and Gabrielle Snyder Beck Professor of Economics and Public Affairs in the Department of Economics and the Woodrow Wilson School, Princeton University. The authors thank Brian Barnier, Alan Detmeister, Karen Dynan, Sylvester Eijffinger, Martin Feldstein, Benjamin Friedman, David Friedman, Jason Furman, Michael Kiley, Kyle Hood, Jennifer Ribarsky, Lucrezia Reichlin, Robert Rich, Ellis Tallman, John Williams and multiple participants at the 2018 ECB Economic Forum for helpful comments and/or discussions. We thank Justine Guillochon and Chiara Osbat of the ECB for help with the EA data and helpful suggestions. Replication files are posted on Watson's Web site.

private workers) in the United States has not increased, with its four-quarter rate of growth fluctuating in a narrow band around 2.5% since late 2015. In the euro area, core inflation, as measured by HICP excluding energy and unprocessed food (HICPxEUUF) for comparability to the US PCE<sub>FE</sub>, has increased by 0.6pp since the first quarter of 2015, yet currently is only 1.2%.

This apparent disconnect between consistent economic growth and the stable and low rates of inflation stands in sharp contrast to earlier episodes, and raises new questions for monetary policy. Is this apparent flattening of the Phillips curve a new and permanent feature of modern economies with credible monetary authorities? Or are tight economic conditions building inflationary pressures that simply have not yet been observed? Answering these questions is especially pressing in the United States, where an already-tight economy will likely become more so as a result of the additional fiscal stimulus provided by the federal tax cuts of December 2017: In its most recent economic update, the CBO projects the deficit-to-GDP ratio for FY2019 (which begins October 1, 2018) to rise to 4.6%.

**Chart 1**

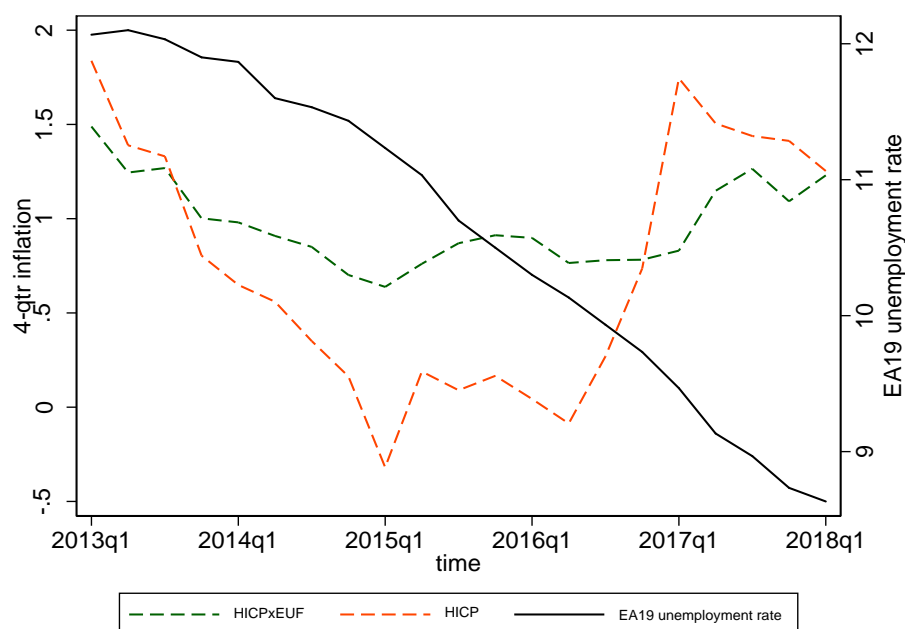
The unemployment rate, PCE inflation, and core PCE inflation in the United States, 2010-2018q1



Source: FRED.

## Chart 2

The unemployment rate, HICP inflation, and core HICP inflation in the EA, 2013-2018q1



Sources: Eurostat and ECB.

Researchers and policy makers have proposed multiple explanations for this apparent flattening of the Phillips curve. One set of explanations focuses on the role and formation of inflation expectations. A commonly proposed explanation is the success of monetary policy in anchoring expectations, however it is difficult to reconcile this theory with the US evidence without also having a reduction in the Phillips curve slope coefficient (e.g. Fuhrer (2012)) or using the short-term unemployment rate as the measure of slack (Ball and Mazumder (2014)). Coibion and Gorodnichenko (2015) suggest that firms' inflation expectations moved *countercyclically* during the recession and recovery because they are overly influenced by oil prices, which increased from 2009 to 2011 and (extending their argument) fell from 2014 through 2017. Another set of explanations focuses on special features of the financial crisis. For example, Gilchrist et. al. (2017) suggest that special features of the financial crisis affecting the pricing behaviour of liquidity-constrained firms, counteracting the expected downward pressure on inflation during the recession and early recovery. A third set of explanations focuses on structural changes that could lead to a reduction of the Phillips curve coefficient. For example, the ability to offshore jobs and increasing openness to trade restrains wages even when the labour market is tight. In addition, technological developments have made it easier to substitute capital (robots, Web sites) for labour, restraining wages and thus prices.

Other explanations, however, have to do with measurement problems. According to this second set of explanations, perhaps the apparent flattening of the Phillips Curve is, at least in part, an artefact of mismeasurement of economic slack or of the rate of price inflation, or both.

The aim of this paper is to examine the possibility that measurement issues, possibly in conjunction with an increasing share of consumption having prices strongly influenced by international markets, play a role in the recent apparent disconnect between activity and inflation. To do so, we re-examine both measures of slack and measures of price inflation, with an eye towards better measurement of cyclical sensitivity.

We begin in Section 2 by examining measures of slack in the United States. One possibility is that the depth of the recession changed labour market dynamics in ways that are not well measured by the unemployment rate alone. For example, many of the unemployed during the recession were unemployed for long periods, and the long-term unemployed have lower job-finding rates and lower search intensity than the short-term unemployed (e.g. Krueger, Cramer and Cho (2014)); thus the short-term rate of unemployment might be a measure of slack more closely linked to inflation than the overall unemployment rate. Alternatively, many of the workers who exited the labour force in the United States are now taking jobs – the labour force participation rate has been flat in the United States since mid-2014, despite strong demographic trends pushing it down – so that there is more slack in the economy than the unemployment rate suggests (e.g. Bell and Blanchflower 2018). We find some evidence that, for the purpose of the Phillips relation, slack might be better measured over this recovery by the short-term unemployment rate than by the standard unemployment rate or other measures, such as the capacity utilization rate. The evidence, however, is weak, and in any event using nonstandard measures of slack does not explain the weakness in the US rate of inflation over the past two years.

We next take up the question of whether noise in the major price indexes, perhaps combined with changes in the economy, could be masking the activity-inflation relationship. This line of investigation is more novel, and our analysis draws on both detailed information about the construction of price indexes by sector and econometric methods to tease out cyclical sensitivity. Our analysis starts with sectoral data, then aggregates the sectoral data to a new price index, which we call Cyclically Sensitive Inflation (CSI).

The first step in the construction of the CSI index is to examine the construction of price indexes at the sectoral level. There is considerable heterogeneity across components in the quality of price measurement. As explained in Section 3, we exclude from our index the most poorly measured price series, which comprise 17% of consumption for the United States.

Of the remaining components of PCE inflation, one would expect *a priori* that the sectoral prices would have different degrees of cyclical sensitivity. At one extreme, the price of commodities such as oil have prices set in world markets, so the link between economic activity in any one country and the change in the oil price will be attenuated. In contrast, many services, such as recreational services or food served at restaurants, are largely non-tradable and have prices that are set in local markets, so should be more subject to local and national cyclical pressures. In Section 3, we use PCE component rates of inflation and an index of real cyclical activity to estimate the weights on the individual components, and then use these estimated weights to construct our index of cyclically sensitive inflation (CSI).

Section 4 turns to the euro area. As in the United States, using different measures of slack does not explain the sluggishness of core inflation. We therefore take the same approach as we did for the United States and ask whether some components of inflation are more cyclically sensitive than others. As in the United States, there is in fact a very wide range of cyclical variability among components of the HICP. For example, services provided by restaurants and hotels, as well as food and non-alcoholic beverages, have inflation rates that are strongly cyclical, while other components, such as housing rents (excluding energy), communications, and health care have small or no cyclical variation. Using the methodology of Section 3, we construct a CSI index for the EA.

The HICP components and PCE components are different, with HICP components being organized along functional consumption categories (by purpose) and PCE being organized by product characteristics, broken down by durable goods, nondurable goods, and services. It is therefore not possible to compare directly the weights on components across the EA and US CSI measures. That said, there are some similarities in the measures. For example, both measures place negligible weight on energy, and place much or most of their weight on goods or services that are locally priced (as opposed to internationally priced).

We see the CSI index as providing another indicator by which to monitor the economy. Because measuring slack is difficult in real time, CSI inflation provides a real-time alternative to estimating slack measure: CSI provides a real-time index of whether cyclical pressures are causing the most sensitive components of inflation to rise or fall. Said differently, in the current regime of largely stable rates of inflation, the combination of measurement error and special factors make it particularly difficult to observe the “signal” of inflation starting to pick up as cyclical conditions tighten. The CSI index provides a new measure of this signal. This monitoring function of the CSI contrasts with two roles of inflation indexes that the CSI is *not* designed to fill: it is not a measure of the overall cost of living (it cannot be, because it does not use consumption share weights), nor is it a new index for a central bank to target.

Over the past year, CSI inflation has picked up slightly in the United States, but not at the pace that preceded the most recent recessions. In the EA, CSI inflation has increased at the same rate as HICPxEU. Thus, at the moment, these CSI measures are indicating that the most cyclically sensitive components of inflation remain quiescent. Because the indexes can be computed in real time, they can be monitored going forward to provide another window on inflation as real economic conditions change.

This paper is related to several lines of research within the vast literature on the relation between inflation and output. The papers most closely related to this one also focus on sectoral inflation. Peach, Rich and Lindner (2013) propose different price-setting mechanisms for goods and services inflation (the former being more trade-sensitive) and use goods and services separately to forecast inflation. Tallman and Zaman (2017) use inflation components to forecast aggregate inflation. Drawing on early presentations of the material in this paper (Stock and Watson, 2016a), at least two groups have developed experimental cyclically sensitive indexes, the Federal Reserve Bank of San Francisco (Mahedy and Shapiro, 2017) and Goldman Sachs



economic research (Struyven, 2017). Déés and Güntner (2017) find improvements to euro area inflation forecasts by disaggregating to four sectors (industry, services, construction, and agriculture). The ECB also has investigated the cyclical properties of HICP components as described in a box in the ECB Monthly Bulletin (ECB (2014)).

This paper is also related to work on core inflation, which uses inflation components to construct a less noisy measure of trend inflation. Research on core and on the use of inflation components to measure trend inflation includes the early papers of Gordon (1975) and Eckstein (1981), and more recently Cristadoro, Forni, Reichlin, Veronese (2005) Boivin, Giannoni and Mihov (2009), and Amstad, Potter and Rich (2017); see Stock and Watson (2016b) for additional references and discussion of this literature. Papers on the apparent flattening of the Phillips curve in the 2000s, and especially since the financial crisis recession includes (among others) Stock and Watson (2010), Ball and Mazumder (2011, 2014), Stock (2011), Gordon (2013), Watson (2014), Kiley (2015), Blanchard (2016), and Bell and Blanchflower (2018). This literature focuses on the United States. Mazumder (2018) finds a stable Phillips curve for the euro area using short-term professional survey expectations data, and he attributes the weakening of EA inflation to a decline in expected inflation.

## 2 Measures of Slack in the United States

Is the puzzling absence of a Phillips relation in the recent US data simply an artefact of mismeasuring slack? In this section, we examine Phillips correlations, Phillips slopes, and inflation forecasting relations using multiple measures of slack. We find that the results for these additional slack measures mirror those for the unemployment gap: for all these slack measures, the Phillips correlation has fallen over time, the Phillips slope has flattened, and inflation forecasts using the candidate slack measure are unstable.

### 2.1 Slack and gaps

Slack is an economic construct that is not measured directly. Slack is commonly estimated using an activity gap computed as the difference between an activity variable measured in real time and an unobserved level of that variable that represents full utilization of productive resources. These full-utilization levels are unobserved but can be estimated. For example, the unemployment gap is the difference between the observed unemployment rate and an estimate of the NAIRU, which can be estimated econometrically using an empirical Phillips relation.

We refer to gap measures in which the full-utilization value is estimated using retrospective (full-sample) data as ex post gap measures, in contrast to gap measures that are available in real time (real time gaps). As new data become available, the ex post estimates of the full-utilization value at any given date, and thus of the gap, are revised. These revisions tend to be largest towards the end of the sample, where the newly available data have the greatest influence. As a result, ex post gaps can be useful for understanding historical relationships and developments, but are noisy –

and potentially misleading – indicators of real-time economic conditions (Orphanides and Norden [2002]).

In this section, we consider seven ex post gaps. The first two are from the Congressional Budget Office (CBO): the unemployment gap, which is the difference between the unemployment rate and the CBO long-term NAIRU, and the output gap, which is the log difference between GDP and CBO's estimate of potential GDP.

The remaining five gap measures are constructed using time series estimates of the full-utilization value. The premise of the time series approach is that, over a period of a decade or longer, a given activity measure fluctuates around a long-term value that tracks the full-utilization value. Thus the long-term mean, or more precisely the estimated mean constructed using a low-frequency filter, of the activity measure can serve as a proxy for the full-utilization value, and deviations from this long-term mean provide estimates of the gap. Concretely, we estimate the low-frequency mean using a two-sided biweight filter with a bandwidth of 60 quarters, and the gap is the deviation of the activity measure from this low-frequency mean.<sup>2</sup>

The five activity gaps estimated using the time series approach are the unemployment rate, the short-term unemployment rate (those unemployed 26 weeks or less as a fraction of the labour force), the employment-population ratio (household survey), the employment-population ratio for ages 25-54, and the capacity utilization rate.<sup>3</sup> To facilitate comparisons, we transform each gap to have the same mean and standard deviation as, and to be positively correlated with, the CBO unemployment gap.

The seven standardized gaps and the slack index are plotted for the period 1984-2018 in Chart 3. Most of the seven measures are highly correlated, with 12 of the 21 correlations exceeding 0.85 and the smallest correlation being 0.48.

In addition to these seven measures, Chart 3 plots a slack index, computed as the first principal component of these seven standardized gap measures. The slack index explains 83% of the total variation in the seven gap measures (trace R-squared). We treat this slack index as an eighth ex post gap measure. The gap index evidently is a central estimate of slack at any given date and is somewhat smoother than the individual measures.

As can be seen in the chart, as of early 2018 nearly all the gaps, including the slack index, stand at historically low levels. This said, the greatest dispersion among the

---

<sup>2</sup> For the unemployment rate, we can compare the CBO estimate of the gap to our time series estimate. Over 1984-2018q1, the two unemployment gap measures have a correlation is 0.95. The two measures differ the most at the end of the sample (where the low-frequency filter must be mainly one-sided, and the CBO NAIRU estimate lacks future inflation); over 1990-2005, the correlation between the two unemployment gaps rises to 0.98.

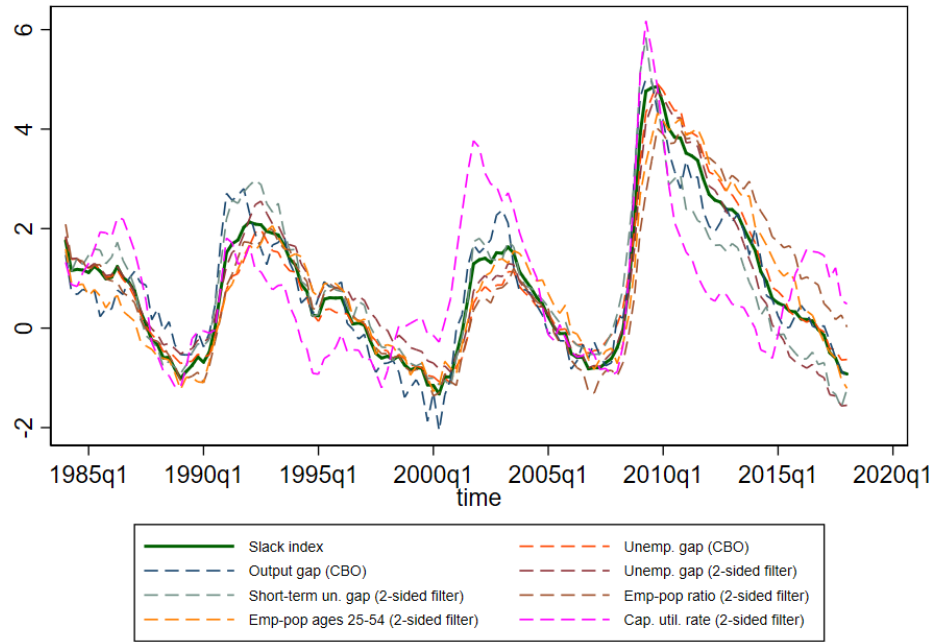
<sup>3</sup> Stock (2011), Gordon (2013), Ball and Mazumder (2014), Krueger, Cramer and Cho (2014), and Watson (2014) generally find that the short-term unemployment rate is a more stable activity variable in empirical Phillips curves than the long-term unemployment rate, using aggregate time series data for the United States, however Kiley (2015) finds no advantage to short-term over the standard unemployment rate using state data. The capacity utilization rate received attention as a possible slack measure in Phillips curve research in the 1990s (e.g. Garner (1994) and Franz and Gordon (1993)). The employment-population ratio is a less commonly used slack measure, but can be thought of as a broad unemployment rate because it incorporates those not in the labour force, including those who might have dropped out of the labour force because of absence of work but would want to work if a job were on offer.



gaps is towards the end of the sample. As of the first quarter of 2018, the capacity utilization gap and the employment-population gap indicate more slack than the unemployment gap, but the short-term unemployment gap indicates even less slack. This dispersion in part reflects the difficulty of estimating full-utilization values, and thus gaps, at the end of the sample.

**Chart 3**

*Ex-post* gaps and slack index for the U.S



Source: Authors' calculations.  
 Notes: Variables are transformed to have same mean, standard deviation, and sign as the unemployment gap.

**2.2 The changing Phillips correlation**

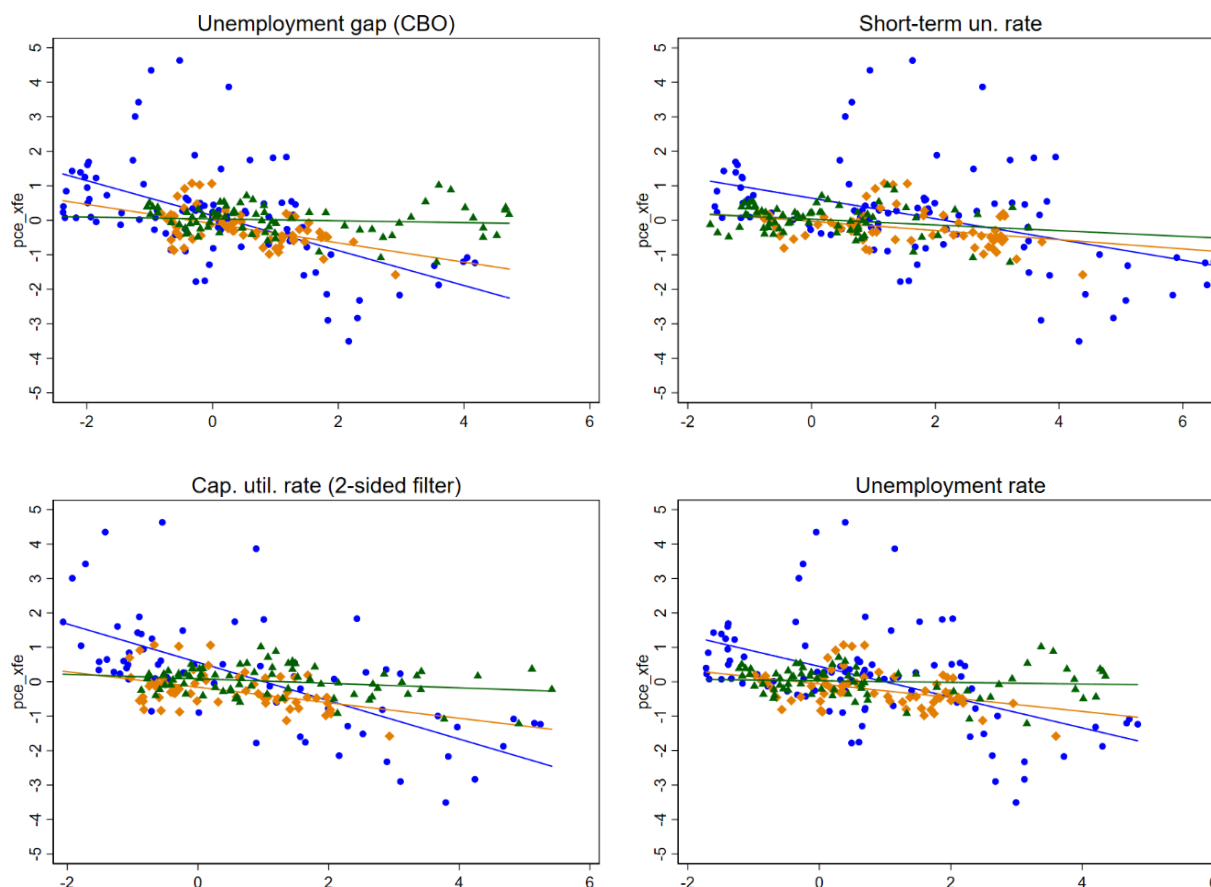
Monetary authorities are interested in achieving inflation targets over medium-term horizons. In addition, rates of inflation have high-frequency variation arising from survey measurement error and from transient special factors. For these reasons, it is conventional to focus on rates of inflation over the past year, and we adopt this convention. Specifically, we focus on the four-quarter inflation rate, which we define using the log approximation,  $\pi_t^4 = 100\ln(P_t/P_{t-4}) = (\pi_t + \pi_{t-1} + \pi_{t-2} + \pi_{t-3})/4$ ,

where  $P_t$  is the quarterly price index and  $\pi_t$  is the quarterly rate of inflation at an annual rate.<sup>4</sup>

#### Chart 4

Evolution of the US Phillips correlation: 4-quarter change in 4-quarter core PCE inflation vs. four standardized gap measures

(1960-83 (blue dots); 1984-99 (orange diamonds); 2000-2018q1 (green triangles))



Source: Authors' calculations.

Notes: The inflation measure is the 4-quarter change from date  $t-4$  to  $t$  in the 4-quarter rate of PCE-xFE inflation. The slack measures are the standardized average value of the quarterly slack variable in the four quarters from date  $t-3$  to date  $t$ , normalized to be positively correlated with the unemployment gap.

Chart 4 shows a Phillips scatterplot of the four-quarter change in four-quarter PCE-xFE inflation ( $\Delta_4\pi_t^4 = \pi_t^4 - \pi_{t-4}^4$ ) vs. the contemporaneous standardized four-quarter moving average of various slack measure ( $x_t^4 = (x_t + x_{t-1} + x_{t-2} + x_{t-3})/4$ ), along with regression lines for three periods, 1960-1983, 1984-1999, and 2000-2018q1. These scatterplot and the regression lines correspond to a benchmark

<sup>4</sup> The PCE price index and its components are available monthly, as are HICP and its components, however some of the activity variables, such as GDP, are only available quarterly. This paper uses quarterly data exclusively, where monthly data are aggregated to quarterly using the average value of the variable (i.e. the index value for prices, or of the unemployment rate) over the months in the quarter. For prices, this yields a quarterly price index. Throughout we use the logarithmic approximation to percentage changes. Four-quarter rates of inflation have the additional useful feature that they are a form of seasonal adjustment, which is useful in our analysis in Section 4 of euro area inflation, which is not seasonally adjusted.

Phillips curve specification  $\Delta_4\pi_t^4 = \beta_0 + \beta_1x_t^4 + u_t^4$ . The slack measures shown are the CBO unemployment gap, the short-term unemployment rate (not gapped), the ex post capacity utilization gap, and the unemployment rate (not gapped).

**Table 1**  
Phillips correlations and slopes for PCE-xFE inflation and various slack measures for the United States

(Phillips relation:  $\Delta_4\pi_t^4 = \beta_0 + \beta_1x_t^4 + u_t^4$ , where  $\Delta_4\pi_t^4 = \pi_t^4 - \pi_{t-4}^4$ ,  $\pi_t^4 = (\pi_t + \pi_{t-1} + \pi_{t-2} + \pi_{t-3})/4$  and  $x_t^4 = (x_t + x_{t-1} + x_{t-2} + x_{t-3})/4$ , where  $x_t$  is a slack measure)

	Correlation			Slope (SE)		
	1960-1983	1984-1999	2000-2018q1	1960-1983	1984-1999	2000-2018q1
<b>Ex-post slack</b>						
Unemployment gap (CBO)	-0.52	-0.48	-0.11	-0.47 (0.11)	-0.28 (0.09)	-0.03 (0.04)
GDP gap (CBO)	-0.51	-0.35	-0.24	-0.31 (0.05)	-0.18 (0.07)	-0.06 (0.04)
Unemployment gap (two-sided filtered)	-0.57	-0.49	-0.07	-0.60 (0.13)	-0.29 (0.10)	-0.02 (0.04)
Short-term unemployment gap (two-sided filtered)	-0.53	-0.49	-0.25	-0.38 (0.08)	-0.22 (0.08)	-0.07 (0.05)
Employment-population ratio (two-sided filtered)	-0.56	-0.44	-0.02	-0.73 (0.17)	-0.24 (0.09)	-0.01 (0.04)
Employment-population ratio ages 25-54 (two-sided filtered)	-0.49	-0.44	-0.03	-0.74 (0.13)	-0.25 (0.10)	-0.01 (0.04)
Capacity utilization rate (two-sided filtered)	-0.64	-0.45	-0.24	-0.52 (0.10)	-0.23 (0.08)	-0.07 (0.03)
Gap index	-0.57	-0.47	-0.14	-0.53 (0.10)	-0.25 (0.09)	-0.04 (0.04)
<b>Real-time slack</b>						
Unemployment rate	-0.49	-0.40	-0.09	-0.43 (0.09)	-0.20 (0.07)	-0.02 (0.04)
Short-term unemployment rate	-0.44	-0.35	-0.24	-0.30 (0.07)	-0.14 (0.06)	-0.08 (0.06)

Source: Authors' calculations.

Notes: All slack measures have been standardized to have the same mean and standard deviation as the CBO unemployment gap, and inverted when needed to be positively correlated with the unemployment gap; thus the slope coefficients have the same units so their magnitudes are comparable. Results for 2000-2018 go through the first quarter of 2018. Standard errors (in parentheses in the final three columns) are Newey-West with 8 lags.

Table 1 provides the correlation between  $\Delta_4\pi_t^4$  and  $x_t^4$ , along with the Phillips slopes, over these three periods for all seven ex post gaps and for the slack index. In addition, results are shown for the (not gapped) unemployment rate and the short-term unemployment rate. For these two measures, the variation in the estimated full-utilization values is fairly small relative to the variation in the activity measure, so that most of the variation in the activity measure is variation in the gap.

By each of these slack measures, the US Phillips correlation has been getting weaker and its slope has been getting flatter. This conclusion is robust to using shorter or longer temporal aggregation and to deviating  $\pi_t^4$  from a  $t-4$  – dated univariate forecast.

## 2.3 Inflation forecasts using slack over the recession and recovery

Our primary focus is on the contemporaneous Phillips relation, especially at business cycle frequencies. In this section, however, we digress to examine the possibility that alternative slack measures might produce stable and informative inflation forecasting models.

The slack measures considered so far are *ex post* and thus are not suitable for a forecasting exercise. We therefore introduce some real-time gaps, where the full-utilization values are computed as a one-sided exponentially-weighted moving average, with a weight with half-life of 15 years.<sup>5</sup> These real-time gaps were computed for the unemployment rate, the short-term unemployment rate, the capacity utilization rate, and the two employment-population ratios. In addition, we used two non-gapped variables, the unemployment rate and the short-term unemployment rate. As an illustration, we examined the performance of these seven real-time gap measures, along with an index of these measures computed as their first principal component, in a prototypical Phillips curve forecasting model,  $\Delta_4\pi_t^4 = \beta_0 + \beta_1x_{t-4} + \beta_2\pi_{t-4}^4 + e_t^4$ , where  $x_t$  is the candidate real-time gap.

Table 2 summarizes results for two illustrative forecasting exercises. The first column summarizes the results of a pseudo out-of-sample forecasting exercise, in which the forecasting model was estimated using pre-recession data (from 1984q1-2007q1) and used to forecast inflation during the recession and recovery (from 2008q1-2018q1; 2008q1 is the first fully out-of-sample date for the four-quarter ahead forecast). The table reports the root mean square forecasting error (RMSFE) in the out-of-sample period from the model including slack, relative to the RMSFE of the model with the slack measure excluded, so a relative RMSFE less than one indicates that the slack measure improved inflation forecasts over the final 17 quarters of the data. The second column reports the sup-Wald test of the hypothesis that the coefficients in this forecasting regression are stable over the 1984q1-2018q1 period.

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<sup>5</sup> The exponential moving average filter yields real time gaps with correlations with the two-sided biweight smoothing gaps between 0.88 and 0.96 for the two unemployment rates and the capacity utilization rate; these correlations are lower (.72 and .79) for the employment-population ratio gaps, which have large nonstationary components. Similar results obtain using one-sided 15-year equal-weighted moving averages to construct the gaps, although those gaps generally have a lower correlation with the two-sided biweight gaps.

**Table 2**

Forecasting annual changes in PCE-xFE inflation using slack variables for the United States

(four-quarter ahead direct forecasting regression:  $\Delta_4\pi_t^4 = \beta_0 + \beta_1x_{t-4} + \beta_2\Delta_4\pi_{t-4}^4 + e_t^4$ )

Predictor slack variable	Sup-Wald test	Pseudo out-of-sample RMSFE ratio, 2008q1-2018q1
Unemployment rate	12.62**	1.517
Short-term unemployment rate	8.51**	1.052
unemployment rate (real time gap)	13.71**	1.480
short-term unemployment rate (real time gap)	9.27**	1.067
employment-population ratio (real time gap)	29.31**	1.338
employment-population ratio ages 25-54 (real time gap)	20.64**	0.989
Capacity utilization rate (real time gap)	23.05**	1.023
Real-time slack index	13.93**	1.362

Source: Authors' calculations.

Notes: The first column reports the Sup-Wald statistic (15% trimming) testing the null hypothesis that all three coefficients in the forecasting regression are stable, when estimated over the period 1984q1-2018q4. The second column is the ratio of the pseudo out-of-sample root mean squared forecast errors of the direct forecasting regression in the table header, to the RMSFE for the restricted version without the slack variable, where all regressions are estimated over 1983q1-2007q1 and the RMSFEs are computed over 2008q1-2018q1.

\*\*Rejects the null of constant coefficients at the 1% significance level.

The results in Table 2 are striking. For all but one of the real-time gap measures, using a gap *worsens* out-of-sample performance; for the sole real-time gap that improves the forecast (the employment-population ratio, ages 25-54), the improvement is negligible. For all the gap measures, the hypothesis of coefficient stability is rejected at the 1% significance level. This finding of instability, illustrated here for simple forecasting models, is in line with the literature on inflation forecasting, which stresses the prevalence of time-variation in forecasting relations using activity variables (e.g. Groen, Paap and Ravazzolo (2013)).

The conjecture that motivated this investigation of alternative gap measures was that perhaps the apparent flattening of the Phillips curve was an artefact of focusing on a gap measure, the unemployment gap, that currently has less value than other gap measures, and that the apparent flattening would be resolved if we found the “right” gap measure. The evidence, however, does not support this conjecture. Thus, if measurement is to be the explanation, we must look not to alternative measures of slack, but rather to inflation itself.

## 2.4 Earnings and slack

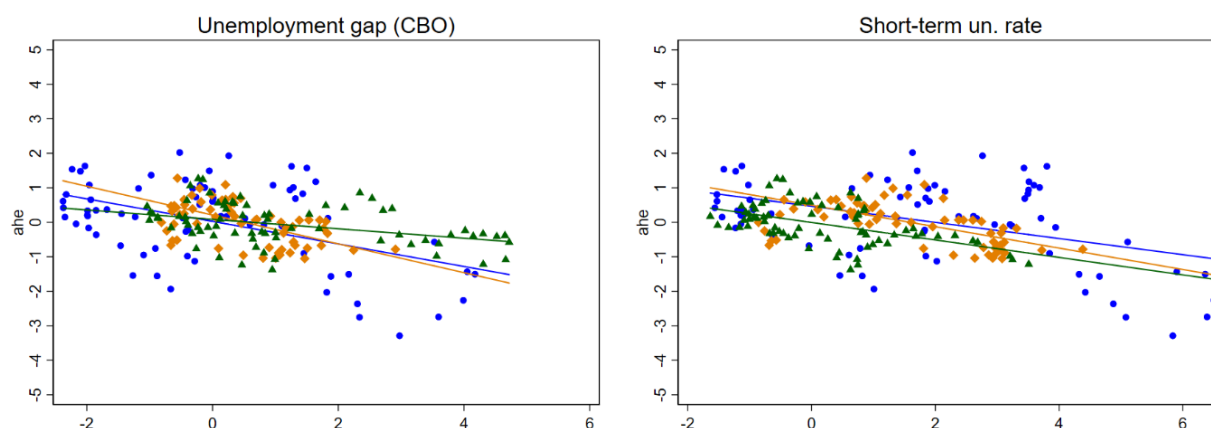
Although our focus is price inflation, we briefly digress to examine stability of the relation between wage inflation and slack measures in the United States. The wage measure we use is average hourly earnings of production and nonsupervisory workers (total private sector). The relationship between wage inflation and slack, especially as measured by the short-term unemployment rate, has been more stable than the corresponding price inflation-slack relationship.

Chart 5 provides two wage inflation scatterplots similar to those in Chart 4 for price inflation; the slack measures in Chart 5 are the CBO unemployment gap and the short-term unemployment rate. Tables 3 and 4 provide the results in Tables 1 and 2, but for wage inflation instead of core PCE inflation.

### Chart 5

Evolution of the US wage Phillips correlation: 4-quarter change in 4-quarter average hourly earnings inflation vs. the CBO unemployment gap and the short-term unemployment rate

(1960-83 (blue dots), 1984-99 (orange diamonds), 2000-2018q1 (green triangles))



Source: Authors' calculations.

Notes: The inflation measure is the 4-quarter change from date  $t-4$  to  $t$  in the 4-quarter rate of AHE inflation. The slack measure plots the standardized average value of the quarterly slack variable in the four quarters from date  $t-3$  to date  $t$ .

Unlike core PCE inflation, the correlation between wage inflation and contemporaneous slack measures falls only slightly, and for some slack measures does not fall at all, from the pre-2000 period to the post-2000 period. This is consistent with the good fit found by Galí (2011) for a new Keynesian wage Phillips curve using data through 2007. For the short-term unemployment rate in particular, the relation between slack and the change in wage inflation appears to be quite stable, although there is an intercept shift consistent with a decline in the wage NAIRU in the post-2000 period.

Also unlike core PCE inflation, for which none of the forecasting relations were stable or provided improvements over the 2008-2018 period, some slack measures provide substantial improvements in the pseudo out-of-sample forecasting exercise. All the real-time slack measures except for the employment-population ratios improve upon using only lagged inflation in the out-of-sample period, especially the short-term unemployment rate, the capacity utilization rate (both real-time gaps), and the real-time slack index. This said, the hypothesis of coefficient stability is rejected for all slack measures.

**Table 3**

Phillips correlations and slopes for average hourly earnings inflation and various slack measures for the United States

(four-quarter inflation and four-quarter moving average of slack measures)

	Correlation			Slope (SE)		
	1960-1983	1984-1999	2000-2018q1	1960-1983	1984-1999	2000-2018q1
<b>Ex-post slack</b>						
Unemployment gap (CBO)	-0.47	-0.52	-0.39	-0.32 (0.11)	-0.36 (0.12)	-0.14 (0.05)
GDP gap (CBO)	-0.41	-0.42	-0.50	-0.20 (0.10)	-0.25 (0.11)	-0.19 (0.05)
Unemployment gap (two-sided filtered)	-0.45	-0.49	-0.42	-0.39 (0.14)	-0.33 (0.12)	-0.15 (0.04)
Short-term unemployment gap (two-sided filtered)	-0.47	-0.58	-0.51	-0.27 (0.10)	-0.31 (0.10)	-0.20 (0.04)
Employment-population ratio (two-sided filtered)	-0.39	-0.46	-0.29	-0.41 (0.21)	-0.29 (0.10)	-0.10 (0.06)
Employment-population ratio ages 25-54 (two-sided filtered)	-0.33	-0.40	-0.33	-0.39 (0.20)	-0.26 (0.12)	-0.12 (0.05)
Capacity utilization rate (two-sided filtered)	-0.41	-0.72	-0.62	-0.26 (0.13)	-0.43 (0.05)	-0.24 (0.05)
Gap index	-0.46	-0.54	-0.46	-0.33 (0.12)	-0.33 (0.11)	-0.17 (0.04)
<b>Real-time slack</b>						
Unemployment rate	-0.45	-0.51	-0.38	-0.31 (0.11)	-0.30 (0.11)	-0.14 (0.05)
Short-term unemployment rate	-0.46	-0.54	-0.51	-0.24 (0.09)	-0.25 (0.10)	-0.25 (0.05)

Source: Authors' calculations.  
Note: See the notes to Table 1.**Table 4**

Forecasting annual changes in wage inflation (average hourly earnings) using slack variables for the United States

(four-quarter ahead direct forecasting regression:  $\Delta_4\pi_t^* = \beta_0 + \beta_1 x_{t-4} + \beta_2 \Delta_4\pi_{t-4}^* + e_t^*$ )

Predictor slack variable	Sup-Wald test	Pseudo out-of-sample RMSFE ratio, 2008q1-2018q1
Unemployment rate	24.29**	0.967
Short-term unemployment rate	20.00**	0.970
unemployment rate (real time gap)	24.14**	0.947
short-term unemployment rate (real time gap)	19.89**	0.915
employment-population ratio (real time gap)	23.49**	1.046
employment-population ratio ages 25-54 (real time gap)	19.59**	1.200
Capacity utilization rate (real time gap)	11.23**	0.872
Real-time slack index	21.87**	0.925

Source: Authors' calculations.  
Note: See the notes to Table 2.

## 3 Cyclically Sensitive Inflation in the United States

We now turn to the possibility that, although the overall cyclical sensitivity of price inflation has been declining, certain goods and services remain cyclically sensitive, and thus could serve as indicators of price pressure. This section continues our focus on the United States; we turn to the euro area in the next section.

We begin by reviewing the components, or sectors, that comprise PCE inflation. Recently there has been increasing attention to the possibility of mismeasuring prices and, as a result, inflation and productivity growth. Our interest here is in whether measurement problems could be obscuring the cyclical movements in inflation. We therefore briefly review some price measurement challenges and how they differentially affect the components of inflation. We then take up cyclical measures of slack, the cyclical properties of the inflation components, and finally the construction of the CSI index.

### 3.1 Components of PCE inflation

Personal consumption expenditures are expenditures on final purchases of goods and services consumed by persons, and PCE inflation measures the rate of price inflation of those goods, weighted by their share in final consumption. The US Bureau of Economic Analysis (BEA) uses 16 third-tier components of consumption (four components of durable goods, four of nondurable goods, seven of household services expenditures, and final consumption expenditures by non-profit institutions serving households (NPISH) that pay for services then provide them to households without charge. We further decompose housing services into two components, housing excluding energy and housing energy services, for a total of 17 components.

These 17 components are listed in the first column of Table 5. The second column gives the component expenditure shares in total PCE (average over 2000s). The components with the largest shares (16% each) are housing ex utilities and health care; the percentage share weights of all other components are in the single digits. The quarterly rates of inflation for the 17 components are plotted in Chart 6.

The PCE price concept is the price paid for final consumption of a good or service. This price could be paid by the final consumer directly, or on behalf of the consumer by a company or institution (e.g. an insurance company or a non-profit serving individuals). Price measurement confronts a number of well-known challenges, of which we focus on two: the estimation of prices when market prices are not available, and the challenge of rolling in prices on new or improved goods or services. Additional challenges include substitution bias, incomplete historical revisions for some sectors when methods change<sup>6</sup>, updating sampling procedures (e.g. incorporating new

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<sup>6</sup> For example, the 2013 PCE revision introduced a number of changes to the imputation of prices for financial services, including the use of a less volatile interest rates to measure foregone interest in accounts at commercial banks that provided unpriced conveniences. The BEA revised the series using the new methodology back to 1985, but before 1985 the series is unrevised. The large break in volatility evident in this component of inflation in 1985 in Chart A.1 is due to this partial revision (Hood (2013)).

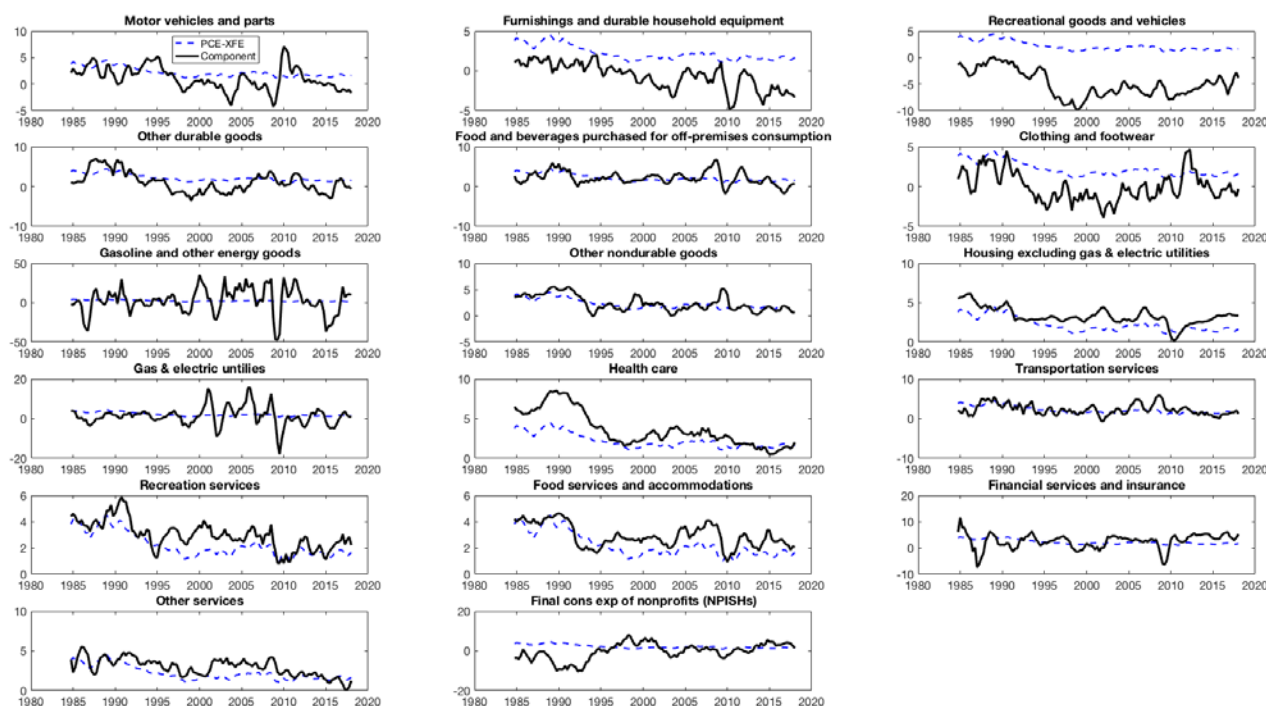


outlets), and (perhaps) introducing prices for non-priced goods provided for free to consumers by businesses (e.g. Google searches). We keep the discussion here brief and refer the reader to Moulton (2018) and US BEA (2017) for details and references.

## Chart 6

### The 17 PCE inflation components in the United States, 1984-2018q1

(each figure plots a different inflation component and, for comparison, PCE-XFE inflation. All inflation rates are 4-quarter  $(\pi_t^4)$ )



Sources: FRED and authors' calculations.

When available, posted market prices are used. Posted market prices are typically available for goods, but not for many services. For example, in the United States, health care prices typically are negotiated prices not posted market prices (negotiated between health care provider organizations and insurance companies), in which case BEA and BLS attempt to estimate prices for specific packages of health services. In other cases, such as some legal services sold as final consumption (wills, real estate closings, personal legal defence fees, etc.), prices are in part estimated based on a cost approach using billable hourly rates and estimated numbers of hours for a service. An extreme example of this is the price index for unpriced services provided to the public by non-profits, such as religious institutions, where the price for religious services (say) is estimated based on the cost of providing those services. Another example of imputation of prices where none exist (either negotiated or market) is many financial services. For example, the price of convenience services provided by a bank for checking accounts is imputed using the interest income forgone by holding a balance in a checking account instead of a non-checkable asset with a higher rate of interest; implementing this concept requires estimating the interest rate on the foregone (counterfactual) investment.

**Table 5**

Third-tier components of PCE inflation and their shares

Component	Share (2000s)	Subtotals
<b>A. Well-measured</b>		
Housing ex utilities	0.16	<b>0.34</b>
Recreation services	0.04	
Food and beverages for off-premises consumption	0.08	
Food services and accommodations	0.06	
Housing - energy utilities component	0.02	<b>0.05</b>
Gasoline and other energy goods	0.03	
<b>B. Some information content</b>		
Other services	0.09	<b>0.29</b>
Other nondurable goods	0.08	
Transportation services	0.03	
Motor vehicles and parts	0.04	
Other durable goods	0.02	
Furnishings and durable household equipment	0.03	
Health care	0.16	<b>0.16</b>
<b>C. Poorly measured</b>		
Recreational goods and vehicles	0.03	<b>0.17</b>
Clothing and footwear	0.03	
Financial services and insurance	0.08	
NPISH	0.03	

Sources: US BEA and FRED for the data, and author's judgement for the A, B, and C categories.

Another challenge for price measurement concerns new goods and quality improvements. The problem with quality improvements arises when a good reaches the end of its life cycle and is replaced by a similar, but improved, good. The new goods problem is an extreme version that arises when a new type of good becomes available, such as the introduction of smart phones. BEA has a number of strategies for addressing the new/improved goods problem. In some cases, the value of the quality improvements can be estimated using hedonic methods. In other cases, the quality improvements are estimated based on changes in production costs, however this method conflates efficiencies in production with quality improvements. In yet other cases, new goods are chained in without an attempt to quality-adjust. The challenges posed by new/improved goods problem is often raised in the context of IT goods, but it includes low-tech as well as high-tech goods. For example, clothing typically has a short life cycle stemming from changing fashions, and prices for a given good (say, a

specific shirt) decline over time as it gets marked down; at some point, the good disappears as new goods (new shirts) are introduced.<sup>7</sup>

Based on these and related considerations, and on discussions with experts on price measurement in the US government and elsewhere, we categorized the 17 PCE components into three working categories, A, B, and C, and grouped the components in Table 5 accordingly.

Category A consists of components that have relatively well measured prices. Prices in these categories tend to be market prices, and the new goods problem (while present) is relatively less pronounced than in other categories. For example, rents (the basis for the housing inflation index) are measured using a rotating survey of a panel of housing rental units with low turnover, and are adjusted for improvements in the units.<sup>8</sup>

Category B contains components which in our judgement have some information content, but for which either the new goods or non-market price problems are potentially substantial. For example, health care prices are measured using (typically negotiated) prices actually paid for specific representative health care goods, but are not adjusted for quality based on outcomes so arguably understate quality improvements.

Category C components are ones that in our judgement have very significant measurement issues, including new/improved goods problems (IT equipment, which falls under recreational goods and vehicles, and clothing) and/or rely mainly on imputed nonmarket prices (like the price index for services provided for free by non-profit institutions serving households (NPISH)).

## 3.2 Cyclical activity measures

As discussed in Section 2, a basic challenge of measuring slack in real time is that slack, as measured by a gap, represents a departure of the actual value of an activity variable from a full-capacity value of that variable, such as the departure of the unemployment rate from the NAIRU. However, the full-capacity value is never observed, so the gap also is unobserved. In addition, at shorter horizons, gaps can be noisy because of measurement error or transitory disturbances. Thus, gap measures of slack have the twin challenges of requiring a low-frequency full-utilization rate and smoothing over higher frequency noise.

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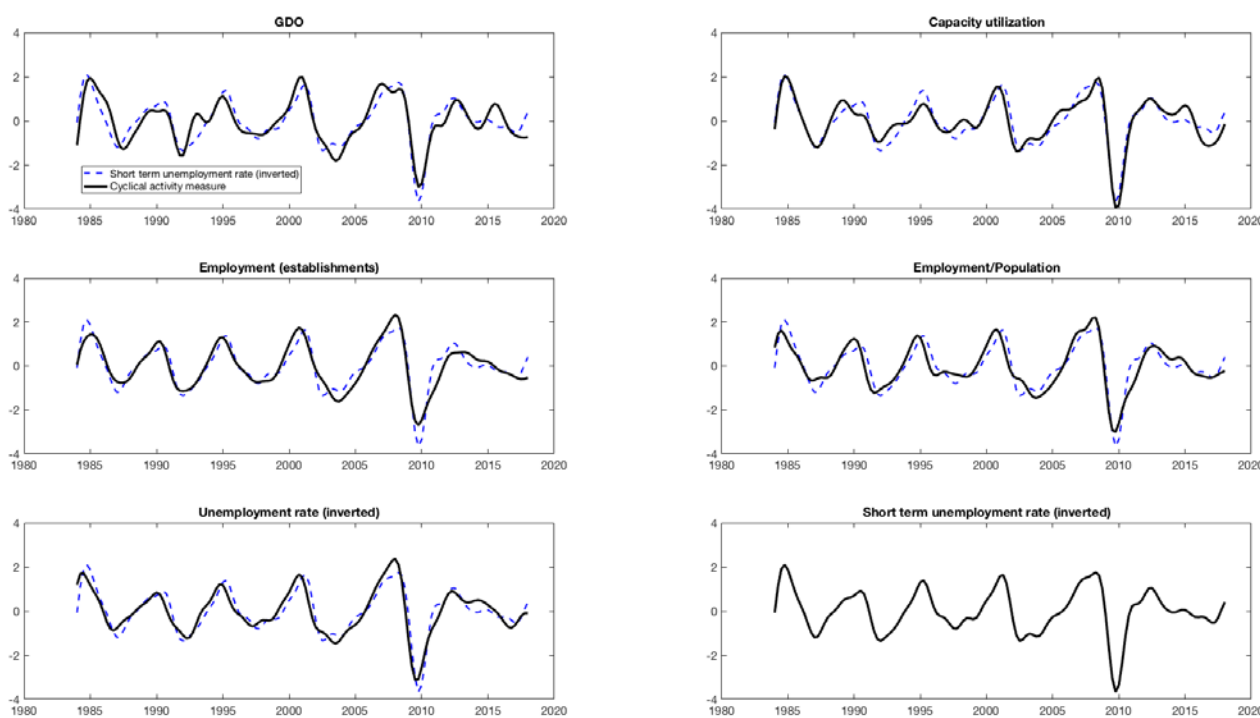
<sup>7</sup> A third challenge, which has been the subject of considerable attention recently, is the free goods problem. This issue is frequently raised in the context of IT services provided for free, such as services provided by free apps or Google searches. The free goods problem also is not new: television provides free goods too. Whether to address the free goods problem raises basic questions about whether NIPA accounting measures welfare (if so, they should be included) or market-based economic activity (if so, they should not). Here we stick to the standard concept of market-based activity so do not venture into the realm of free goods.

<sup>8</sup> For owner-occupied housing, the housing services component treats the price the owner pays as the rents the owner would pay to herself, where those rents are imputed based on rents for comparable homes in the local market. This imputation introduces imputation error, especially for more expensive homes for which the rental market is thin. Nevertheless, the imputation is based on actual rental prices so the imputation simply places greater weight on some rental units than others.

For the construction of cyclically sensitive inflation, we handle these twin challenges by using a time series filter to extract the movements of activity variables that are of the primary economic interest, those that occur over time horizons typical of the business cycle. Specifically, for an activity measure  $x_t$  we filter  $x_t$  using a band-pass filter with pass band of 6-32 quarters (the filter is described in the Appendix). The band-pass filtered version of  $x_t$ , which we denote  $x_t^{BP}$ , eliminates low-frequency trends so in this sense is like a gap measure, where the “trend” consists of fluctuations with a period of longer than 32 quarters. In addition, it smooths over high-frequency fluctuations including noise from survey measurement error. Loosely, this band-pass filtered version of  $x_t$  is like a gap measure, where the full-capacity value is computed using a two-sided filter and it is smoothed to eliminate noise. Like the ex post gap measures of Section 2,  $x_t^{BP}$  is a full-sample measure (a two-sided filter), and thus is least reliable at the end of the sample (where the filter is necessarily one-sided).

**Chart 7**  
Cyclical activity measures for the United States

(each figure plots a different cyclical activity measure (black) and the short-term unemployment rate cyclical activity measure (blue))



Sources: FRED and authors' calculations.

Notes: The cyclical activity measures are band-pass filtered of the various activity variables, using a pass band of 6-32 quarters as explained in the Appendix. The band-pass filtered series are standardized to have mean zero and unit variance. The unemployment rates are multiplied by  $-1$  so that they co-vary positively with the output gap.

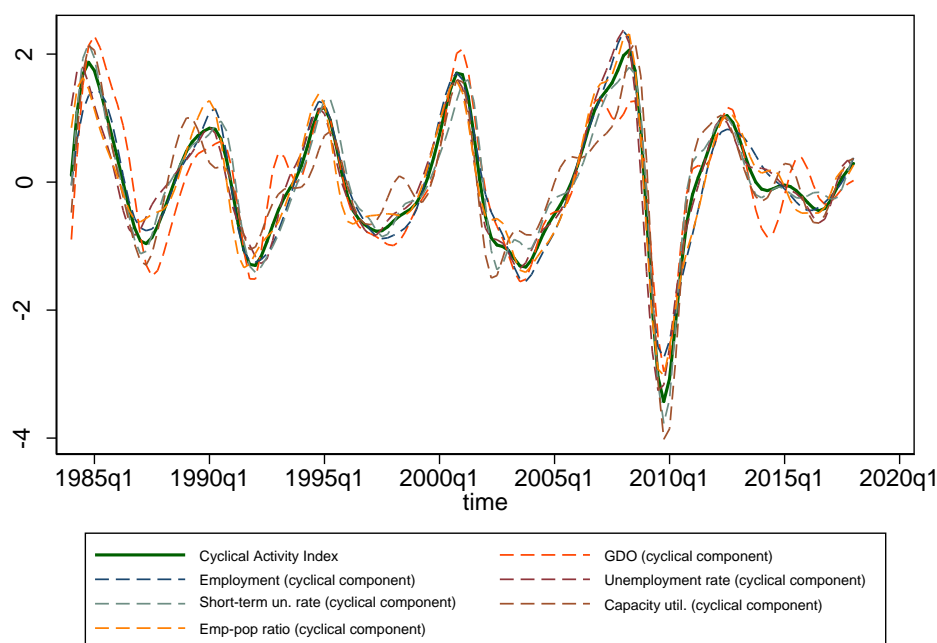
We consider six activity variables: Gross Domestic Output (GDO, the geometric average of GDP and Gross Domestic Income, see Nalewaik, 2010), the capacity utilization rate, establishment employment, the employment-to-population ratio (household survey), the unemployment rate, and the short-term unemployment rate. The band-pass filtered cyclical measures computed from these six variables are plotted in Chart 7. To facilitate subsequent visual comparisons with inflation, the cyclical activity variables are standardized to have the same mean and standard deviation, and the unemployment rate activity variables are multiplied by  $-1$  to co-vary

positively with output. (Note that this “output gap” sign convention is the opposite of the “unemployment gap” sign convention in the previous section.)

The six cyclical activity measures are evidently very similar, however they exhibit different timing, as can be seen by comparing each measure to the cyclical component of the short-term unemployment rate (shown for reference in each panel). The cyclical components of the short-term unemployment rate, GDO, and capacity utilization are approximately contemporaneous, however establishment employment, the employment-population ratio, and the unemployment rate each lag the short-term unemployment rate by 2 quarters.

We use these six series to construct a composite index of cyclical activity, computed as the first principal of the second lag of the short-term unemployment rate, GDO, and capacity utilization, and the unlagged value of the other three cyclical measures. This composite activity index (CAI) is plotted in Chart 8, along with the six constituent cyclical activity measures (in three cases, lagged two quarters). The composite index explains 92% of the variation (trace R2) of its six constituent cyclical activity measures.

**Chart 8**  
Cyclical activity measures for the United States and the cyclical activity index



Source: Authors' calculations.

Notes: The six cyclical activity measures are the band-passed filtered activity variables listed in the legend. The cyclical activity index is the first principal component of the six cyclical activity measures. The capacity utilization rate is lagged two quarters, and the unemployment rate and short-term unemployment rate are lagged two quarters and normalized to co-vary positively with the output gap.

### 3.3 Cyclical properties of inflation components

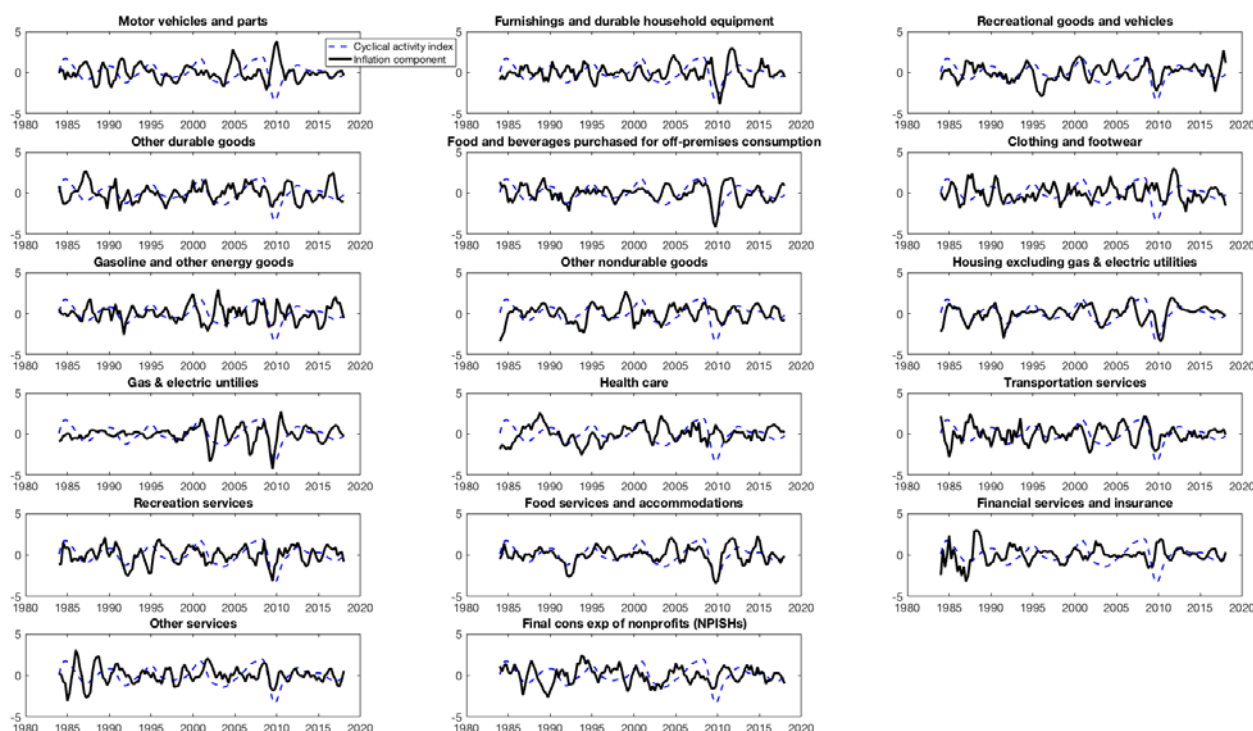
We begin our examination of the variation in cyclical properties of sectoral inflation by comparing movements in the four-quarter change of four-quarter inflation to the

composite index of cyclical activity (the CAI). These series are plotted in Chart 9 for the 17 components. The correlations between the inflation components and the cyclical index are given in Table 6 for band-pass filtered inflation (first column) and the four-quarter change of four-quarter inflation (second column). Recall that the CAI sign convention is the “output gap” sign convention, so positive comovement (procyclical inflation) corresponds to a downward-sloping Phillips relation.

## Chart 9

### Seventeen inflation components and the composite index of cyclical activity

(four-quarter change of four-quarter inflation ( $\Delta_4\pi_{it}^4$ ), standardized to have mean zero and unit standard deviation)



Sources: FRED and authors' calculations.

The variation across components in the cyclical comovements of inflation and activity is striking. For some components, cyclical inflation (i.e. band-pass filtered) is very highly correlated with the cyclical activity index; these sectors include food services and accommodations (correlation = 0.67) and housing excluding energy (also 0.67). Other components, however, either exhibit little cyclical variability or vary countercyclically. These noncyclical components include other nondurable goods, transportation services, health care, gasoline and other energy goods, clothing and footwear, and financial services and insurance. Motor vehicles and parts is countercyclical, a feature that is largely driven by the price jump in used cars in October 2009 following the end of the “cash for clunkers” program. For most components, correlations for four-quarter changes of four-quarter inflation are lower than for band-passed inflation, however they show the same pattern across components as do the band-pass inflation correlations.

These correlations and plots are consistent both with cyclical sensitivity varying across sectors and with the quality of measurement varying across sectors. The sectors with

the highest cyclical correlations tend to be dominated by services that have prices determined in local (non-tradable) markets and which are relatively well-measured: housing services, recreational services, and food services and accommodations. Food and beverages off-premises is relatively well-measured and although raw commodity prices are set internationally, there is a substantial local (non-tradeable) component of food prices.

**Table 6**  
Correlations between inflation components and the cyclical activity index, and CSI weights, 1984-2018q1

Component	Correlation between cyclical activity index and:		CSI weight ( $w_i$ )
	Band-pass inflation	4-qtr change in 4-qtr inflation	
Motor vehicles and parts	-0.24	-0.37	0.000
Furnishings & durable household equipment	0.28	0.10	0.000
Recreational goods and vehicles	0.34	0.25	<i>excluded</i>
Other durable goods	0.24	0.10	0.000
Food and beverages purchased for off-premises consumption	0.56	0.43	0.159
Clothing & footwear	-0.03	-0.08	<i>excluded</i>
Gasoline & other energy goods	-0.01	-0.04	0.000
Other nondurable goods	0.08	0.06	0.000
Housing excluding gas & electric utilities	0.67	0.48	0.629
Gas & electric utilities	0.23	0.13	0.022
Health care	-0.03	-0.11	0.000
Transportation services	0.04	0.02	0.000
Recreation services	0.41	0.28	0.086
Food services & accommodations	0.67	0.46	0.036
Financial services & insurance	-0.04	-0.12	<i>excluded</i>
Other services	0.09	0.15	0.069
NPISH	0.27	0.14	<i>excluded</i>

Source: FRED.

Notes: CSI weights are estimated by nonlinear least squares estimation of the regression in Equation (1), using the 13 Category A and B components of PCE inflation.

The sectors with the smallest cyclical correlations tend to be internationally traded goods (e.g. gasoline); sectors with prices that are heavily influenced by internationally traded goods (e.g. transport services, for which a cost is energy prices); sectors with managed or negotiated prices (health care and transportation services); and/or sectors with prices that are poorly measured (financial services and insurance and clothing & footwear). The components of other services prices are in many cases estimated using costs (e.g. attorneys' hourly costs), and the low correlation of that sector might be a consequence of the cost-based imputation missing cyclical variation in mark-ups. One surprising finding is the procyclicality of NPISH inflation, which might stem from procyclicality of the costs used to impute NPISH prices rather than actual procyclicality of those prices (recall that those prices in fact do not exist because these services are provided without charge).



### 3.4 Cyclically Sensitive Inflation

We now turn to the construction of the Cyclically Sensitive Inflation (CSI) index. We exclude on a priori grounds the four Category C components in Table 5 (the most poorly measured components), so we use only the thirteen components in Category A and B.

Our benchmark CSI index is a weighted average of the thirteen component rates of inflation, where the weights maximize the correlation between the composite index of cyclical activity and the four-quarter change in the four-quarter moving average of the index, subject to the constraint that the weights are positive and add to one. These weights are estimated by nonlinear least squares estimation of the regression,

$$CAI_t = \beta_0 + \beta_1 \sum_{i=1}^{13} w_i \Delta \pi_{it}^4 + u_t, \text{ subject to } 0 \leq w_i \leq 1 \text{ and, } \sum_{i=1}^{13} w_i = 1 \quad (1)$$

where  $CAI$  is the composite index of cyclical activity. The quarterly CSI rate of inflation is  $\pi_t^{CSI} = \sum_{i=1}^{13} \hat{w}_i \pi_{it}$ .

The CSI weights on sectoral inflation, estimated over the 1984-2018q1 sample, are reported in the final column of Table 6. The estimates place nonzero weight on only a few sectors: two-thirds of the weight is placed on housing ex energy, 16% is placed on food and beverages off-premises, with the remaining weight spread over recreation services, other services food services & accommodations, and the energy component of housing services. The only goods component that enters the CSI index is food and beverages off-premises. Notably, 93% of the weight in the CSI index is on the relatively well-measured Category A series, even though those components comprise only 39% of consumption.

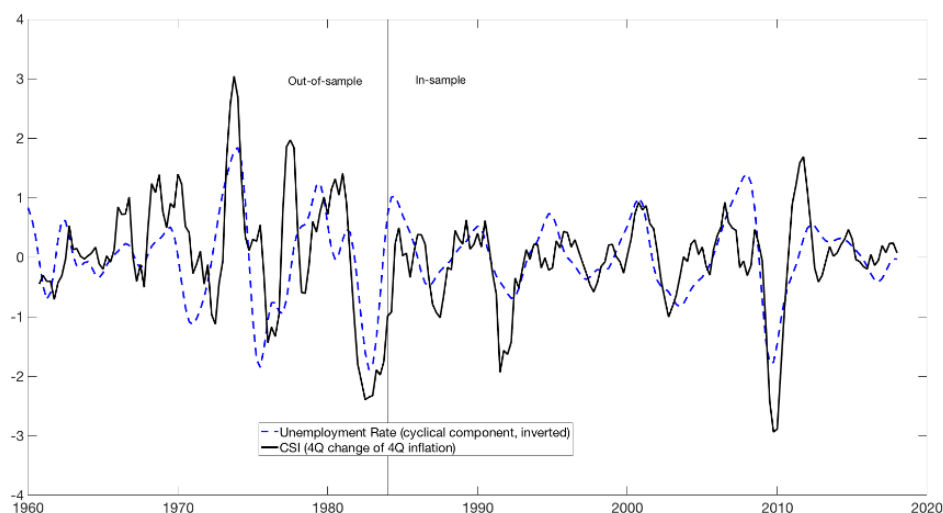
Chart 10 plots the four-quarter change in the resulting four-quarter CSI inflation index, along with the normalized standardized band-passed unemployment rate, over the period 1960-2018 (we use the band-passed unemployment rate here because the cyclical activity index starts in 1967, when the capacity utilization rate becomes available). The vertical line in the chart marks the start of the 1984-2018 sample over which the weights were estimated; for the 1984-2018 sample, the CSI index in Chart 10 is the in-sample predicted value from estimation of regression (1). In the 1960-1983 period, the CSI was computed by applying the 1984-2018 weights in Table 6 to the historical values of the PCE components.



### Chart 10

#### Four-quarter change in four-quarter CSI inflation ( $\Delta_4\pi_t^{CSI,4}$ ) and the normalized cyclical component of the unemployment rate, 1960-2018

(CSI inflation is computed using weights estimated over 1984-2018 (after the vertical line))



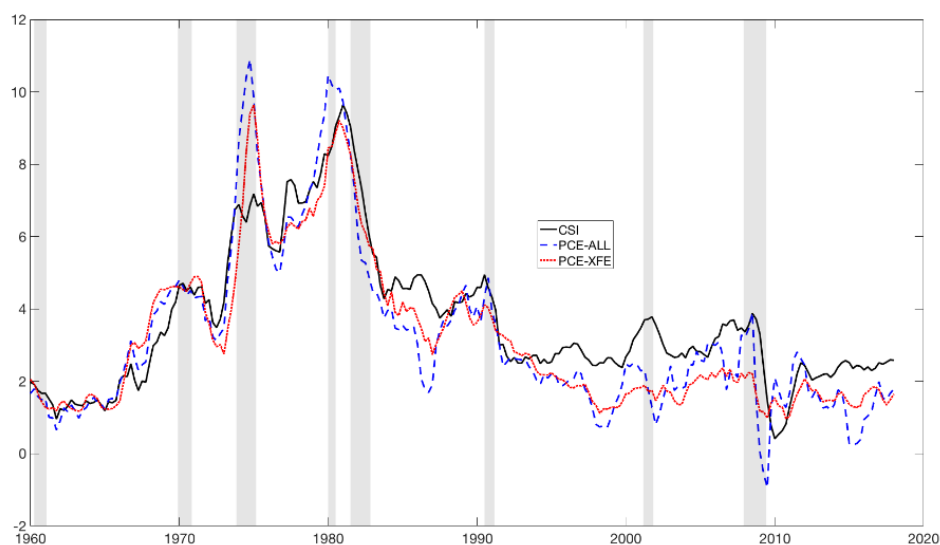
Sources: FRED and authors' calculations.

Because the CSI weights were estimated over the 1984-2018 sample, the 1960-1983 sample provides an opportunity to assess the cyclical stability of CSI inflation. Inspection of Chart 10 suggests that the cyclical properties of CSI inflation are stable in the pre-estimation sample. The correlation between the two series in Chart 10 is 0.57 in both the estimation (1984-2018) and pre-estimation (1960-1983) samples. A regression test of the stability of this relationship in and out of sample does not reject stability at the 10% significance level. Similar stability results are found for the other band-pass filtered activity variables.

There are a number of reasons why these correlations might be smaller in the 1960-1983 out-of-sample period than in the estimation period, including the supply-side sources of the inflation shocks of the 1970s, differences in monetary policy regimes, and changes in the relative quality of measurement of the components. In this light, this stability of the cyclical behaviour of the CSI index in the pre-estimation period suggests that its cyclical behaviour could be stable in the post-estimation period as well.

Chart 11 plots CSI inflation (in levels) along with headline PCE and PCE-xFE inflation. We note three features of Chart 11.

First, CSI has more pronounced cyclical movements than the other measures, especially towards the end of the last three expansions: CSI rises as the cyclical peak approaches and subsequently falls during the recession and the early recovery. This pattern is evident in every recession since 1960, except for the brief first recession of the twin recessions of the 1980s.

**Chart 11**US four-quarter inflation rates for the United States: PCE, PCE<sub>x</sub>FE, and CSI

Sources: FRED and Authors' calculations.  
 Note: Shading denote NBER recessions.

Second, the relationship between CSI inflation and the two other inflation series changes over time. During the 1960s and early 1970s, the three inflation measures moved together. Starting in the early 1980s, however, CSI inflation frequently diverged from the headline and core. For example, during the 1990s core and headline declined while CSI inflation remained constant, then CSI inflation rose substantially towards the end of the 1990s expansion. CSI inflation also shows stronger cyclical behaviour than core around the financial crisis recession. These changing patterns are summarized in Table 7, which reports correlations between the band-passed unemployment rate and four-quarter changes in four-quarter inflation for CSI, headline, and core. Both core and headline were strongly cyclical in the 1970s, but much less so since 1984, in contrast to CSI inflation which is cyclical in all three periods.

**Table 7**

Correlations between the band-passed unemployment rate and various inflation measures

(four-quarter difference of four-quarter inflation)

Inflation measure	1960-1983	1984-1999	2000-2018q1
PCE-all	0.69	0.18	0.27
PCE-xFE	0.46	-0.03	0.27
CSI	0.57	0.41	0.64

Source: Authors' calculations.

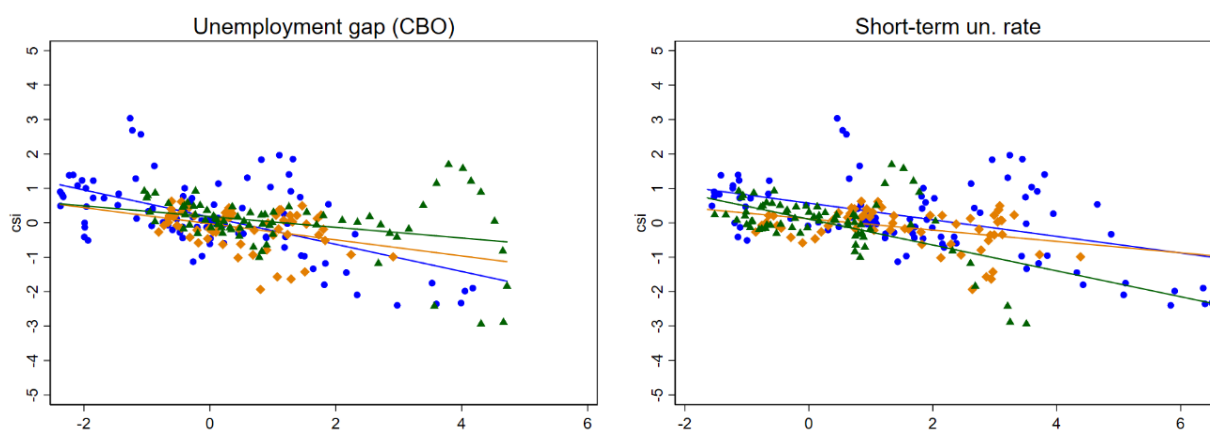
Third, the CSI index seems to be less sensitive to energy prices than headline or even core inflation. For example, CSI inflation did not move appreciably during the oil price jump of 1973, although both headline and core spiked, nor did it fall by as much as headline or core during the oil price collapse of 1986. Neither CSI nor core PCE inflation fell during the oil price decline of 2014-15.

One of the motivations for this investigation was the flattening of the Phillips curve and the declining Phillips correlation using conventional measures of inflation and a variety of slack measures, so it is of interest to examine whether this phenomenon is also true for CSI inflation. Chart 12 provides two Phillips scatterplots, which can be compared directly to their PCEExFE counterparts in the first row of Chart 4. Table 8 computes Table 1 using CSI inflation instead of PCEExFE. For all the slack measures except the employment-population ratio, the Phillips correlation and slope is stable across the 1984-1999 to 2000-2018 samples (although the slopes are imprecisely estimated), and the correlations are substantially larger with CSI than with PCEExFE.

Finally, we note that the behaviour of CSI and core PCE inflation has differed since 2014: From 2013q4 through 2018q1, four-quarter core PCE inflation was unchanged at 1.5%, but CSI inflation increased from 2.1% to 2.6%.

### Chart 12

Evolution of the US CSI inflation Phillips correlation: 4-quarter change in 4-quarter CSI inflation vs. the CBO unemployment gap and the short-term unemployment rate



Source: Authors' calculations.

Notes: The inflation measure is the 4-quarter change from date  $t-4$  to  $t$  in the 4-quarter rate of CSI inflation. The slack measure plots the standardized average value of the quarterly slack variable in the four quarters from date  $t-3$  to date  $t$ .

**Table 8**

Phillips correlations and slopes for average hourly earnings inflation and various slack measures for the United States

(four-quarter inflation and four-quarter moving average of slack measures)

	Correlation			Slope (SE)		
	1960-1983	1984-1999	2000-2018q1	1960-1983	1984-1999	2000-2018q1
<b>Ex-post slack</b>						
Unemployment gap (CBO)	-0.61	-0.34	-0.32	-0.42 (0.10)	-0.21 (0.10)	-0.15 (0.15)
GDP gap (CBO)	-0.62	-0.54	-0.49	-0.29 (0.08)	-0.29 (0.13)	-0.25 (0.14)
Unemployment gap (two-sided filtered)	-0.64	-0.36	-0.31	-0.52 (0.12)	-0.23 (0.10)	-0.15 (0.15)
Short-term unemployment gap (two-sided filtered)	-0.61	-0.46	-0.54	-0.34 (0.09)	-0.22 (0.10)	-0.29 (0.13)
Employment-population ratio (two-sided filtered)	-0.59	-0.32	-0.19	-0.59 (0.15)	-0.18 (0.10)	-0.09 (0.12)
Employment-population ratio ages 25-54 (two-sided filtered)	-0.50	-0.28	-0.24	-0.57 (0.15)	-0.17 (0.11)	-0.12 (0.14)
Capacity utilization rate (two-sided filtered)	-0.70	-0.47	-0.64	-0.43 (0.08)	-0.25 (0.12)	-0.35 (0.11)
Gap index	-0.65	-0.42	-0.41	-0.46 (0.11)	-0.23 (0.10)	-0.20 (0.15)
<b>Real-time slack</b>						
Unemployment rate	-0.56	-0.32	-0.30	-0.38 (0.11)	-0.17 (0.09)	-0.15 (0.15)
Short-term unemployment rate	-0.52	-0.34	-0.53	-0.27 (0.09)	-0.14 (0.09)	-0.36 (0.17)

Source: Authors' calculations.  
Notes: See the notes to Table 1.

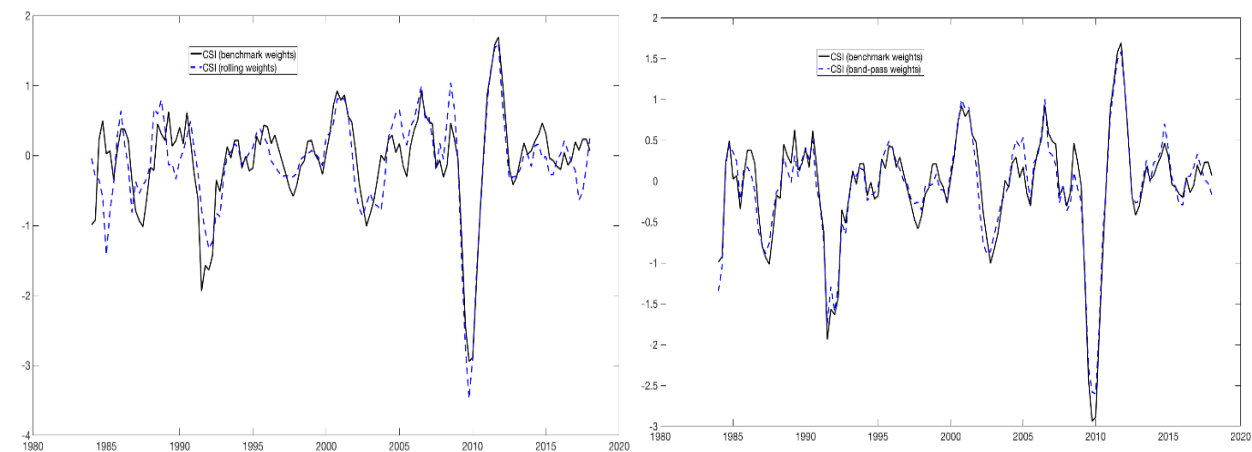
### 3.5 Sensitivity analysis

We summarize five sets of sensitivity checks.

First, the estimates reported above were computed using the full 1984-2018q1 sample, and it is of interest to whether and how the weights and the resulting CSI inflation have been stable over time. We therefore recomputed the CSI measure by estimating Equation (1) using rolling regressions with a 60-quarter window. The resulting rolling CSI inflation is compared with the full-sample CSI index in the left panel of Chart 13, which plots both series as 4-quarter changes in 4-quarter inflation. Although there is substantial time variation in the rolling weights themselves, the components that receive weights do not differ substantially over time (most weight is put on housing, food & accommodation services, food & beverages off-premises, and recreation services), and the predicted changes in CSI inflation differ little between the full- and rolling-sample estimates. This finding that the weights are unstable, but the CSI inflation estimate is not, seems to be a consequence of the relatively high correlation among those components that receive weight.

### Chart 13

Sensitivity checks: 4-quarter changes in 4-quarter CSI inflation using rolling (left) and band-pass (right) estimates of weights



Sources: FRED and authors' calculations.

Notes: For the left figure, the weights were estimated using rolling regressions with a 60-quarter window. For the right figure, the weights were estimated using the 13 band-passed components of inflation as the regressors, instead of four-quarter changes of four-quarter inflation.

Second, the benchmark CSI computed using Equation (1) uses four-quarter changes of 4-quarter sectoral inflation. An alternative approach is to estimate the weights using band-passed sectoral inflation instead, then using those weights to compute CSI from the component quarterly inflation series. The resulting CSI, using band-pass weights, is plotted in the right panel of Chart 13, also in 4-quarter changes of 4-quarter inflation. Evidently using band-pass inflation instead of 4-quarter changes of 4-quarter inflation to estimate the weights makes little difference.

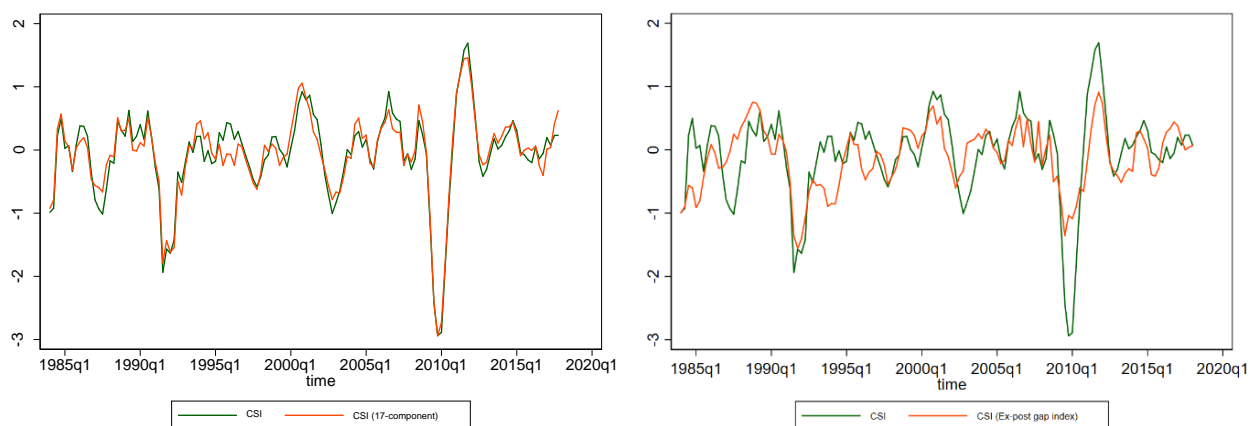
Third, we excluded the four Category C components on *a priori* grounds because they are poorly measured. As a check, we re-estimated the CSI using all 17 components. Of the four poorly-measured components, only recreational goods and vehicles entered with non-negligible weight (0.07), otherwise the 13- and 17-component CSI index weights are similar, with housing ex energy, food & beverages off-premises, and food services & accommodations getting the most weight (in that order). As can be seen in the left panel of Chart 14, this change has negligible effect. The correlation between the 13- and 17-component indexes (four-quarter differences of four-quarter inflation) is 0.98 on the 1984-2017 estimation sample. We prefer the 13-component index on *a priori* measurement grounds but take these results as indicating that estimated CSI is insensitive to these judgements about measurement quality.

Fourth, the band-passed activity measures are one measure of slack that complements more familiar ex post gap measures such as the CBO unemployment gap. To see whether the CSI is sensitive to using a traditional definition of slack, we re-estimated the CSI index using the slack index from Section 2.1 (the first principal component of the seven standardized ex post gap measures, see Chart 3) as the dependent variable instead of the band-pass filtered CAI. As seen in the right panel of Chart 14, the resulting CSI index differs from the CSI index estimated using the CAI as the dependent variable. To inform the choice of which slack measure to use, we considered an index consisting of the CIA and the CBO unemployment and GDP gaps,

and estimated the weights of that index simultaneously with the CSI weights. The results placed 80% of the weight on the CAI and yielded a CSI very nearly the same as the CSI using the CAI alone. These results merit additional discussion. Because they are similar to ones for the EA, we defer that discussion to Section 4.

#### Chart 14

Sensitivity checks: 4-quarter changes in 4-quarter CSI inflation using all 17 components (left) and the gap index as the dependent variable (right)



Sources: FRED and authors' calculations.

Notes: 17-component CSI inflation weights are estimated using all 17 components in Table 9. The gap CSI (right) is estimated using the gap index as the dependent variable, using the 13 better-measured components.

Fifth, the single cyclical activity index imposes either no or second lags (only) of the component cyclical activity variables. As an alternative, we estimated the CSI weights to maximize the correlation between the 13 component inflation series (4-quarter changes of 4-quarter inflation, and alternatively band-passed) and the 6 real activity variables including 0-3 lags each for a total of 24 activity indicators. The weights were restricted to be between 0 and 1 and each set of weights (on inflation, and on activity) were restricted to sum to one, so this method corresponds to maximizing the restricted canonical correlation. The resulting activity index is numerically very close to the composite cyclical activity index used in our benchmark estimation, as is the resulting CSI (results not shown).

## 4 CSI for the euro area

Our analysis of inflation components in the euro area (EA) parallels that in Section 3 for the United States. Although the methods are the same, there are two important differences in the data. First, as discussed in Section 3.1, the HICP components are different than the US PCE components, most importantly the purpose-based tier-two HICP components mix goods and services and do not break out energy goods separately as is done in the product-based PCE. This has implications for the construction and interpretation of CSI. Second, the quarterly HICP data begin in 1996q1 so the data span is shorter, with fewer cyclical movements, resulting in less precise estimation.

## 4.1 HICP components

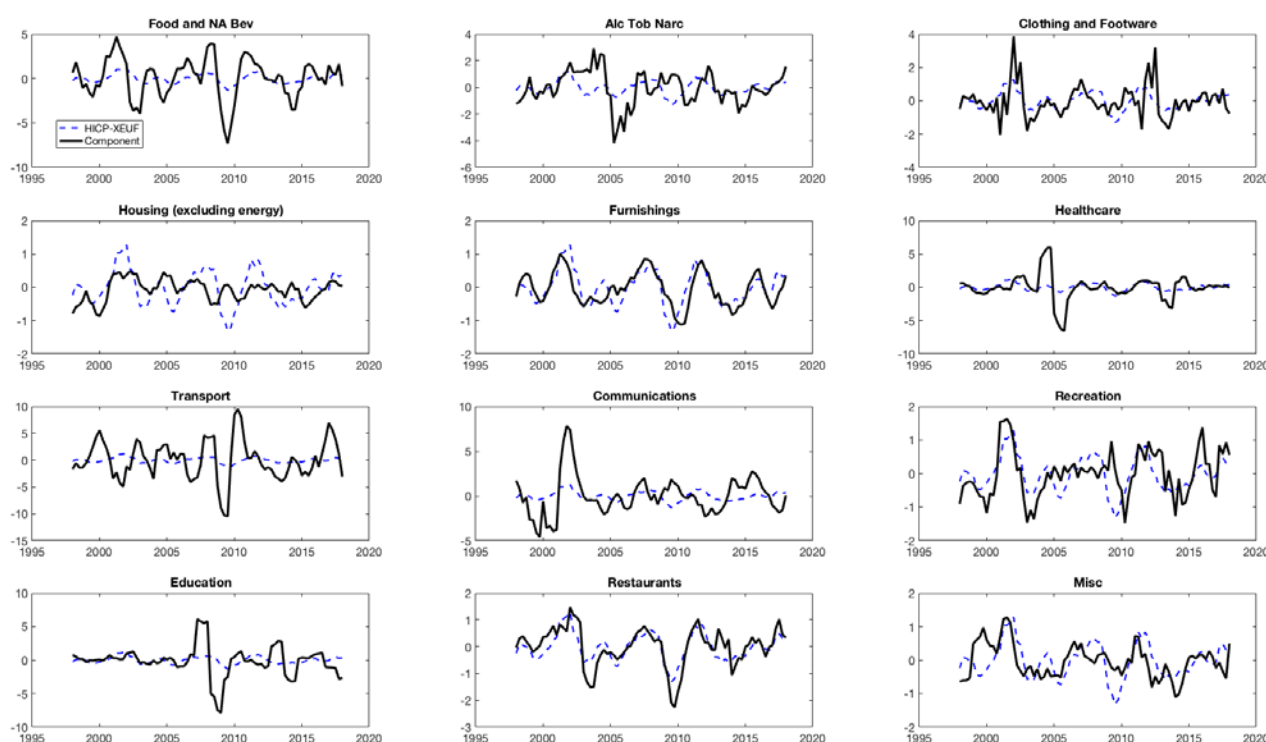
We use the 12 tier-two HICP components with a modification for housing, where we use housing excluding energy.

The organization of sectoral HICP is different than for US PCE: the tier-two HICP components are organized by purpose of expenditure rather than by product type (goods and services). The key implication for our analysis is that the HICP components generally contain both goods and services. For example, HICP transport includes transportation services (air, train, bus), fuel purchased by households (diesel and gasoline for cars), and purchases of automobiles. In addition, the coverage concept is also different: the consumption concept for PCE is all final consumption by households, whereas the HICP concept is household final monetary consumption expenditure (Eurostat (2018)). Thus, among other things, the HICP concept (like the US CPI) excludes consumption provided for free to consumers by non-profit institutions (NPISH in the United States).

**Chart 15**

The 12 second-tier HICP components: four-quarter inflation for the euro 19 countries

(component inflation (black) and HICPxEUF inflation (blue), 4-quarter moving average)



Sources: Eurostat and authors' calculations.

Another difference is that the Eurostat component data are provided only in non-seasonally adjusted form. We handle the seasonality by using 4-quarter changes and/or 4-quarter moving averages of the quarterly data. This amounts to assuming constant multiplicative seasonal factors in the levels of the indexes.

The tier-two quarterly HICP component series are available starting 1996q1.<sup>9</sup> The 1997q1-2018q1 quarterly component rates of four-quarter inflation are plotted in Chart 15, along with HICPxEU (HICP excluding energy and unprocessed food).

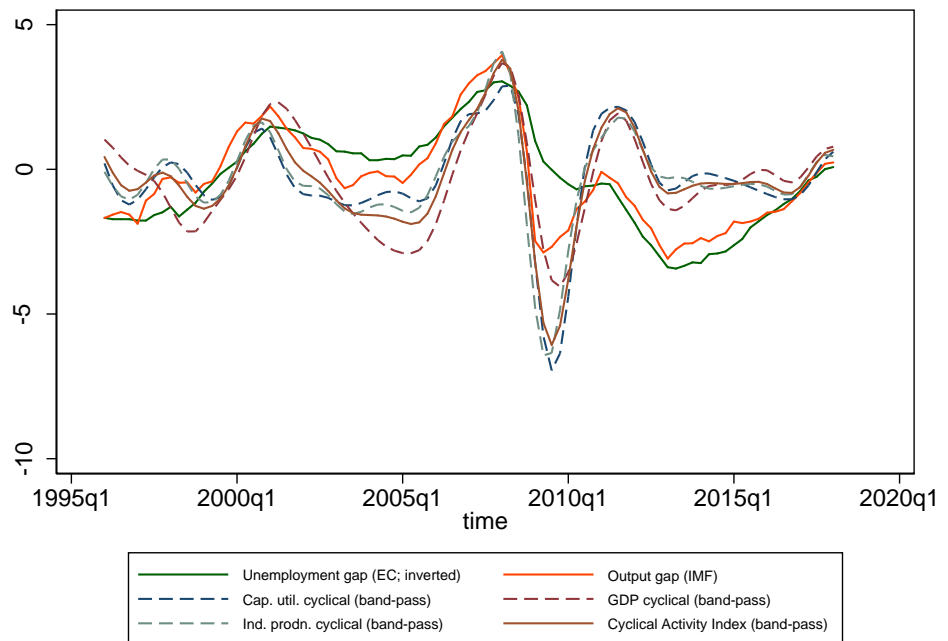
## 4.2 Euro area measures of cyclical activity

We construct three cyclical activity variables for the EA using EA GDP, the EA harmonized unemployment rate (inverted), and EA capacity utilization, all band-pass filtered as described in Section 3.2. We standardize these three series and compute an EA index of cyclical activity as the simple average of these three cyclical measures. The three constituent series and the index are plotted in Chart 16. Evidently, the three activity variables all co-move strongly at business cycle frequencies, and their co-movements are generally well captured by the single index.

**Chart 16**

Cyclical activity variables, the Cyclical Activity Index, and ex post gaps for the euro area

(all variables are transformed to have the same mean and standard deviation as the IMF percentage output gap, and the cyclical activity index is the equal-weighted average of the three band-passed cyclical activity variables)



Sources: EUROSTAT and authors' calculations.

Notes: The cyclical activity measures are band-passed versions of the indicated series, with a pass band of 6 to 32 quarters, as described in the Appendix.

As a comparison, Chart 16 also plots the EA unemployment gap (using the European Commission NAWRU) and the EA output gap (computed using the IMF potential

<sup>9</sup> Some of the lower level components from which the tier-two components are constructed are initially missing, and not all sub-components are available until 2001q1. As a result, the coverage of some of the tier-two inflation rates changes over the first few years of the sample.



output series).<sup>10</sup> The gap series and band-pass series broadly move together but with several differences that are important for interpreting the results. Most importantly, the swings in the band-pass series are higher frequency than the ex post gap series. Thus the cyclical series have been roughly neutral since 2013, whereas the gaps have only become roughly neutral in the past year. Mechanically, this is a consequence of the gaps being deviated from a very slowly-moving potential series, whereas the band-pass filter in effect subtracts off a more volatile trend. All the variables – gaps and band-pass – suggest that EA conditions are currently neutral to tight.

### 4.3 Cyclical sensitivity of EA inflation components

The 12 inflation components are plotted in Chart 17, along with the EA cyclical activity index. The correlations between these components and the activity index is given in the first column (for band-passed inflation) and second column (for 4-quarter changes of 4-quarter inflation) of Table 9.

Although there is less heterogeneity of the cyclical comovements of sectoral inflation with the cyclical activity index, some components are more cyclically sensitive than others. Restaurants & hotels and food & non-alcoholic beverages and show strong procyclical movements, as does furnishings & household items. Some components show little cyclicality, notably health care and communications (which includes postal and telephone services, and telephone equipment).

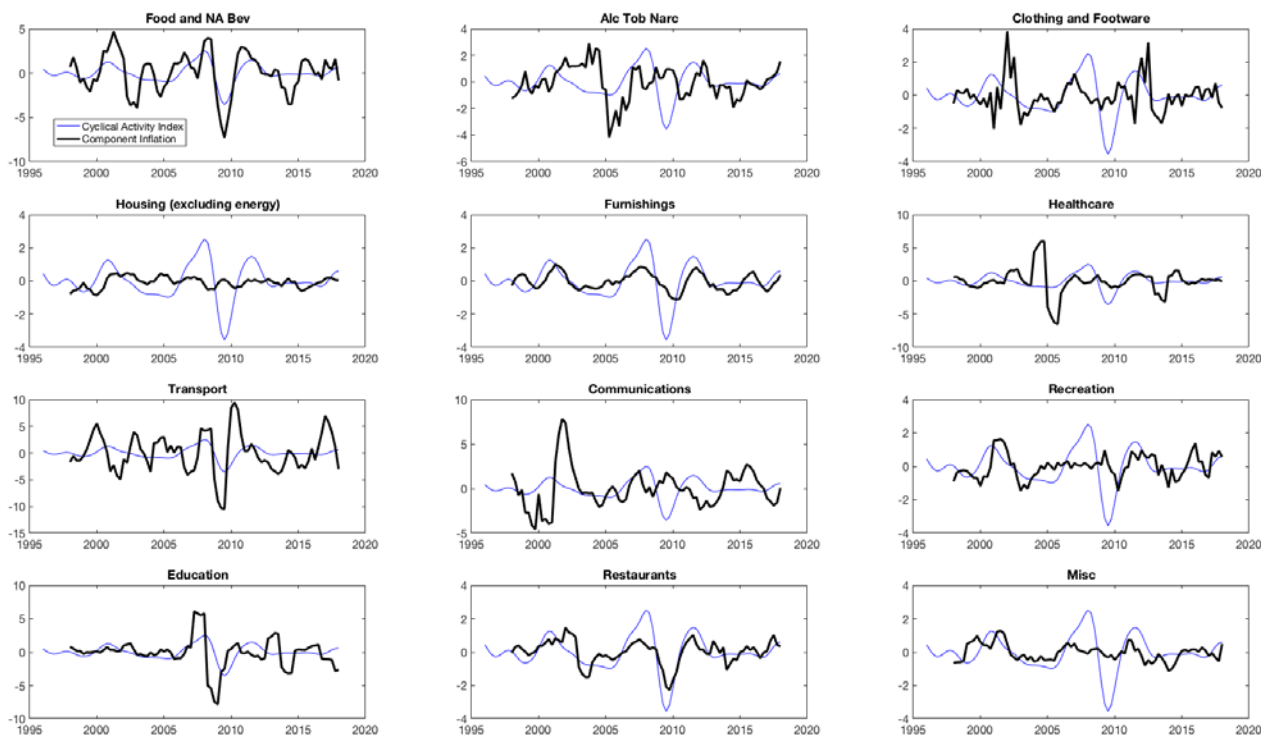
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<sup>10</sup> Both the EC NAWRU and IMF potential output are annual series. We used linear interpolation and distribution, respectively, to obtain quarterly values, and the quarterly gaps were computed as deviations of the seasonally adjusted series from their respective potential values.

## Chart 17

### Components of HICP inflation and the EA cyclical activity index

(component inflation is 4-quarter difference of 4-quarter inflation)



Sources: Eurostat and authors' calculations.

**Table 9**

Components of HICP for the euro area: correlations with the cyclical activity index and CSI weights, 1997-2018q1

Component and HICP code	Consumption share (2018)	Correlation between cyclical activity index and 4-qtr change in 4-qtr inflation	CSI weight ( $w_i$ )
Food & non-alcoholic beverages (01)	0.155	0.73	0.125
Alcohol, tobacco, & narcotics (02)	0.040	-0.05	0.000
Clothing & footwear (03)	0.059	0.16	0.000
Housing excluding energy (04x)	0.064	0.02	0.000
Furnishings, household items, & routine maintenance (05)	0.062	0.63	0.440
Health (06)	0.048	0.12	0.042
Transport goods & services (07)	0.154	0.21	0.043
Communications (08)	0.032	-0.06	0.000
Recreation & culture (09)	0.092	0.24	0.000
Education (10)	0.010	0.27	0.011
Restaurants & hotels (11)	0.098	0.72	0.338
Misc. goods & services (12)	0.092	0.35	0.000

Sources: EUROSTAT and authors' calculations.

Notes: CSI weights are estimated by nonlinear least squares estimation of the regression in Equation (1), using the 11 non-housing HICP second tier components and housing excluding energy (which we refer to as (HCIP-04x)).

Despite the many differences between the EA and US categories, it is noteworthy that there are some similarities in the cyclical behaviour. In particular, in both the EA and

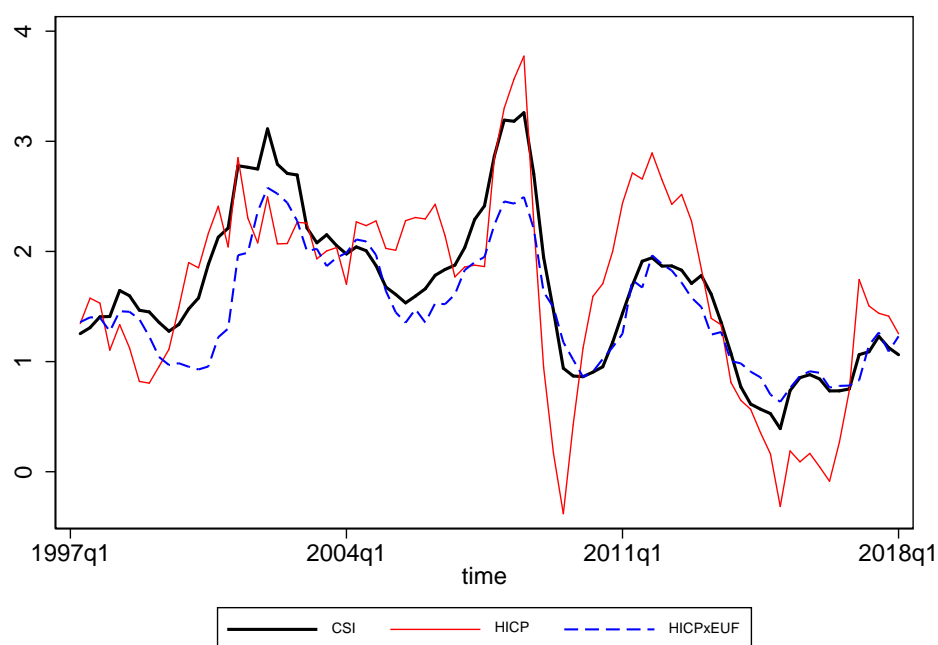
US, food & beverages off-premises and food services & accommodations are cyclically sensitive, whereas health care prices are not.

## 4.4 Euro area CSI

The final column of Table 9 provides the CSI weights obtained by estimating regression (1); the dependent variable is the EA cyclical activity index, and the regressors are the 12 HICP components, in four-quarter changes of four-quarter inflation. The resulting CSI inflation index is plotted in Chart 18, along with overall HICP and HICPxEUf.

**Chart 18**

CSI inflation, HICP, and HICPxEUf for the euro area, 1997q4-2018q1



Sources: EUROSTAT and authors' calculations.

The EA CSI places more than three-quarters of its weight on food & non-alcoholic beverages and on furnishings & household items and on restaurants & hotels; food & non-alcoholic beverages receive a weight of 0.125. Together, these three categories receive 90% of the weight in the CSI index. Compared with HICPxEUf, which is comprised of the non-energy components in HICP categories 03-12, CSI places substantially more weight on household furnishings and on restaurants & hotels, and substantially less on recreation & culture and on miscellaneous goods & services.

The US and EA components represent different categories. Still, there are similarities and differences between the US and EA CSI indexes that merit comment. The component that receives the most weight in the United States, housing excluding energy, receives no weight in the EA and indeed housing essentially does not move cyclically in the EA.

A surprising finding, evident in Chart 18, is that EA CSI inflation is quite similar to HICPxEUF. This is especially intriguing because the CSI weights in Table 4.2 differ substantially from the consumption share weights for some components. Especially over the past ten years, CSI inflation essentially looks like a smoothed version of HICPxEUF.

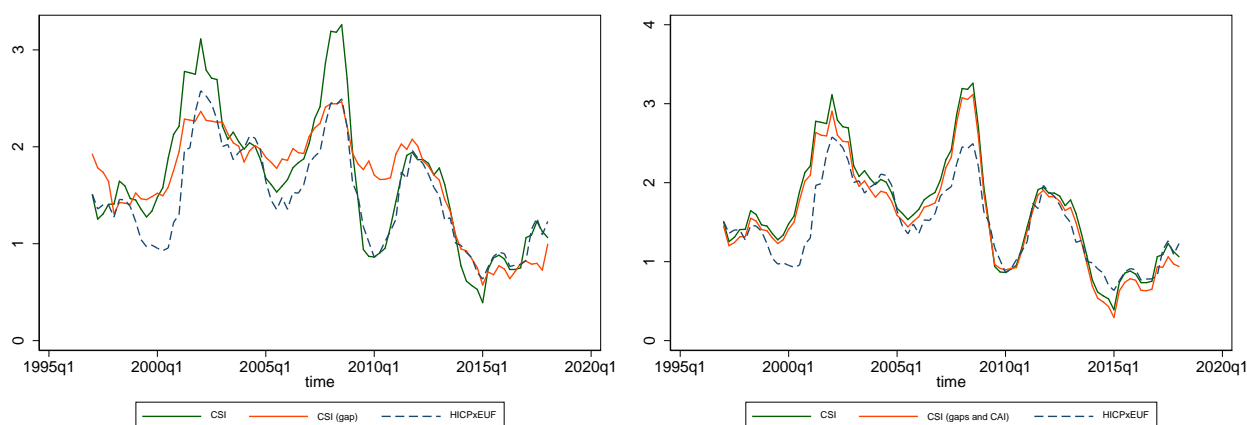
## 4.5 Sensitivity analysis

As can be seen in Chart 16, the band-passed cyclical activity variables, and their average which is the cyclical activity index, at times give different readings on slack than either the European Commission unemployment gap or the IMF output gap. We therefore estimated an alternative CSI, using as the dependent variable in Equation (1) a gap index, computed as the average of the unemployment gap and the output gap, where both gaps were standardized to have mean zero and variance one and (as in Chart 16) the unemployment gap was normalized to co-vary positively with the output gap.

The resulting CSI-gap series is plotted in Chart 19 (left), along with the CSI series estimated using the (band-pass) cyclical activity index and HICPxEUF. The resulting CSI inflation series is rather different from the CSI inflation series fit to the band-pass filtered activity index, in particular it exhibits smaller cyclical movements in 2007-2010. This finding is similar to that for the United States, where the corresponding sensitivity check also showed differences between the CSI estimated using a conventional gap (the US slack index) or the band-passed cyclical activity index (see Chart 14).

**Chart 19**

Sensitivity check: CSI inflation and CSI fit to gap index, 1997q4-2018q1



Source: Authors' calculations.

Notes: The CSI index is fit to the cyclical activity index, which is the average of the three band-passed activity series. In the left figure, the alternative CSI (green) is fit to a gap index, which is the average of the standardized EC unemployment gap (inverted) and the IMF output gap. In the right figure, the weights on the activity variables were also estimated econometrically, using the activity index, the EC unemployment gap, and the IMF output gap.

We make three remarks about the sensitivity of the CSI to the choice of the cyclical activity index (our benchmark) vs. a gap for the EA. First, mechanically this difference seems to be driven by different behaviours of the two slack measures around the time

of the financial crisis recession. Second, the weights of the gap CSI are fall mainly on furnishings, housing excluding energy, and miscellaneous goods and services.

Third, the choice between the two slack measures can be informed empirically. The usual way to approach the question of the relation between slack and inflation is to start with a slack measure and to examine its link to inflation. But, in keeping with the examination of multiple slack measures in Section 2, an alternative framing is, of various possible measures of slack, which moves most closely with inflation? One way to answer that question is to compute the linear combinations of slack measures, and separately of inflation components, that have the greatest correlation using constrained canonical correlation analysis. We undertook this exercise using the cyclical activity index (see Chart 16), the EC unemployment gap, and the IMF output gap. The estimated weight on the CAI is 0.82, on the unemployment gap is 0.18, and on the output gap is 0.00. Augmenting the CAI by the two gaps yields a negligible improvement in fit (the correlation increases from 0.868 to 0.876). The resulting CSI, shown in the right panel of Chart 19, is essentially the same as the benchmark CSI index based on only the (band-passed) CAI. We interpret these results as indicating that, when the data on inflation are allowed to choose the slack index, the choice is not a conventional gap but rather the cyclical (band-passed) measures. Said differently, the band-passed measures, not conventional gaps, are the measures that commove most closely with the cyclically sensitive components of inflation.

## 5 Conclusions

Different components of inflation have very different cyclical properties. Goods that are traded in international markets tend to have little cyclical variability. Health care prices also have only a small cyclical component, perhaps because they are poorly measured or because they are, in many cases, negotiated prices paid on behalf of consumers. In contrast, prices that are determined largely in local markets, such as prices at restaurants and hotels, have large cyclical components. Such prices get the most weight in the CSI index, both in the euro area and in the United States. In addition, some components of inflation are better measured than others, and our results suggest that cyclical movements in headline and core inflation are, in part, masked by noise imparted by the poorly measured components.

We see the main use of the CSI index as an early indicator that tight – or loose – economic conditions are having an effect on the rate of inflation. Given a set of historically estimated weights, the CSI index can be computed in real time, and in principle can be computed monthly (although we have only done so quarterly). Given the challenges of estimating slack in real time, the CSI index provides a new window on movements in the rate of inflation. Because the CSI index tends to focus its weights on sectors with locally determined prices, it provides a way to separate out prices that are domestically determined from prices that are heavily influenced by international conditions.

In the United States, the CSI index has been rising for the past three years, in contrast to overall PCE inflation, which has been largely quiescent (our data on components go

through 2018q1); however, that increase is modest, from 2.1% to 2.6% over the 2014-2018q1 period.

In the euro area, the CSI rate of inflation is remarkably similar to core HICP inflation, and over the past two years (2016q1 to 2018q1), both CSI and core HICP inflation increased only 0.3 percentage points, from 0.9% to 1.2% for HICPxEU and from 0.8% to 1.1% for CSI. The EA CSI index places most of its weight on furnishings (which includes domestic services, household services, and nondurable household goods), and on restaurant and hotel services. The household furnishings index has been volatile since 2015q1 but on net has shown little change. In contrast, the restaurant and hotel component of CSI has risen 0.7pp since 2015q1, of which 0.3pp of the increase has been since 2017q1.

The Eurostat components differ from the BEA components at the second-tier level and it is possible that the BEA framework, which is organized around the NIPA categories of goods and services, is more conducive to isolating cyclical movements than is the Eurostat framework. This suggests extending the CSI concept to the next level of aggregation, or perhaps working with different aggregation than used by Eurostat. We leave that to future work.

## Appendix: Data sources and transformations

Data on PCE component shares and price indexes for the United States are from the US NIPA Tables 2.3.4U and 2.3.5U. Real data and PCE aggregates (PCE-total and PCExFE) were obtained from FRED. Euro area HICP components data are from the [ECB data warehouse](#). Real data for the EA were obtained from FRED and the IMF and OECD Web sites.

The band-pass filter is a two-sided Butterworth filter of degree 6, with lower and upper cut-offs corresponding to periods of 32 and 6 quarters, respectively. The series were padded using an AR(6) prior to filtering.

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# Comment on “Slack and Cyclically Sensitive Inflation” by James H. Stock and Mark W. Watson

By Lucrezia Reichlin<sup>1</sup>

## Abstract

This paper addresses in a novel way the classic problem of the identification of the Phillips curve. The authors' (SW from now on) approach is to study disaggregated price variables in order to identify those components of inflation that are more cyclical and better measured. The cyclical components are then aggregated in an index – the cyclically sensitive index (CSI) of inflation – which can be used as an indicator of cyclical pressures on inflation. Results are presented for both the United States and the euro area.

The question of whether a cyclically sensitive inflation index can be constructed from disaggregated data is similar to the question of the identification of the Phillips curve. If cyclical real economic activity is correlated with some components of inflation, this implies that the Phillips curve is not dead, but rather lost in noisy data. It also indicates that monetary policy systematically responding to the output gap and inflation has not “killed” the signal at business cycle frequency.

This paper is therefore a contribution to the vast literature on the Phillips curve and helps in addressing the question of whether the latter has disappeared or possibly flattened.

In the discussion that follows I will provide some additional motivation for SW's approach, analyse their results and compare them with an alternative approach based on Hasenzagl, Pellegrino, Reichlin and Ricco (2018). In the latter, rather than aggregating inflation components based on their cyclicalities, we extract a common cycle between inflation, inflation expectations and real activity using a multivariate model. This is a signal extraction exercise aimed, as in SW's paper, at identifying a cyclical component of headline inflation which can be interpreted as its Phillips curve component.

Although results differ in the assessment of recent cyclical pressures, both approaches identify a cyclical component and point to the presence of a Phillips type relationship in the data.

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<sup>1</sup> London Business School and CEPR.

# 1 Motivation

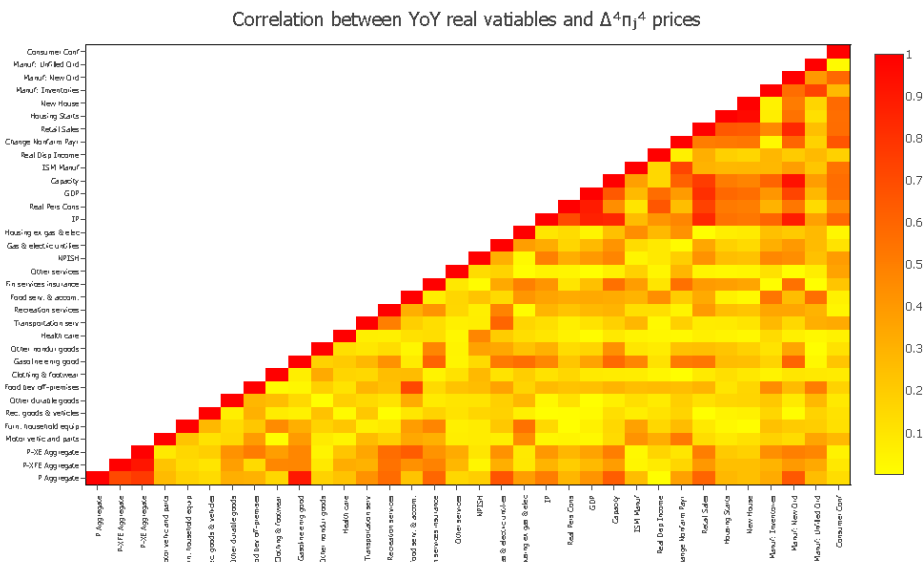
There are three difficulties in inflation modelling.

1. Inflation components are not strongly correlated amongst themselves and less so than sectoral real activity indicators.
2. Correlations between real activity indicators and inflation are typically weak and very much dependent on how data are transformed (detrending, growth rates, etc.).
3. Inflation is dominated by slow-moving trends associated with monetary policy regimes and noisy components associated mainly with energy.

Chart 1 illustrates features i and ii. It shows the correlation matrix of prices expressed as the rate of growth of year-on-year inflation and real variables expressed in year on year growth rates. The heat-map ranges from pale yellow for weak correlations to red for strong correlations. It shows that both the correlations amongst prices and those between prices and real variables are weak (pale yellow) while the correlations amongst real variables are stronger (orange or red).

**Chart 1**  
Inflation components and conjunctural indicators

(YoY, percentages)



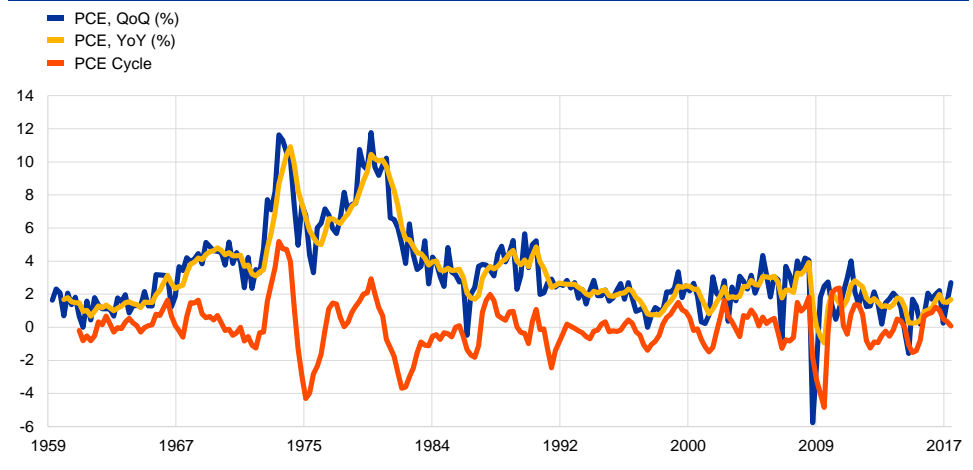
Notes: Data from Q1-1959 to Q4-2017.

Chart 2 illustrates feature iii. It shows different transformations of the aggregate PCE index: (a) quarterly inflation which reveals both a persistent component (the trend) and noisy high frequency fluctuations, (b) the year on year growth rate which retains the trend but smooths the high frequency volatility, and (c) the year-on-year growth rate of the latter which is a stationary variable (SW's CSI is constructed from the rate of growth of year on year inflation). The chart shows that the low frequency dynamic (the trend) dominates: once the series is de-trended we are left with a small stationary

component, possibly correlated with a cycle of real economic activity. To search for such a correlation one must first transform the data – whether disaggregated or aggregated. However, the result of such a search will inevitably depend on the way the series have been transformed, which explains why there is very little consensus on the nature of cyclical inflation.

### Chart 2

US PCE inflation – different transformations



Sources: Haver and author's calculations.

Notes: PCE cycle indicates the year-on year growth rate of year-on-year inflation.

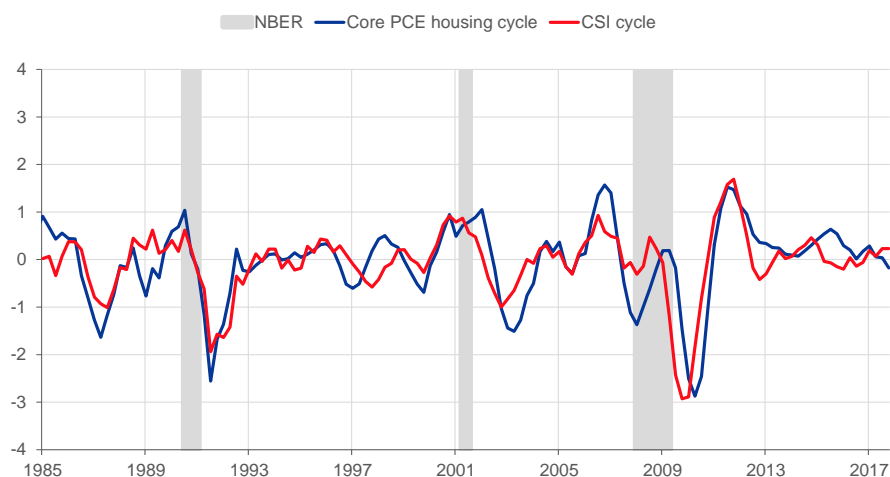
The heterogeneity of inflation components (see Chart 1) suggests that aggregate inflation may hide interesting cyclical features and this motivates SW's analysis. However, Chart 2 also points to the dominance of the trend component, which requires data transformation. And, as I have said, the assessment of the nature of inflation cyclicity will depend on such data transformations.

## 2 The CSI index

Chart 3 plots the US CSI against housing excluding energy (labelled as "core PCE housing cycle") both transformed as the fourth difference of the year on year growth rate (the cycle).

**Chart 3**

Housing prices and the CSI

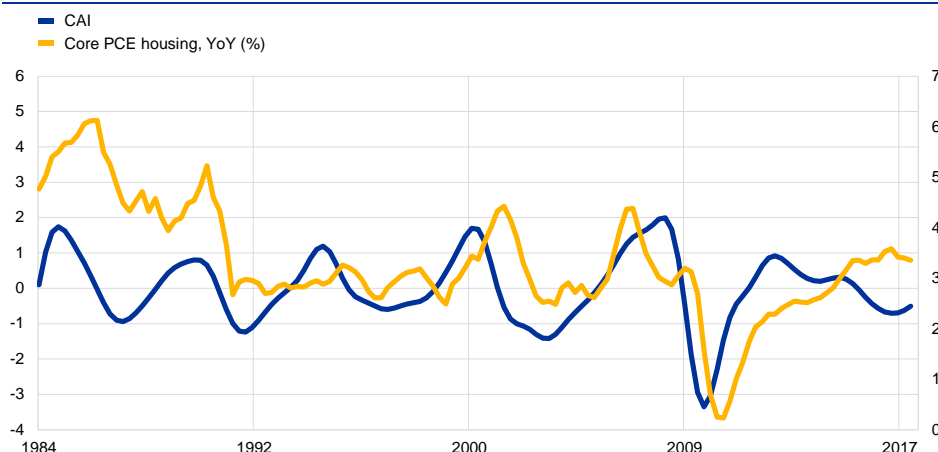


The chart shows that the index is strongly correlated with housing. This is not surprising since, as can be seen in Table 3.2 in the paper, housing accounts for 63% of the CSI (while it accounts for just 23% of the PCE). The second most important component is “food and beverages purchased for off premises consumption” with a weight of about 16%. Other components weigh either zero or very little.

Clearly housing in the United States is very cyclical and this is the key result of the paper. Chart 4 plots the CAI – which is the cyclical component of the real variables estimated by SW – against housing inflation.

**Chart 4**

Housing prices and the CAI

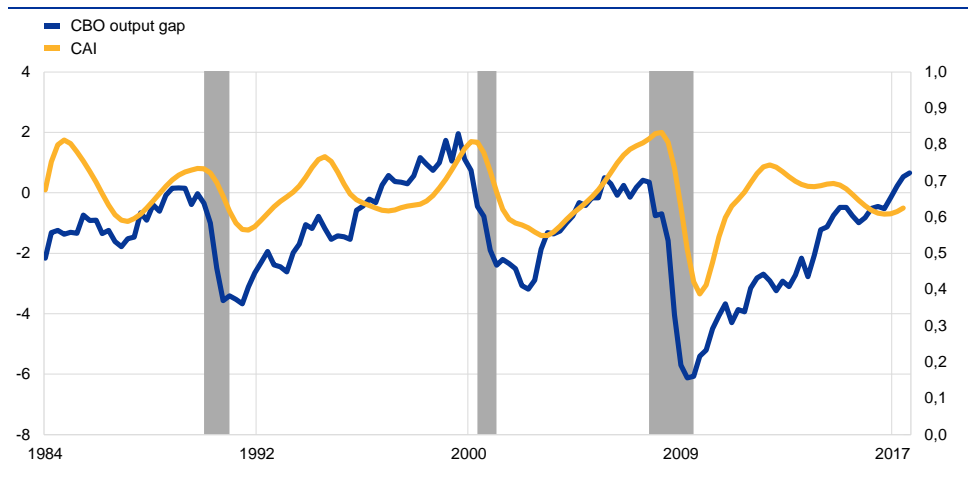


The chart shows a close association between the two series which provides the intuition for why the maximization problem used by the authors to construct the CSI gives so much weight to housing.

But how robust is this result with respect to different indicators of cyclical activity?

Chart 5 plots the CAI against the Congressional Budget Office (CBO) output gap. The two measures of the cycle have a weak correlation with the CAI, pointing to a cyclical softening from 2012 whereas the CBO indicates a cyclical strengthening. The filtering methodology for real variables may have quite a big impact on the CSI index which is something we will evaluate further in the discussion.

**Chart 5**  
The CAI and the CBO output gap

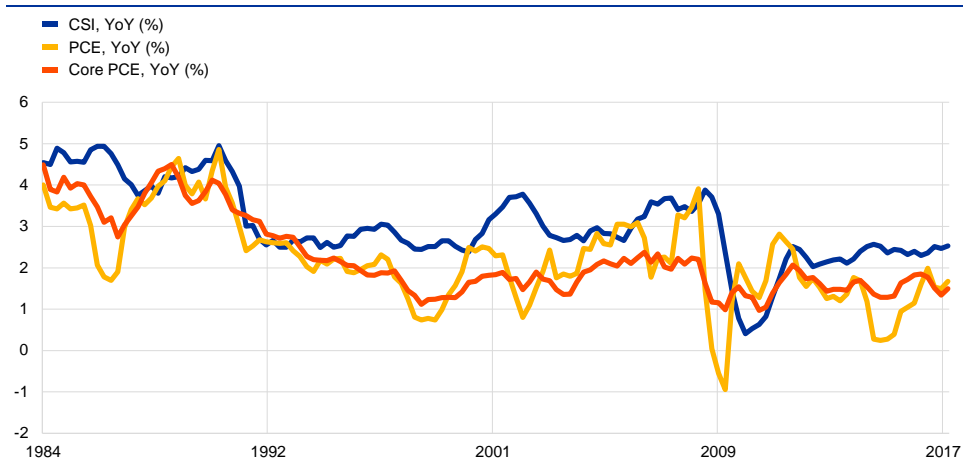


Another question is whether the methodology succeeds in extracting a business cycle component cleaned of lower frequency asset price movements and higher frequency oil cycle movements.

Chart 6 plots the CSI in year-on-year growth rate against PCE and core PCE with the same transformation. It shows that the CSI has been higher than both core and headline PCE since the early 90s. This suggests that the index is not cleaned from level shifts, possibly reflecting features of housing fluctuations which reflect asset prices beyond cyclical conditions. For example, the index signals since 2012 stronger cyclical pressures on inflation than what can be detected from either the headline or core series.

## Chart 6

### The CSI, PCE inflation and PCE core inflation – US data



The problem is that the indicator is the result of several steps (detrending real variables, detrending inflation, etc.) each of which can be challenged thereby leading to controversies which are difficult to handle in policy discussions.

A more general question is what we can learn from the discrepancy between the CSI and PCE. If a persistent discrepancy does not translate into measured inflation or is not a leading indicator for it, should the policy maker care? In other words, should he/she respond to the CSI signal rather than to core or headline inflation?

To shed some light on the robustness of SW's results, in the next section I will provide a different method to extract cyclical inflation and use the results for interpretation of the CSI. And in the section after that I will use the model to forecast headline inflation.

## 3 A trend-cycle model of inflation

The approach I will present here is based on Hasenzagl, Pellegrino, Reichlin and Ricco (2018). Rather than focusing on many disaggregated variables we focus on aggregate inflation (CPI for the United States and HICP for the euro area) and oil inflation. We jointly model real variables and inflation variables exploiting multivariate information to extract trends and cycles of the variables of interest rather than detrending ex ante. Crucially, we use price expectation data to identify trend inflation and separate an oil cycle from a Phillips curve cycle. The idea here is that, since oil is the most volatile component of inflation and affects many price components, the identification of the Phillips curve relies on proper "cleaning" from the oil component.

Data include the unemployment rate, GDP, headline inflation, oil inflation, professional forecasters' expectations (SPF) and consumer expectations (Michigan survey). Let me summarize the basic features of the model:

1. Each variable is modelled as the sum of a cycle (a stationary ARMA component) and a trend (a random walk component).

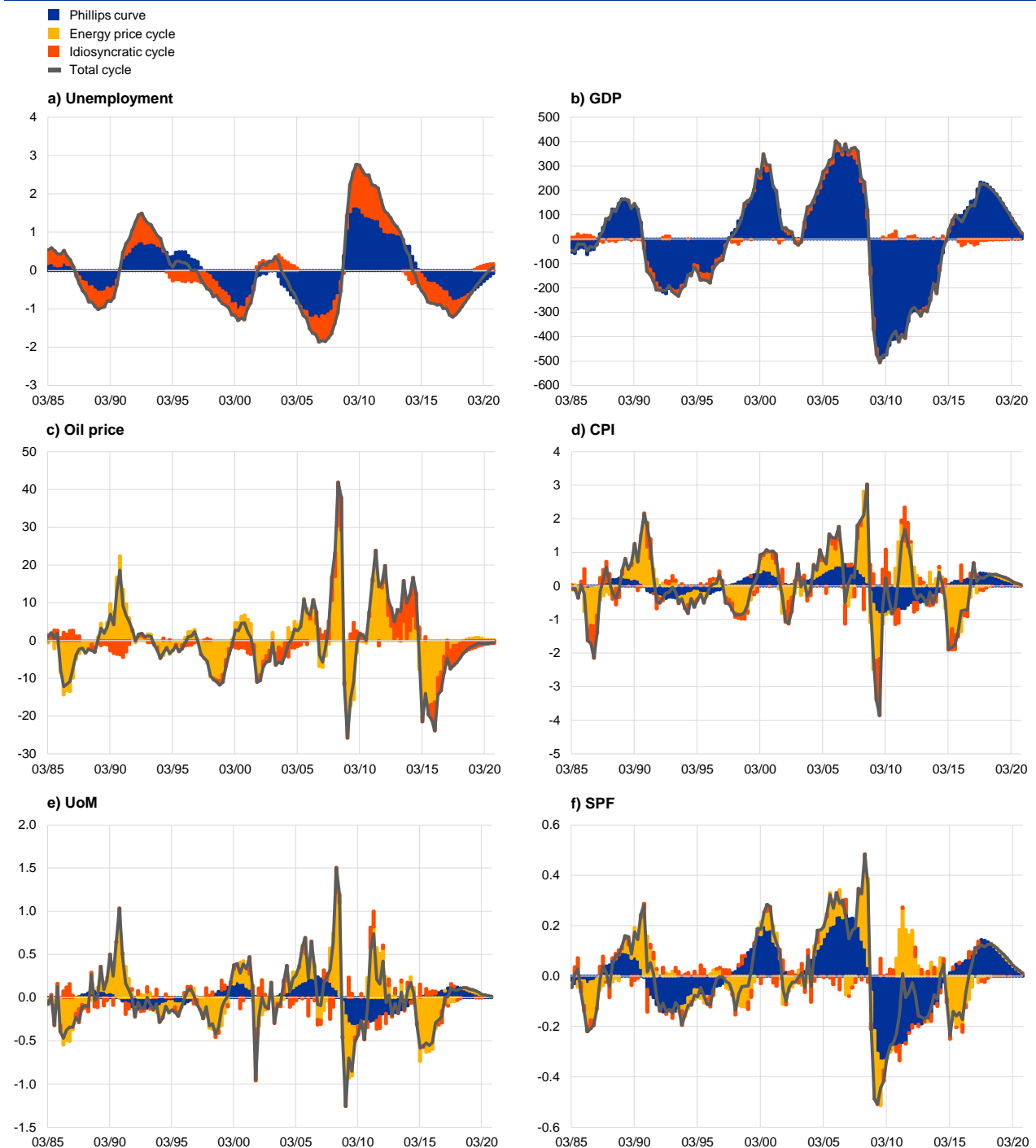
2. The cycle is split into three orthogonal components: (1) a Phillips curve cycle which is common to real variables, headline inflation and inflation expectations; (2) an oil price cycle which is common to headline inflation, oil inflation and inflation expectations; and (3) an idiosyncratic cycle reflecting measurement error.
3. Trend inflation is the common random walk component between inflation and inflation expectations and we allow for idiosyncratic trends for real variables, oil and inflation expectations.

The Phillips curve cycle of headline inflation extracts a stationary component which is closely correlated to the real economy cycle and therefore should be similar to the CSI. While the CSI is constructed from disaggregated information, our approach is based on extracting a component from aggregate inflation. The only disaggregated information we use is the oil price since, as I have mentioned, extracting that part of the oil price cycle which is orthogonal to the business cycle is key to identify the Phillips curve. Notwithstanding the differences in methodology between this approach and that of SW, the Phillips curve component of inflation augmented by trend inflation should be highly correlated with the CSI in year on year growth rate. Let us then present the results from the trend-cycle model and then compare them with the CSI.

Chart 7 shows the cycles of all variables included in the model and their historical decomposition into the Phillips curve cycle, the oil price cycle and idiosyncratic measurement error.

## Chart 7

### CPI trend-cycle model – historical decomposition of the cycle – US data



Sources: own calculations based on Hasenzagl, Pellegrino, Reichlin and Ricco, 2018.

Note: SPF stands for survey of professional forecasters. UoM stands for University of Michigan consumer survey.

The blue area in GDP represents the Phillips curve component of the GDP cycle and can be interpreted as the output gap. The model is telling us that the bulk of the cycle of GDP is captured by this component while the measurement error idiosyncratic residual is very small (the yellow area). As for CPI, the blue component represents a

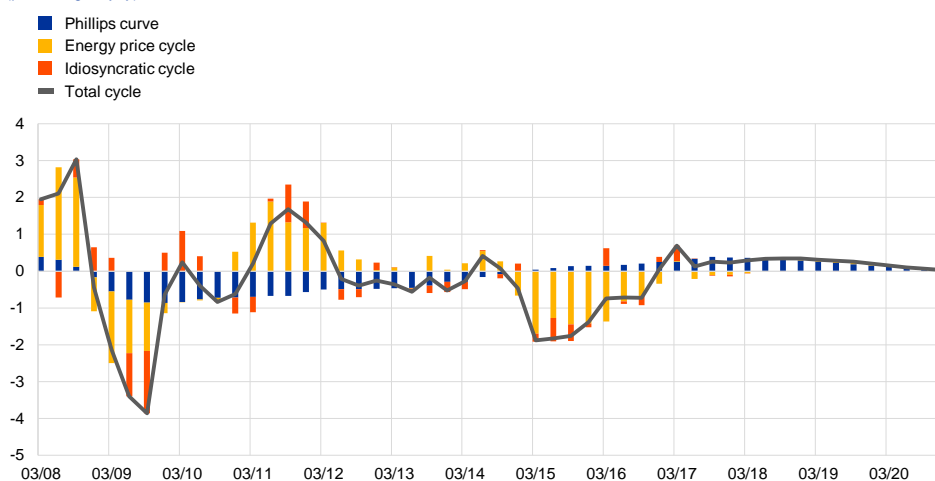


smaller fraction while both the oil cycle and the measurement error are relatively large. This provides further motivation to SW's approach since it shows that heterogeneity of price behaviour and measurement issues are quantitatively relevant. Interestingly, the oil price cycle often moves in the opposite direction to the Phillips curve cycle, which explains why the latter signal is difficult to extract from the data. Chart 8 zooms in to focus on the 2008-2017 sample.

### Chart 8

#### CPI trend-cycle model – historical decomposition of the cycle – US data

(percentages, yoy)



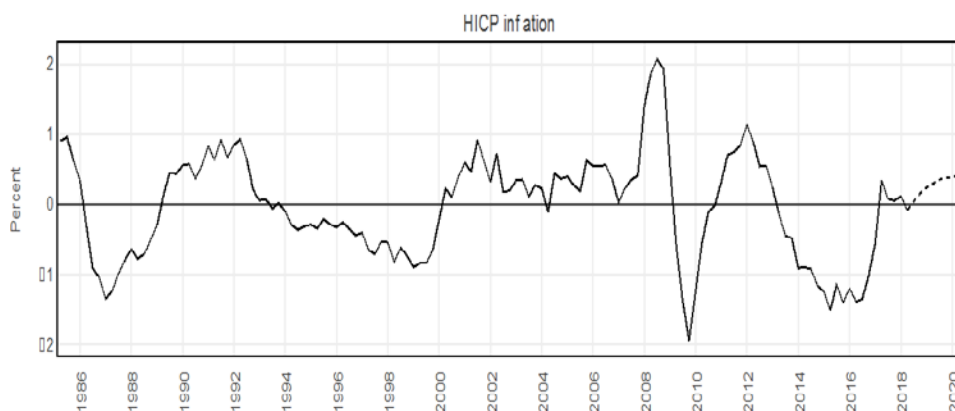
Sources: own calculations based on Hasenzagl, Pellegrino, Reichlin and Ricco, 2018.

In the 2010-2012 sample, which has been described as a period of “missing disinflation” by the literature, a downward pressure on prices associated with a negative output gap is hidden by upward pressure associated with the oil price. From the end of 2015 the opposite is true: oil drags prices down while the Phillips curve exercises a moderate upward pressure. The first part of that period has been characterized by “missing inflation”: this decomposition explains the puzzle.

Chart 9 illustrates the results for the euro area.

### Chart 9

#### HICP trend-cycle model – historical decomposition of the cycle – euro area data



Sources: own calculations based on Hasenzagl, Pellegrino, Reichlin and Ricco, 2018.

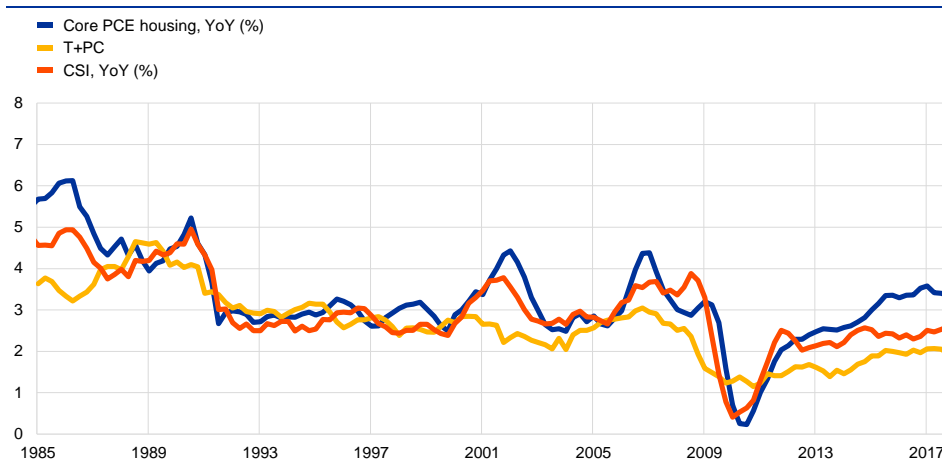
Notice that in July 2008 the inflation cycle was mostly explained by oil, which continued to exercise upward pressure on HICP even when the economy started weakening. In July the ECB increased the policy rate. In 2011 oil was pushing inflation up while the Phillips curve moved it in the opposite direction. The ECB increased the policy rate twice. It can be argued that in all these occasions the central bank was confused about the cyclical signal on inflation since oil was clouding it.

Let us now compare the Phillips curve component with the CSI.

Chart 10 plots the CSI in levels (the cyclically sensitive component of year-on-year PCE inflation), housing prices, and the Phillips curve cycle plus trend inflation.

### Chart 10

#### CSI year-on-year, housing year-on-year and Phillips curve plus trend inflation (TC model) – US data

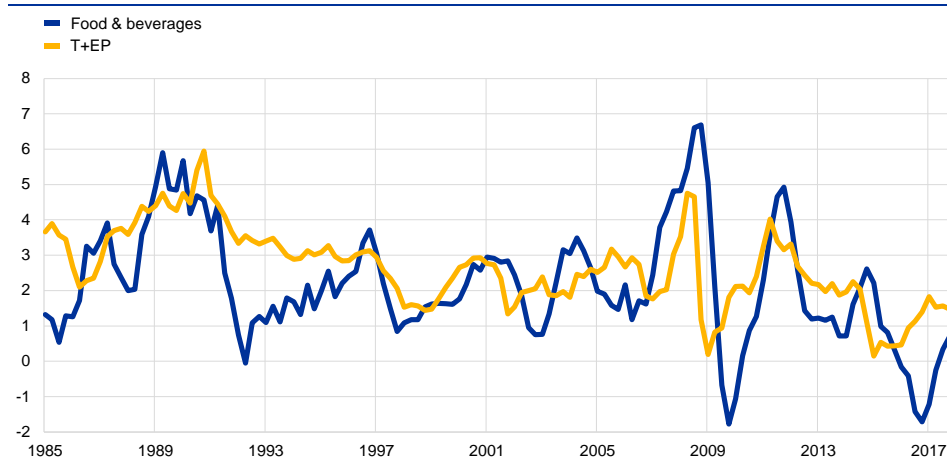


Results indicate that, as expected, these series are highly correlated. However, since 2001 both housing and the CSI are persistently higher than the Phillips curve. This confirms the conjecture that the CSI captures a persistent component of housing

which is related to lower frequency dynamics possibly associated with asset prices. From 2012, on the other hand, the CSI is lower than housing. This is explained by the second largest component in the index – food – which drags it down. Food is indeed correlated with oil which in those years, unlike housing, declined. To support this point, Chart 11 plots food prices and the energy cycle augmented by trend inflation as estimated by the trend-cycle model.

### Chart 11

Food inflation year-on-year and oil cycle+trend inflation (TC model) – US data



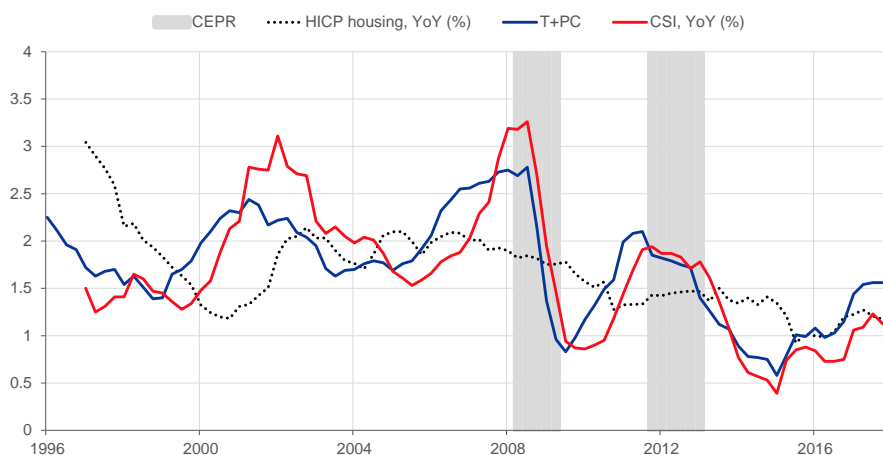
Summing up, the SW methodology produces an index which reflects mostly the dynamics of housing prices and to a lesser extent that of food prices. The index is highly correlated with a stationary component defined as the common cycle between inflation, inflation expectations, GDP and unemployment which I labelled the Phillips curve component of headline inflation. However, it might be influenced by persistent dynamics in housing prices and oil (through its effect on food). These features may lead to miss-signalling cyclical pressures on prices.

Chart 12 shows results for the euro area by plotting the CSI against HICP housing and the trend-cycle model Phillips curve plus trend. Not surprisingly (given the role of housing in the HICP) the CSI is not well correlated with housing in this case while it is more closely correlated with the Philips curve component. Notice, however, that at the end of the sample the CSI is lower than the Phillips curve, again because it is dragged down by the indirect effect of oil.

Although one can quarrel about the best way to extract cyclical signals from inflation data, the difficult task is to disentangle the business cycle component from two other cycles: a longer one, related to asset prices and a shorter one, related to oil. Failing to achieve this matters. For example, the CSI indicates positive but constant cyclical inflation since 2012 for the United States while the Phillips curve computed from the trend-cycle model suggests a gradual upward pressure since 2015 due to the closing of the output gap. As for the euro area, the trend-cycle model sees upward cyclical pressure on HICP associated with a gradual closing of the output gap since 2017 while the CSI sees neutral pressure.

### Chart 12

CSI year-on-year, HICP housing year-on-year and Phillips curve plus trend inflation – euro area data



Notes: CEPR indicates recessions as dated by the Center of Economic Policy dating committee.

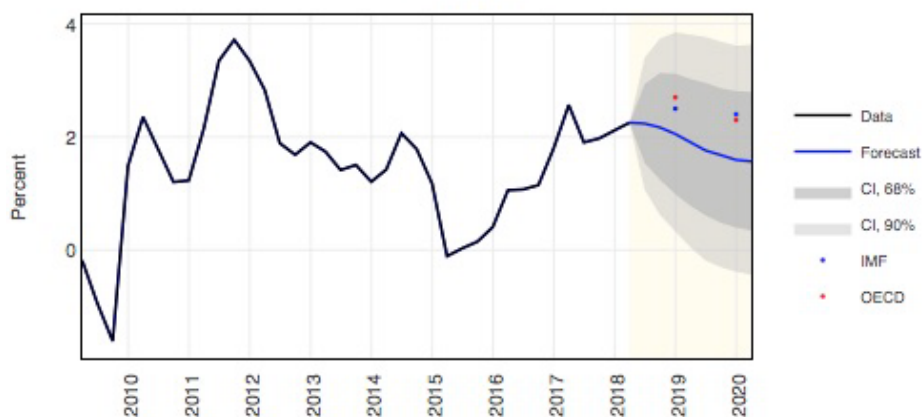
## 4 Forecasting

I will now assess the implications of the trend-cycle model for forecasting headline inflation. Inflation is hard to forecast because it is dominated by a low frequency component: the trend. The cyclical component is small but should help forecasting.

Charts 13 and 14 show the forecasts using data up to the first quarter of 2018 for the United States and the euro area respectively.

### Chart 13

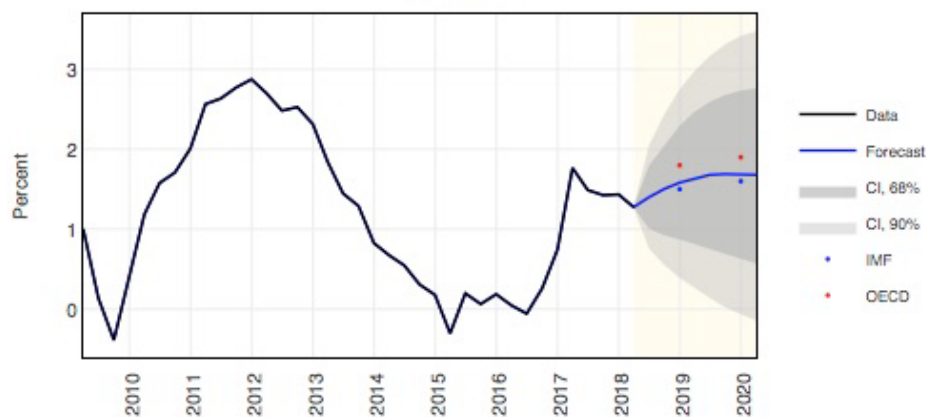
Trend-cycle model – Forecast of CP inflation – US data



Sources: own calculations based on Hasenzagl, Pellegrino, Reichlin and Ricco, 2018.

**Chart 14**

Trend-cycle model – Forecast of HICP inflation – euro area data



Sources: own calculations based on Hasenzagl, Pellegrino, Reichlin and Ricco, 2018.

For the United States the model estimates a rather stable trend (see Hasenzagl, Pellegrino, Reichlin and Ricco (2018)) and a cycle which has peaked. Forecasts from the trend-cycle model, which are lower than both the OECD and IMF forecasts, show a gradual decline of inflation. For the euro area the model does not detect a peak in the cycle yet and therefore predicts a small increase in HICP inflation which then flattens more or less in line with the official forecasts.

## 5 Conclusions

The analysis of inflation data, either from a disaggregated point of view, as suggested by SW, or by extracting unobserved components from aggregate data as in the trend-cycle model, clearly point to there being cyclical features. This provides the evidence that the Phillips curve is alive and well.

## References

Hasenzagl, T., Pellegrino, F., Reichlin L. and Ricco, G. (2018), "A Model of the Fed's View on Inflation", Centre for European Policy Research, *Working Paper Series*, No 12564.

# Inflation Expectations – a Policy Tool?<sup>1</sup>

By Olivier Coibion<sup>2</sup>, Yuriy Gorodnichenko<sup>3</sup>, Saten Kumar<sup>4</sup> and Mathieu Pedemonte<sup>5</sup>

## Abstract

We assess whether central banks should use inflation expectations as a policy tool for stabilization purposes. We review recent work on how expectations of agents are formed and how they affect their economic decisions. Empirical evidence suggests that inflation expectations of households and firms affect their actions but the underlying mechanisms remain unclear, especially for firms. Two additional limitations prevent policymakers from being able to actively manage inflation expectations. First, available surveys of firms' expectations are systematically deficient, which can only be addressed through the creation of large, nationally representative surveys of firms. Second, neither households' nor firms' expectations respond much to monetary policy announcements in low-inflation environments. We provide suggestions for how monetary policymakers can pierce this veil of inattention through new communication strategies. At this stage, the answer to the question of whether inflation expectations should be used as an active policy tool is “not yet”.

## 1

## Introduction

Policymakers have long understood the importance of communication strategies and the management of economic expectations. Since the early 1990s, central banks have become increasingly open in discussing their actions, objectives and views about the economy. This shift was motivated by the idea that clear communication can help reduce financial and economic volatility in response to central banks' decisions as well as augment the tool set of monetary policy (Blinder et al. 2008). For example, statements about the expected path of future short-term interest rates can affect contemporaneous long-term interest rates and therefore influence current economic conditions even in the absence of any immediate policy change.

The onset of the Great Recession and the constraints imposed by the zero-lower-bound (ZLB) on interest rates have brought these less traditional tools to

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<sup>1</sup> We are grateful to Jane Ryngaert, Ha Thu Bui and Jacob Weber for research assistance on this project. We thank Kate McCarthy at Deloitte for providing us with survey data from the Deloitte European CFO Survey. We thank Geoff Kenny for sharing time series of eurozone consumers' inflation expectations and Philippe Andrade for sharing inflation swap data. We thank Ricardo Reis and participants of the 2018 Sintra conference for feedback. This research was funded in part by the National Science Foundation.

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the forefront of policymaking. Along with quantitative easing policies, forward-guidance about the path of future interest rates has become one of the primary tools through which central bankers try to affect economic outcomes. Discussion has also focused on alternative policies that can affect the economy contemporaneously through expectational channels, such as raising the inflation target or adopting nominal-GDP/price-level targets. At the heart of these policies lies a mechanism hinging on the inflation expectations of agents: convincing them that inflation will be higher in the future should, in the absence of interest rate policy offsets due to the zero bound, lower their perceptions of current real interest rates and therefore induce households and firms to increase their spending today. Higher expected inflation can also lead firms to immediately raise their prices in anticipation of rapidly declining relative prices, and workers may similarly bargain for larger nominal wage increases. So communications that directly impact agents' inflation expectations can potentially be used to stabilize economic conditions when traditional policy tools are limited.

Many policymakers have been resistant toward this approach, likely because a central tenet of monetary policymaking over the last thirty years is that they should strive to “anchor” inflation expectations rather than vary them for stabilization purposes. Yet many theoretical models suggest that communications policies that move expectations can be very powerful at the zero-bound, helping policymakers stabilize both prices and output. Should policymakers therefore reconsider their trepidation toward these types of policies? Can they work? Do households and firms really respond to changes in their inflation expectations? If so, is it feasible for policymakers to affect these expectations in a way that enables them to treat expectations management as another policy tool? This paper provides a synthesis of what we know about these questions.

Our starting point is that it is important to draw a distinction between the inflation expectations of professional forecasters or financial market participants and those of households and firms. Central bank discussions and communications often focus on the former, and with good reason. How financial markets perceive the path of future monetary policy drives contemporaneous long-term interest rates and therefore provides a direct transmission mechanism of monetary policy actions to households' and firms' decisions, even at the zero bound on short-term nominal interest rates. The new communications strategies pioneered by central banks since the 1990s have largely been successful in anchoring the long-run inflation expectations of financial markets in advanced economies. Descriptions of policymakers' views of the economy and their expectations of future policy decisions through policy statements, speeches, and post-meeting press briefings have helped reduce financial market volatility.

However, theory suggests that the primary mechanism whereby inflation expectations affect households' decisions is through their perceived real interest rate, which depends not just on the nominal interest rates faced by agents but also on their expectations of future inflation. Similarly, firms' expectations of inflation should matter not only for their pricing and wage-setting decisions but also for their investment and hiring decisions via the role of perceived real interest rates and more broadly because of the relationship between inflation and real economic activity. Because our interest is

in evaluating the scope for using the inflation expectations channel as a policy tool, our focus must be on the expectations of households and firms.

Importantly, the inflation expectations of these different agents are not interchangeable. We document a number of dimensions along which they differ. For example, while professional forecasters and financial market participants have inflation expectations that appear well-anchored (close to the inflation target on average with little cross-sectional variation), this is unambiguously not the case when it comes to households and firms. To shed light on whether the expectations channel can be a useful policy tool, it is therefore important to understand how the inflation expectations of households and firms are formed and how/whether they affect their economic decisions.

We review evidence on how various forces (shopping experience, salience of prices, informational interventions, etc.) influence the inflation expectations of households and firms. In contrast to professional forecasters and financial markets who seem to track macroeconomic developments closely and respond to policy shocks relatively quickly, households and firms are remarkably inattentive to inflation dynamics in developed countries that have experienced low inflation rates for several decades. In contrast, economic agents in high-inflation environments (e.g. Iran, Ukraine, Uruguay, Argentina, Israel) seem to pay considerable attention to inflation, indicating that the inattention to inflation and monetary policy conditions on the part of households and firms in advanced economies is likely a result of the successful monetary policies of the last thirty years. In the absence of much aggregate variation in inflation, these agents appear to have become reliant on the prices of goods they observe on a frequent basis, such as gasoline and food prices, to make inferences about broader price movements. As a result of the volatility in these prices and the heterogeneity of people's consumption baskets, we observe much more volatility in the inflation expectations of households and firms than we do for more informed agents like professional forecasters, more disagreement both in terms of their beliefs about future as well as past inflation, and more uncertainty in their forecasts. In short, their expectations look anything but anchored.

This inattention to inflation and monetary policy on the part of households and firms in advanced economies could imply that their inflation expectations simply do not matter for their economic decisions, thereby rendering the inflation expectations channel ineffectual. This is, however, demonstrably incorrect. We review the burgeoning literature on inflation expectations and economic decision-making and argue that the evidence strongly suggests that there is indeed a causal and economically significant effect of inflation expectations on the economic choices of both households and firms. In the case of households, the evidence supports theoretical predictions that, at least at the ZLB, an exogenous increase in the inflation expectations of households leads them to increase their consumption, which should ultimately lead to higher inflation as well through general equilibrium effects. For firms, inflation expectations clearly affect economic decisions but the mechanism through which this effect operates is not fully established yet. For example, evidence from New Zealand where there was no ZLB suggests that when firms raise their inflation expectations, they then tend to raise their employment and investment with little change in their prices. Newer evidence from



Italy during a ZLB period suggests instead that raising the inflation expectations of firms there leads them to raise their prices but reduce their employment. Further work that clarifies both the direct effects of changes in inflation expectations on economic decisions, as well as their general equilibrium consequences, will be necessary before they can effectively be used as a direct policy tool.

Furthermore, there are two additional important issues that need to be addressed before the active management of inflation expectations is added to the roster of policymakers' stabilization tools. The first is a simple measurement issue: do we know what agents' inflation expectations are? We discuss available surveys of inflation expectations of households and firms from many countries, focusing on how the surveys are conducted and how we can interpret their results. While household surveys are widely available and generally of high quality, surveys of firms' expectations are much more limited in availability, scope, and quality. We document a number of dimensions along which different surveys of firms depart from ideal survey design and argue that these limitations make the current measurement of firms' inflation expectations a binding constraint for their use in policymaking: if we cannot measure the policy instrument, it is unlikely to be a good candidate as a tool for economic stabilization. Because of the unique challenges associated with surveying firms, this constraint is unlikely to be relaxed without a concerted effort on the part of statistical agencies and/or central banks to implement new, large-scale surveys of firms in their countries.

The second major challenge to the use of inflation expectations as a policy tool is the abysmal track record of the typical communication strategies of central banks in affecting households' and firms' inflation expectations. We document this record in a number of ways, building on recent work that studies the inattention of economic agents, and in particular their lack of knowledge about inflation dynamics and monetary policy. We document, for example, that large policy change announcements in the United Kingdom, United States and eurozone seemed to have only limited effects on the beliefs of households and firms, despite widespread news coverage. Only financial market participants and professional forecasters seem to pay much attention to the actions of monetary policymakers. While this inattention to aggregate inflation and monetary policy in advanced economies may itself be a reflection of the success of policymakers in keeping inflation low and stable over the last thirty years, it nonetheless presents a challenge for any policymaker that now seeks to break through this veil of inattention.

Despite this inattention to monetary policy on the part of households and firms, recent evidence suggests that when households and firms are provided with explicit information about inflation or monetary policy, their inflation expectations respond very strongly. This indicates that there is scope for new and improved communication strategies on the part of policymakers to use inflation expectations as a more direct policy tool for stabilization purposes. Furthermore, the magnitudes of the changes in inflation expectations from the provision of simple messages about recent inflation rates or the central bank's target dwarf the estimated effects of other policies like quantitative easing or forward guidance on nominal interest rates. This suggests that communications focused on the inflation expectations of households and firms should

lead to much larger changes in perceived real interest rates – and therefore effects on economic activity – than policies that are currently used. A layered communication strategy, i.e. one that treats households/firms and financial markets differently, could therefore serve as a useful complement to current strategies that are almost exclusively targeting the latter.

Based on recent research, we suggest some practical guidelines and initial steps. The first is that when trying to affect the inflation expectations of households or firms, simple and transparent messages are best. Typical public releases from central banks have no more effect on households' beliefs than information about recent inflation rates. News summaries of the central bank's statements have even less effect. While the detailed descriptions in typical policy releases may have proven helpful in minimizing financial volatility by clarifying the path of future policy to financial market professionals, the opaqueness of these statements means they have not had the desired effect on the general public.

Policymakers can also vary the type of information provided depending on what the desired effect on expectations may be. Because households and firms adjust their beliefs in response to new information like Bayesians (i.e. putting some weight on the provided signal), policymakers can emphasize different facts depending on whether they would like expectations to rise or fall. For example, providing information about the inflation target systematically moves agents' forecasts toward that target value. But policymakers can emphasize other numerical values (e.g. recent inflation rates or price movements of specific goods) if they want to push expectations in a different direction. Because providing households and firms with these types of information has only short-lived effects on expectations (they generally die off within six months), policymakers can generate transitory effects on expectations through short-lived communications campaigns or longer-lived effects through repeated exposure of agents to news. Central banks have employed similar methods with financial markets (e.g. doing vs. not doing forward guidance, changing the expected duration of zero interest rates, changing the nature of the guidance from time-dependent to state-dependent, etc.). The same principles of altering communications to the circumstances can be applied to a new layer of communications targeting households and firms.

Finally, we recommend that policymakers exploit new ways of transmitting information to the public besides the traditional news media, and more in the spirit of public health campaigns that target specific subsets of the population. Much as corporate marketers and politicians are now exploiting new means of targeting narrower groups of individuals with messages tailored for specific groups, central banks could also target their information treatments more precisely through social media, targeted ad campaigns, etc. Such a targeted strategy can help generate larger movements in expectations by identifying and concentrating on populations that are relatively less informed or whose expectations tend to respond more to new information.

More targeted information treatments by monetary policymakers could also help address one of the fundamental challenges associated with currency unions: the one-size-fits-all nature of traditional monetary policies. Consider, for example, a union in which the "North" is booming while the "South" is in recession. The central bank

cannot accommodate both through changes in its interest rate instrument. However, targeted and differentiated communications strategies within each region could be used to try to lower inflation expectations in the North while raising them in the South, thereby generating lower perceived real interest rates in the region that needs monetary accommodation (South) while raising perceived real rates in the region that needs contractionary policy (North). Precise communications strategies could also be used to target specific industries or subgroups of the population. Layered communications strategies could therefore be used not only during zero bound periods but as a more general tool to address geographic or other economic imbalances within a common currency area.

Finally, an enhanced and layered communication strategy would ultimately enhance the credibility and independence of central banks. The success of monetary policymakers in stabilizing inflation over the last thirty years in advanced economies has reduced the cost to households and firms of being inattentive to aggregate conditions, and they have naturally changed their expectations formation as a result, as predicted by the Lucas critique. As a result of this inattention, most economic agents are now largely unaware of just how successful monetary policy has been. A layered communication strategy that helps agents recognize the stability of aggregate inflation would help reinforce the credibility of central banks and thereby help ensure their continued independence. Indeed, Hayo and Neuenkirch (2014) and Ehrmann et al. (2013) find that subjective and objective knowledge about the ECB is positively correlated with the central bank's trust and credibility.

Because communication strategies that directly affect inflation expectations could ultimately provide policymakers with a new and powerful stabilization tool during ZLB periods, address regional divides within currency areas even outside the ZLB, and enhance central bank credibility, their potential usefulness is high. We still lack a nuanced understanding of the mechanism through which inflation expectations affect decisions, clear measures of these expectations, and proven strategies to change them, so this policy tool is not yet ready for prime-time. But now is the time to make progress on all three fronts so that it can be deployed in the next crisis. With it, monetary policymaking may finally become more like a scalpel and less like a hammer.

The paper is structured as follows. Section 2 documents differences in the properties of inflation expectations across different types of agents, like households, firms, professional forecasters and financial market participants, to illustrate how they are not interchangeable. It also provides stylized facts on how the inflation expectations of households and firms are formed. Section 3 discusses recent empirical evidence on the effect of inflation expectations on households' and firms' economic decisions, which provides the basis for the potential use of inflation expectations as a policy tool but also illustrates the limitations to our current knowledge about the transmission of expectations to economic decisions. Sections 4 and 5 discuss two additional challenges that potentially limit the scope of such policies: measurement issues due to limited survey availability/quality (Section 4) and the general insensitivity of households' inflation expectations to monetary policy decisions and announcements

(Section 5). Section 5 then proposes guidelines for new communication strategies that address these limitations. Section 6 concludes.

## 2 Characteristics and Determinants of Inflation Expectations

How are inflation expectations formed? Whose expectations should we care about? These have been perennial questions in macroeconomics and they do not have a simple answer. But they arise regularly in monetary policy discussions, as well as in many other settings.<sup>6</sup>

Whose expectations matter depends, of course, on the context. In the case of pricing decisions, it is the expectations of firms that are at stake. For consumption and savings decisions, household expectations are more relevant. In the determination of financial asset valuations, marginal investors are likely those whose expectations are most important. If the expectations of these different agents are the same, as they are in standard macroeconomic models, this distinction becomes moot. But in practice, this is very unlikely to be the case.

To illustrate these differences, Panel A of Chart 1 plots the time series of mean inflation 1-year ahead expectations in the United States for households (Michigan Survey of Consumers), professional forecasters (CPI forecasts from the Survey of Professional Forecasters (SPF) run by the Federal Reserve Bank of Philadelphia) and financial markets (Federal Reserve Bank of Cleveland). While these three measures of expectations tracked each other closely through the early 1990s, we can observe large wedges appearing between household expectations and those of professionals and financial market participants thereafter. For example, household expectations have averaged around 3.5% since the early 2000s while those of professionals averaged around 2%.

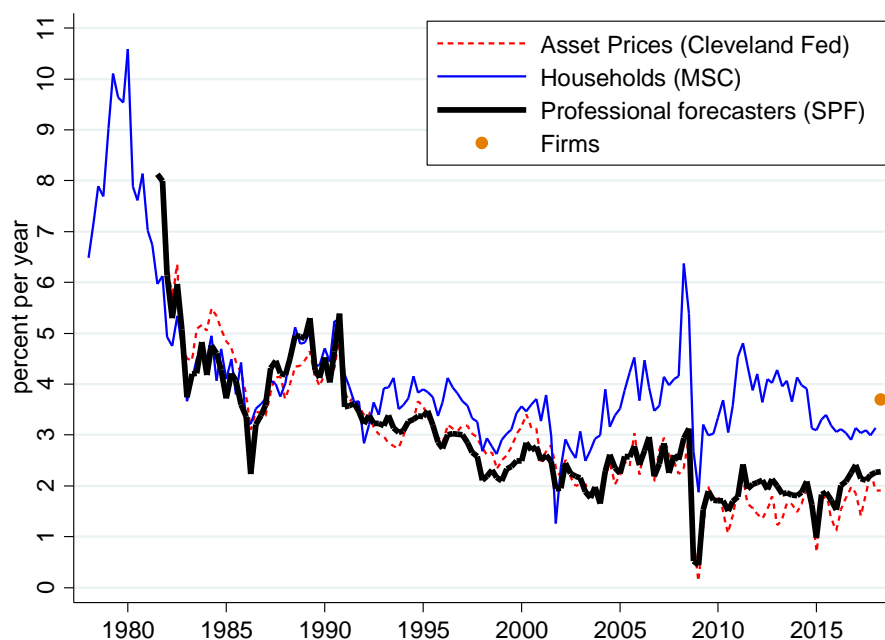
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<sup>6</sup> See for example Fed Chairwoman Janet Yellen's (2016) speech: "Another gap in our knowledge about the nature of the inflation process concerns expectations... Yet another unresolved issue concerns whose expectations--those of consumers, firms, or investors--are most relevant for wage and price-setting, a point on which theory provides no clear-cut guidance. More generally, the precise manner in which expectations influence inflation deserves further study. Perhaps most importantly, we need to know more about the manner in which inflation expectations are formed and how monetary policy influences them". ECB Vice-President Vítor Constâncio (2017) has expressed a similar view: "For policymakers, this [recent research] seems to suggest that there is an important role of the central bank in shaping the expectations of the general public, not only that of financial markets. It also suggests that more research is needed to understand the different factors that shape the inflation expectations of individual households..." See Coibion, Gorodnichenko and Kamdar (forthcoming) for a survey.

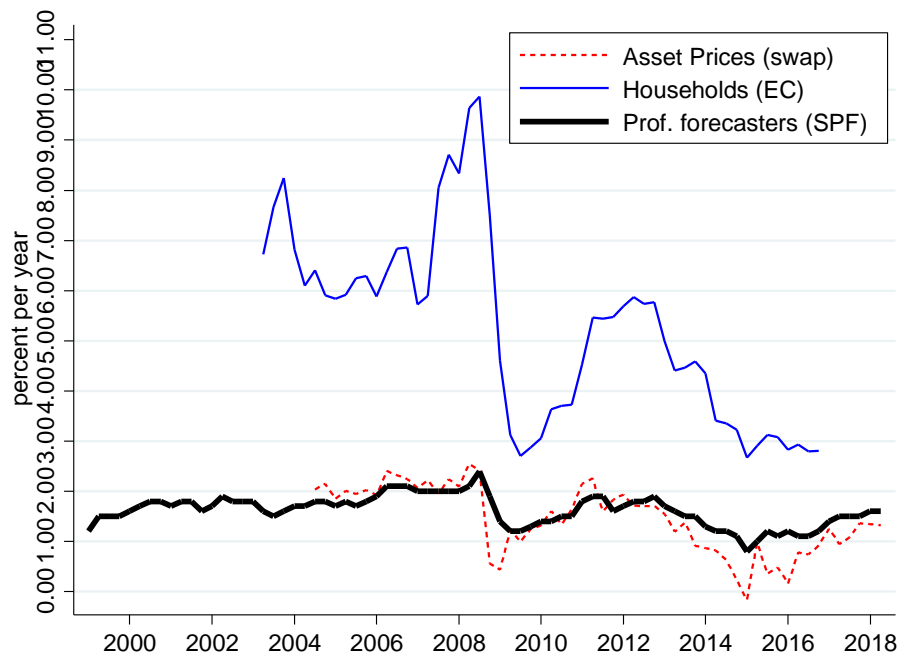
### Chart 1

#### One-Year-Ahead Inflation Expectations for Different Agents

Panel A: United States



Panel B: Euro area



Notes: Panel A reports US time series for expectations of financial markets (reported by the Federal Reserve Bank of Cleveland), households (Michigan Survey of Consumers), professional forecasters (Survey of Professional Forecasters run by the Federal Reserve Bank of Philadelphia), and firms (run on an established panel of firms). Panel B reports eurozone time series for expectations of financial markets (inflation swaps, ICAP and Thompson Reuters), households (European Commission, reported in Duca et al. 2017), and professional forecasters (Survey of Professional Forecasters run by the European Central Bank).

This difference is not unique to households. In April 2018, we conducted a survey of firms in the United States, using panellists from a prominent nationally-representative survey of firms in manufacturing and services. Hundreds of top executives were asked to report their point forecasts for CPI inflation over the next twelve months. 55% reported that they simply did not know. Of the remaining respondents, the average forecast was 3.7%, well above what professional forecasters and financial market participants were expecting but close to the forecasts of households.<sup>7</sup>

Panel B reports equivalent forecasts of one-year-ahead inflation expectations as for the United States but now for households in the euro area (the European Commission survey of households, see Duca et al. 2017), professional forecasters (Survey of Professional Forecasters run by the European Central Bank (ECB)) and financial markets (1-year inflation swaps, ICAP and Thompson/Reuters). As in the United States, household inflation expectations deviate systematically from the expectations of professionals and financial market participants. A similar feature can also be found in New Zealand (see Coibion, Gorodnichenko and Kumar (forthcoming); henceforth CGK), the first country to adopt inflation targeting over twenty-five years ago and in which inflation has remained relatively low and stable since. One might expect individuals there to provide an upper bound on how anchored inflation expectations can be, yet as can be seen in Table 1, households and firms in New Zealand still have expectations which deviate dramatically from those of professional forecasters. Households at the time, for example, were predicting inflation of well above 3% while firms in New Zealand surveyed in CGK displayed even higher mean forecasts of inflation. In contrast, professional forecasters were predicting inflation around only 2%.

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<sup>7</sup> While our analysis focuses on one-year-ahead inflation expectations of households and firms, long(er)-run inflation forecasts of these agents are strikingly similar to short-term inflation forecasts of these agents (e.g. Armantier et al. 2013, Coibion, Gorodnichenko and Kumar (forthcoming), Kumar et al. 2015). In a typical case, if a firm (household) expects inflation to be X% next year, it has approximately X% expectation for inflation 3 or 5 year into the future.

**Table 1**  
Inflation Expectations

		Central Bank	Professional Forecasters	Households	Firms
<b>Panel A. Inflation expectations in the USA</b>					
2018Q1	Mean	1.9	2.2	3.0	3.7
	St. Dev.	(0.2)	(0.4)	(2.6)	(2.6)
<b>Panel B. Inflation expectations in New Zealand</b>					
2016Q4	Mean	1.7	1.6	2.8	2.7
	St.Dev.		(0.2)	(2.6)	(2.4)
2016Q2	Mean	1.6	1.3	2.3	2.8
	St.Dev.		(0.2)	(2.1)	(2.3)
2014Q4	Mean	1.1	1.7	3.1	4.5
	St.Dev.		(0.3)	(2.0)	(2.8)
2014Q3	Mean	1.6	1.9	3.5	4.1
	St.Dev.		(0.2)	(2.4)	(2.5)
2014Q1	Mean	1.9	2.0	3.7	6.1
	St.Dev.		(0.3)	(2.1)	(2.7)
2013Q4	Mean	1.3	2.0	3.6	5.3
	St.Dev.		(0.2)	(2.4)	(3.2)
<b>Panel C. Inflation perceptions in New Zealand</b>					
2016Q4	Mean			2.4	n.a.
	St.Dev.			(2.4)	n.a.
2016Q2	Mean			1.8	2.6
	St.Dev.			(1.5)	(2.1)
2014Q4	Mean			2.9	3.9
	St.Dev.			(2.2)	(2.4)
2014Q3	Mean			2.9	n.a.
	St.Dev.			(2.0)	n.a.
2014Q1	Mean			2.9	5.5
	St.Dev.			(1.8)	(3.3)
2013Q4	Mean			3.1	4.4
	St.Dev.			(2.0)	(3.5)

Notes: The sources of data for Panel A are as follows: "Central bank" are from [FOMC Projections materials](#) (March 21, 2018; PCE deflator), "Professional Forecasters" are from the Survey of Professional Forecasters (SPF; CPI; 2018Q1), "Households" are from the Michigan Survey of Consumers (MSC; "prices in general"; 2018Q1), and "Firms" are from the PMI Markit Survey ("prices in general"; April 2018). Panels B and C are taken from Kumar et al. (forthcoming). "Central Bank" forecasts (CPI) are from Monetary Policy Statements of the Reserve Bank of New Zealand. "Professional Forecasters" are from Consensus Economics (CPI). "Households" are from the Reserve Bank of New Zealand's Survey of Households (the survey elicits inflation expectations only from households who can define inflation). "Firms" are from the survey run in Kumar et al. (forthcoming). St.Dev. reports the cross-sectional standard deviation (disagreement) of forecasts. St.Dev. for Central Bank in Panel A reports the difference between the upper and lower ends of central tendency.

Differences across groups are not limited to mean forecasts. As is well-known, disagreement about inflation among households dwarfs that among professional forecasters (e.g. Mankiw, Reis and Wolfers 2003). For example, in the United States in March 2018, the cross-sectional standard deviation of inflation forecasts across households in the Michigan Survey of Consumers was 3.0% but was only 0.4% in the SPF. Again, surveys of firms yield similar results as for households. In the April 2018 survey we ran of US firms, we found a cross-sectional standard deviation of 4.1% in inflation forecasts. Table 1 illustrates the same feature for New Zealand: disagreement among households and firms is an order of magnitude larger than it is among

professional forecasters. Hence, along either metric, it is clear that one should not expect the inflation expectations of professional forecasters or those of financial market participants to be representative of the beliefs of households and firms. This does not imply that the expectations of the former are unimportant or irrelevant to monetary policymaking, but simply that if the channel we are interested in stems from the decisions of households and firms as well as their expectations – as in the case of the inflation expectations channel – then it is important to focus specifically on the expectations of these agents and not assume that they are well-represented by more readily-available measures. In this section, we consider a number of factors that, based on previous research, play an important role in how households and firms form their expectations.

## 2.1 Priors and Perceptions of Inflation

A particularly striking feature of household and firm beliefs over inflation, and one that was documented as early as Jonung (1981), is that they not only disagree about future inflation but they display almost the same amount of disagreement about recent inflation dynamics. Indeed, the strongest predictor of a household's inflation forecast is typically what they believe inflation has been over the recent past, something which is in principle readily available and which some other types of agents, like professional forecasters, do not disagree about. This finding has been documented in detail for households (see Ranyard et al. (2008) for a survey of this literature) and more recently for firms (e.g. CGK, Kumar et al. 2015). Table 1, for example, shows that the beliefs of households and firms in New Zealand about recent rates of inflation are disconnected from actual values and subject to similar disagreement among these agents, despite widespread availability of data on inflation. In a survey of German consumers in 2015, Dräger and Nghiem (2018) find that approximately 50% of respondents believed that inflation over the previous twelve months had been 5% or above, at a time when actual inflation was 0.3%. Duca et al. (2017) document a similar finding for the entire euro area: in 2015, the average perceived inflation rate among surveyed households across all euro-member countries was just under 5%.<sup>8</sup>

This inattention to recent inflation dynamics, however, varies with the economic environment. Households in high-inflation countries, like in Argentina, tend to be much better informed than households in low-inflation countries about inflation (Cavallo et al. 2017). A similar result obtains for firms: while firms in low-inflation environments tend to appear quite uninformed about recent inflation dynamics, this is much less the case in higher-inflation countries like Uruguay (Frache and Lluberá, 2017), Iran (Afrouzi et al., 2018), or Ukraine (Coibion and Gorodnichenko, 2015b). This suggests that a full understanding of how households and firms form their expectations requires models that explicitly formalize how agents endogenously choose to allocate their attention to different variables in light of their economic circumstances (e.g. Reis, 2006a, 2006b, Gorodnichenko, 2008, Afrouzi, 2018).

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<sup>8</sup> The perceived inflation rate stays high even after removing outliers, see Arioli et al. (2017).



The economic environment that agents perceive to have experienced can shape their views in very long-lasting ways. For example, Ehrmann and Tzamourani (2012) and Malmendier and Nagel (2016) document that people who lived through a high inflation have systematically higher inflation expectations and stronger dislike for inflation than people who did not have this experience.<sup>9</sup> This gradual adjustment of beliefs to new economic settings carries over to how they respond to economic shocks and various informational treatments. For example, Armantier et al. (2016), Cavallo et al. (2017), and Binder and Rodrigue (2017) run experiments on households in which they are provided with new information and find that the adjustment of beliefs to new information is consistent with Bayesian updating. That is, economic agents update their beliefs depending on the strengths of their priors and signals. This behaviour is consistent with economic agents being rational but facing informational rigidities. A particularly important source of signals about aggregate price levels emphasized by households and firms is the set of prices that they observe in their daily lives.

## 2.2 Shopping Experience

Shopping naturally offers people an opportunity to observe prices. Because prices and inflation rates can vary widely across households (e.g. Coibion, Gorodnichenko and Hong, 2015, Kaplan and Schulhofer-Wohl, 2017, Johannsen, 2014), people may extrapolate their own experiences to the aggregate economy. Consistent with this view, Bryan and Venkatu (2001), D'Acunto et al. (2018) and others document that women tend to have higher inflation expectations than men because women tend to do grocery shopping more frequently: once one conditions on exposure to frequent prices changes in stores, the systematic differences in inflation expectations between men and women disappear. In a similar spirit, Cavallo et al. (2017) found that recent shopping experience has a strong influence on inflation expectations: people tend to assign high weights to goods that they just purchased. Kumar et al. (2015) also find that shopping experience is a major source of information for firm managers in New Zealand when these managers form their inflation expectations. Johannsen (2014) reports that groups which experience more dispersed rates of inflation also tend to disagree more about inflation, consistent with shopping experiences parlaying into the inflation expectations of individuals.

Although consumers' inflation expectations appear to display excess sensitivity to price changes of products in their consumption baskets, consumer prices are not equal in influencing inflation expectations. For example, Harris et al. (2009), Coibion and Gorodnichenko (2015a), Wong (2015), and others find that US consumers are sensitive to gasoline prices above and beyond what is justified by the share of

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<sup>9</sup> More generally, there is a large literature (e.g. Souleles, 2004, Ehrmann, Pfajfar and Santoro, 2017) relating inflation expectations/perceptions and various demographic characteristics of households.

expenditures on gasoline.<sup>10</sup> Panel A of Chart 2 illustrates this excess sensitivity of US household inflation expectations relative to professional forecasters by plotting the two against the level of gasoline prices. There is a striking correlation between movements in the level of gasoline prices and the households' inflation expectations. On the other hand, the relationship between gasoline prices and predictions of professional forecasters is much weaker. The same pattern holds in the euro area, as illustrated in Panel B of Chart 2.<sup>11</sup>

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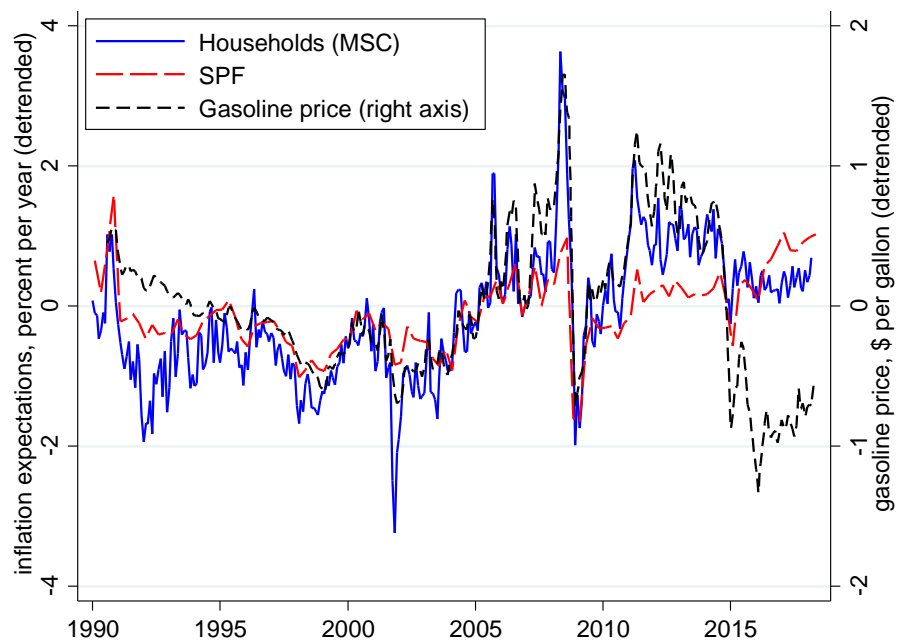
<sup>10</sup> Central bankers are aware of this sensitivity. Yellen (2016): “[T]he longer-run measure of inflation expectations from the Michigan Survey has historically exhibited some sensitivity to fluctuations in current gasoline prices...” and “[A] monthly survey conducted by the Federal Reserve Bank of New York shows a noticeable decline over the past two years in household expectations for inflation three years ahead. However, these readings on shorter-term expectations may also be influenced by current gasoline prices.” Carney (2013) made a similar observation, “[W]e’ve seen a bit in the past when you have a coincident survey [of the general public’s inflation expectations] with something as obvious and important to people as energy prices move, you get these spikes.”

<sup>11</sup> One would expect a weaker relationship between gas prices and household inflation expectations in the euro area than in the United States for at least two reasons. First, gasoline taxes are much higher in Europe, so a \$1 increase in oil leads to a smaller percentage increase in gasoline prices in Europe than in the United States. In addition, diesel is much more common in Europe than the United States. (as is public transportation), making the price of basic gasoline less of a common price signal to households than in the United States.

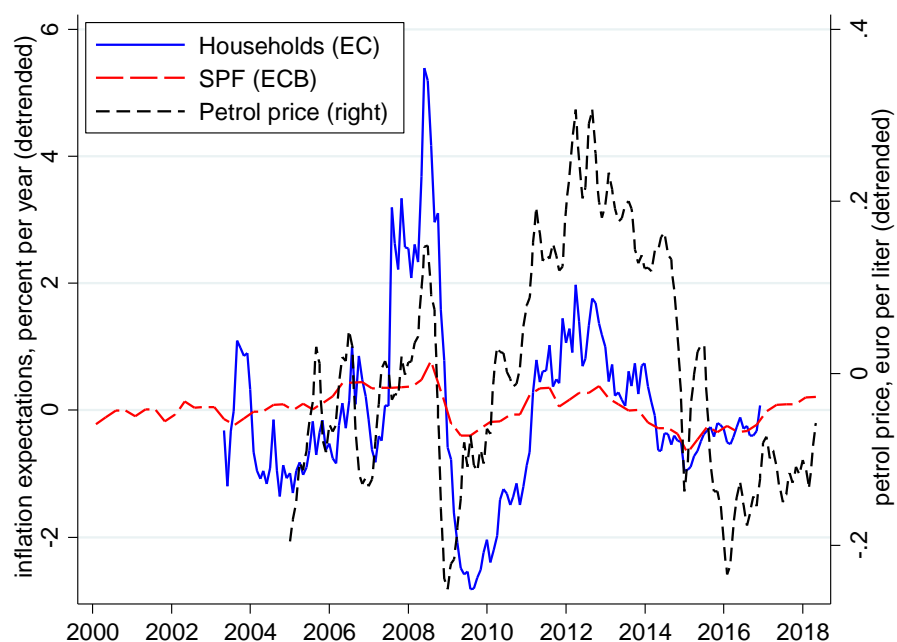
## Chart 2

### Household Inflation Expectations and Gasoline (Petrol) Prices

#### Panel A: United States



#### Panel B: Euro Area



Notes: The chart reports time series of inflation expectations of households and professional forecasters as well as gasoline (petrol) prices. All series are linearly detrended.

Relatedly, food prices also appear to have a disproportionately significant effect on inflation expectations of households (e.g. Clark and Davig, 2008). Coibion and

Gorodnichenko (2015b) document that Ukrainian households' and firms' inflation expectations react strongly to changes in the exchange rate of the hryvnia (Ukrainian currency) and the US dollar. Afrouzi et al. (2018) document a similar finding in Iran. A common theme across these studies is that salient prices of frequently-purchased, homogenous goods appear to strongly influence inflation expectations. One may rationalize this influence by appealing to costs of collecting and processing information: economic agents use easy-to-collect/digest prices correlated with inflation to inform themselves about aggregate inflation.

## 2.3 Media

Another natural source of information about inflation is media coverage of inflation. For example, Carroll (2003) documents that more intensive newspaper coverage of inflation dynamics closes the gap between the inflation expectations of households and those of professional forecasters. Subsequent work (e.g. Dräger 2015, Lamla and Maag, 2012) finds similar effects for other countries. Using in-depth interviews of firm managers, Kumar et al. (2015) document that media is the main source of information for managers when they form inflation expectations. The available evidence, however, suggests that, in low-inflation countries, media coverage may be a relatively weak force in moving inflation expectations.<sup>12</sup> For example, Pfajfar and Santoro (2013) find that exposure to news about inflation leads consumers to a more likely revision of inflation expectations but a revised forecast is not systematically closer to a professional forecast.

## 2.4 Knowledge about Monetary Policy

An additional factor that can affect agents' forecasts is their understanding of monetary (and fiscal) policy. While there is an extensive literature studying how monetary policy affects the economic expectations of financial market participants and professional forecasters, evidence for the effects on households and firms is more limited.<sup>13</sup> Previous work has found that households who are more informed about the central bank's objectives or who have greater trust in the central bank tend to have better behaved inflation forecasts (e.g. Kamada, Nakajima and Nishiguchi, 2015, Christelis et al., 2016). But informed/trusting households seem to be in short supply. Binder (2017), for example, uses a variety of polling data to show that most US households are unaware of the Federal Reserve's leadership and objectives. In a

<sup>12</sup> Haldane (2017) made a similar observation: "Studies have examined the factors that influence how the media intermediate central bank messages. There is mixed evidence on how well the media performs this task. There is evidence the media leads to a better understanding of the ECB's monetary policy. But in the United States and Germany, there is evidence the media may sometimes impair communication and bias opinion."

<sup>13</sup> In evaluating effects of central banks' policies on inflation expectations, the literature has largely focused on whether inflation targeting makes inflation expectations of financial markets and professional forecasts less sensitive to macroeconomic news shocks (e.g. Beechey et al., 2011, Gurkaynak et al., 2010). More recent studies examine how forward guidance changed expectations of these agents (e.g. Campbell et al., 2012, Andrade et al., 2015). Other work has sought to establish whether inflation targeting regimes have more anchored expectations of professional forecasters (Pierdzioch and Rülke, 2013, Dovern et al., 2012).

similar spirit, Kumar et al. (2015) document that, among firm managers in New Zealand, only thirty percent can correctly identify the name of the Reserve Bank Governor (out of four choices) and 31% can identify the central bank's main objective as being to keep inflation low and stable (out of five choices). This result also extends to Europe. For example, van der Crujisen et al. (2015) find that just over half of Dutch survey respondents correctly identified as a true statement (out of only two options) that the ECB targets a rate of inflation of close to but just below 2%.

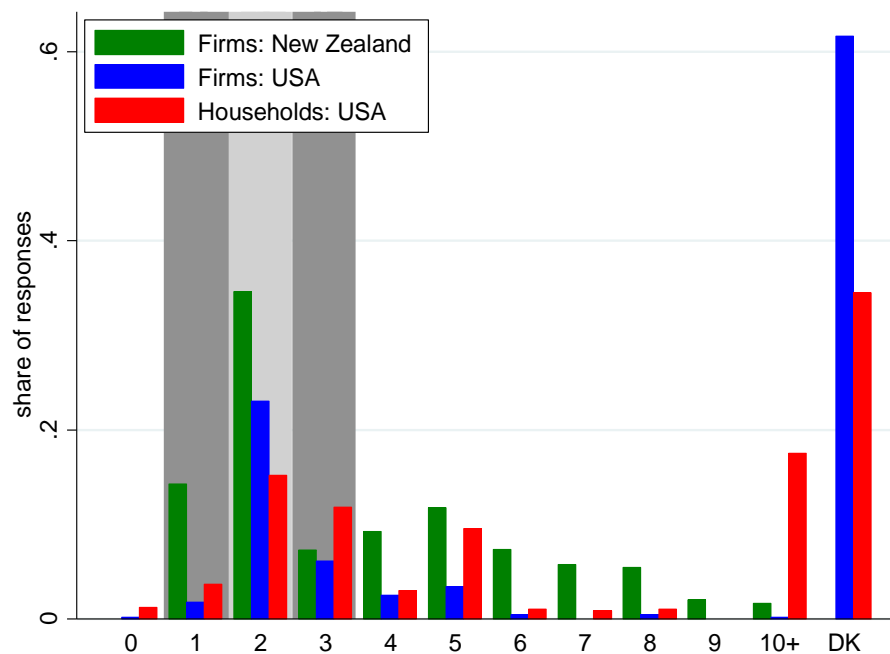
In parallel surveys of US firms and households in April 2018, we asked respondents what inflation rate the US Federal Reserve was trying to achieve in the long run. The survey of firms was done through the same nationally-representative panel of executives in manufacturing and services in the United States as described in Section 2 (i.e. from a pre-existing private survey of firms). The survey of households is described in more detail in Coibion, Gorodnichenko and Weber (2018) but reflects a pilot study with about 1,500 responses from US households participating in the AC Nielsen Homescan project. In each case, respondents were asked to report a point value as their answer but had the option to decline to answer. For comparison, we also report the distribution of beliefs about the RBNZ's inflation target from the survey of firms in New Zealand described in Kumar et al. (2015).

The resulting distributions of answers from each survey are plotted in Chart 3. In both US surveys, respondents had the ability to select "I don't know" as a possible answer. In the case of US firms, over 60% of respondents selected this option. Around 25% correctly selected 2% as the Federal Reserve's inflation target, with the vast majority of remaining respondents providing an answer greater than 2%. US households yielded a similar distribution: around 20% correctly picked 2% while over 50% responded that they did not know or thought that the Fed's inflation target was 10% or more per year. These results reflect even less knowledge about monetary policy than in New Zealand, where around 35% answered 2% and approximately 50% were in the correct range of the RBNZ's inflation target range of 1-3% per year.

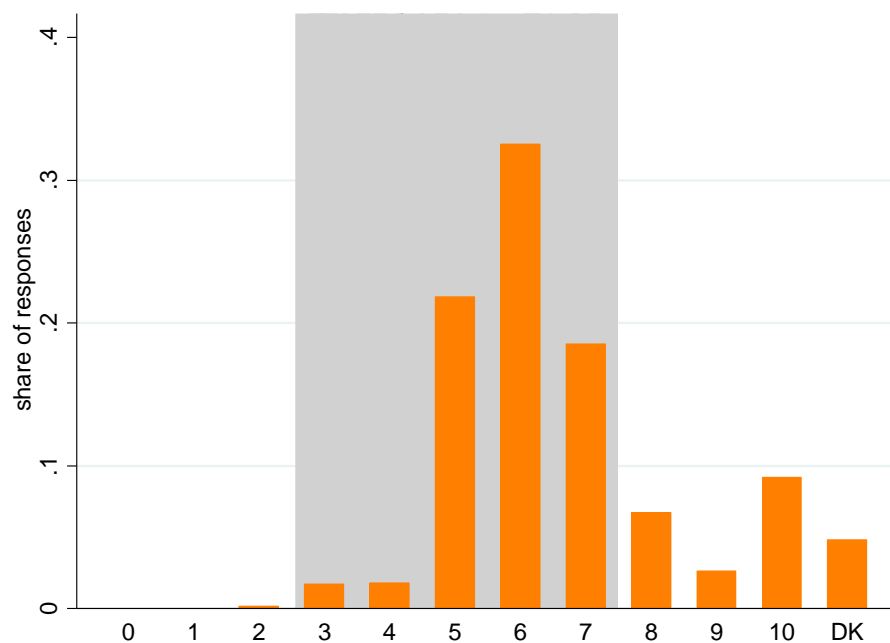
### Chart 3

#### Belief about the Central Bank's Inflation Target

Panel A: Belief in the United States and New Zealand



Panel B: Belief in Uruguay



Notes: The chart shows the distribution of how households and firms perceive inflation targets of central banks. DK means "do not know". 10+ includes responses of 10% or more. Inflation target in the United States is 2% (light shaded area, Panel A). Inflation target in New Zealand is 1% to 3% (dark shaded area, Panel A). Inflation target in Uruguay is 3% to 7% (shaded area, Panel B).

In Panel B, we also report results from a survey in Uruguay (described in Coibion, Frache, Gorodnichenko and Lluberas, 2018) in which a representative sample of firms

were asked about the central bank's inflation target, which is currently a range of 3% to 7%. Uruguay has experienced relatively high inflation in recent decades<sup>14</sup> and, as reported in Frache and Lluberas (2017), firms there are relatively more informed about inflation than firms in New Zealand. Consistent with this view, we find that firms in Uruguay are relatively well informed about the inflation target there: only about 5% report that they don't know the target and less than 20% picked a value for the target outside the target range. This provides further support for the notion that economic agents in higher and more volatile inflation environments are more informed about inflation and monetary policy.

## 2.5 Summary and Discussion

Different agents face different incentives and costs to acquiring and processing information. It should therefore not be surprising to find systematic differences across agents in terms of how they form their expectations. The inflation expectations of households and firms, in particular, deviate in systematic ways from those of professional forecasters and financial market participants. As a result, those interested in identifying economic mechanisms that rely on the decisions and beliefs of households and firms should focus on the expectations of these agents and not assume that they are well-approximated by other more readily-available survey measures. They are not.

The inattention of households and firms to inflation and monetary policy in advanced economies is likely a reflection of policymakers' success in stabilizing inflation around a low level for decades. This stability has reduced the benefit to being informed about aggregate inflation, leading many to rely on readily available price signals to make inferences about aggregate inflation. This inattention to aggregate information about inflation and monetary policy, however, need not imply that their beliefs do not affect their decisions. The channels running from expectations to actions are what we now turn to.

## 3 Do Inflation Expectations Affect Economic Decisions?

For inflation expectations to be useful as a policy tool, it is essential to know whether they affect economic decisions, as suggested by theory. In this section, we summarize and extend recent empirical evidence on the ways in which inflation expectations affect the economic decisions of both households and firms.

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<sup>14</sup> According to the Uruguayan National Institute of Statistics, Uruguay had an annual inflation rate of 6.6% in 2017. Between 2008 and 2018, the average inflation rate was 8.2% and the range was 6.6% to 9.8%.

### 3.1 Consumers' Decisions and their Inflation Expectations

The standard (and primary) channel through which inflation expectations are expected to affect households' economic decisions is via a consumption Euler equation, which relates the expected growth in consumption to the expected real interest rate:

$$c_t = E_t c_{t+1} - \sigma [i_t - E_t \pi_{t+1}] = E_t c_\infty - \sigma \sum_{j=0}^{\infty} E_t (i_{t+j} - \pi_{t+1+j})$$

or equivalently that current deviations of consumption from long-run levels ( $c_t$ ) depend on whether current and future real interest rates ( $i_t - E_t \pi_{t+1}$ ) are expected to be above or below normal. An increase in expected inflation  $E_t \pi_{t+1}$  lowers the perceived real interest rate (for a fixed nominal interest rate  $i_t$ , as would be the case at the ZLB), thereby reducing the incentive to save and raising current consumption.

A large body of work now exists which tests this mechanism using household surveys of consumption and expectations. While early work on this found little evidence that high inflation expectations were associated with higher desired consumption (Bachmann, Berg and Sims (2015) using the Michigan Survey of Consumers), subsequent work has found much more positive evidence. For example, using inflation expectations from the New York Fed's Survey of Consumer Expectations, Crump et al. (2015) estimate a value of 0.8 for intertemporal elasticity of substitution  $\sigma$ . Dräger and Nghiem (2018) find similar results for German households using a survey developed by the University of Hamburg. D'Acunto, Hoang and Weber (2016) use survey data from the harmonized Survey of Consumers for German households and find that households with higher inflation expectations are more likely to report that now is a good time to buy. Ichiue and Nishiguchi (2013) find evidence consistent with the Euler equation using household survey data in Japan during the ZLB period. Pooling data from seventeen European countries, Duca et al. (2017) also find when households expect inflation to go up, they tend to be more positive toward spending on consumer durables.<sup>15</sup> Finally, Armantier et al. (2015) use an incentivized experiment to show that households act upon their reported inflation expectations which is consistent with Malmendier and Nagel (2016) documenting that inflation experiences shape not only inflation expectations but also financial choices of consumers (e.g. consumers who have lived through high inflation tend to invest less in nominal bonds and tend to borrow through fixed-rate mortgages).

One limitation faced by this literature is that causality from higher inflation expectations to higher desired levels of consumption does not automatically follow from the positive correlations between the two. A particularly striking paper therefore is by D'Acunto, Hoang and Weber (2016), who use the pre-announced increase in the VAT in Germany in 2005 as a source of exogenous variation in inflation expectations of German households relative to those of other European countries. They find that the rise in inflation expectations of German households relative to comparable households in neighbouring countries was associated with higher reported willingness

<sup>15</sup> Related work has studied how inflation expectations affects other decisions they face, for example the composition of their assets (Vellekoop and Wiederholt, 2017).



to spend by these households, despite no differences in their expectations of future income and other forces. Jointly, these results therefore suggest that there is a causal chain running from higher inflation expectations to higher consumption levels, at least in the absence of offsetting interest rate responses such as during the zero-bound.

### 3.2 Firms' Decisions and their Inflation Expectations

With respect to how inflation expectations affect firms' decisions, empirical evidence is significantly more limited. This primarily reflects the fact that survey data on firms' inflation expectations is less readily available, as discussed in more detail in Section 4. Nonetheless, recent work has begun to systematically exploit existing surveys of firms' expectations.

Particularly relevant is CGK. They implement a sequence of nationally representative surveys of firm managers in New Zealand starting in 2013. These surveys inquire as to managers' expectations of future inflation as well as other macroeconomic and firm-specific expectations, such as their expected hiring, pricing and investment decisions over the next six months. To assess the causal effect of inflation expectations on firms' decisions, they conduct the following experiment. In one of the waves of the survey, some managers were provided with information about the Reserve Bank of New Zealand's (RBNZ) inflation target while others – the control group – were provided no such information. Six months later, a follow-up survey was done to assess what actions firms had taken over the previous six months in terms of their prices, wages, hiring and investment. In addition, firms were asked again about their inflation expectations. Because the provision of information about the RBNZ's inflation target strongly affected inflation expectations but did not lead to changes in managers' expectations of other macroeconomic variables, this treatment (being provided information about the RBNZ's inflation target) can be interpreted as generating exogenous variation in inflation expectations which can then be used to assess the causal effect of these expectations on firms' economic decisions.

CGK document several findings from this experimental design. First, the provision of information led to a large and immediate downward revision of inflation expectations for firms who were initially uninformed about the target (i.e. those who thought the target was 4% or more). Second, this effect had almost completely dissipated within six months, suggesting that the provision of this type of information affects beliefs only for a limited duration. Cavallo et al. (2017) document a similar short-lived effect for consumers. Third, treated firms did not change their prices or wages in ways that were statistically or economically different from firms in the control group, despite the pronounced difference in their beliefs about inflation. Fourth, treated firms significantly reduced their hiring and investment relative to the control group. In other words, the exogenously generated reduction in inflation expectations led to a significant decline in firms' use of inputs into the production process, providing direct evidence of a causal mechanism running from firms' inflation expectations to their economic decisions.

A closely related paper that also provides evidence of a causal link from inflation expectations to firms' decisions is Coibion, Gorodnichenko and Ropele (2018, CGR

henceforth). These authors exploit a quasi-experiment in a survey of firm expectations in Italy. In 2012Q3, the survey randomly divided firms into two groups. One group (1/3 of respondents) was asked about their inflation expectations at different horizons, before being asked the remaining questions in the survey. The other group (2/3 of respondents) were first told what the most recent rate of inflation was in both Italy and the eurozone before being asked about their inflation expectations. Importantly, this split of firms was sustained over the next five years and firms in the treatment group were told the most recent values of inflation in each quarter of the survey. Unlike the one-time experimental provision of information considered in CGK, the Italian case provides an example of a repeated and long-lived information treatment that generates significant and persistent differences in inflation expectations across firms over time. Because firms are asked about their economic decisions in each wave (price changes and employment), this design can be used to study how exogenous variation in inflation expectations affects prices and employment decisions over time. The sample covers a ZLB period thus providing a direct assessment of how firms can respond to attempts to raise inflation expectations.

This alternative quasi-experiment generates a number of results that mirror those found by CGK in New Zealand. First, the selective treatment of some firms with information about recent inflation is a strong instrument for inflation expectations of firms, generating pronounced exogenous variation in inflation expectations. Second, the effects of the information treatment are again short-lived: information treatments die out after about six months, very similar to that found in CGK. Hence, persistent differences between the beliefs of the two groups of firms only happen because of the repeated treatment of firms with new information. Third, CGR find a limited effect of inflation expectations on prices: firms with higher inflation expectations charge higher prices over the first few months but these effects dissipate rapidly and the passthrough is limited (for a one percentage point increase in inflation expectations, firms raise prices by at most 0.2 percentage points). Andrade et al. (2018), using inflation expectations data from a representative survey of manufacturing firms in France, similarly document that higher inflation expectations are followed by rising prices on the part of firms.

Despite these similarities, CGR find a dramatically different effect in how inflation expectations translate into the employment decisions of firms: firms with higher inflation expectations reduce their employment over the next year, the opposite reaction from that found in New Zealand. They also report reduced plans for future investment plans over the same horizon. These results apply to various subsamples based on firms' size, location, sector, and export status.

One possible explanation for why this difference occurs suggested by CGR is that, unlike in New Zealand, changes in the inflation expectations of firms in Italy are associated with changes in their other economic expectations: higher inflation expectations from the treatment lead Italian firms to become more pessimistic about the overall economy both contemporaneously and in the future, more pessimistic about the business conditions facing their specific firm, more pessimistic about their ability to access credit, and more uncertain about the future. Firms with exogenously higher inflation expectations also report that they feel a greater need to raise prices

because they foresee higher prices for raw materials but a need to reduce prices because of lower demand for their products. In short, an increase in inflation expectations from the information treatment in Italy is perceived like a negative supply shock to the economy and the firm, whereas firms in New Zealand do not materially change their expectations of other macroeconomic variables when they exogenously change their inflation expectations.

These results suggest several important policy implications. First, the mapping from inflation expectations to firms' actions appears to depend on context (e.g. macroeconomic conditions, the ability of the central bank to stabilize the economy, etc.) and may have unintended effects. For example, CGR estimates indicate that raising inflation expectations at the ZLB can result in lower employment and investment, which is counter to predictions of standard macroeconomic models. Second, shaping inflation expectations can influence inflation directly: if a firm can be convinced that inflation will be higher in the future, it may raise prices in response thus generating a higher inflation now. Again, the link between inflation expectations and pricing decisions of firms should be explored further, but results in CGR imply that such direct effects on inflation may be possible and thus management of inflation expectations can offer a new tool to control inflation and more broadly the economy.

### 3.3 Summary and Discussion

The previous two sections show that there is clear empirical evidence supporting causal effects from inflation expectations to economic decisions of households and firms, although the specific channels and mechanisms remain in doubt for firms. Furthermore, we have focused only on the direct effects of these policies on each type of agent and abstracted from the general equilibrium effects each of their responses would subsequently induce. Despite these caveats, these results suggest that, in principle, there is scope for policymakers to affect inflation expectations for stabilization purposes. For this to be successful, however, requires two additional ingredients. First, policymakers must be able to measure inflation expectations of these agents to gauge how much policy action is needed. Second, policymakers need specific communication tools to affect these expectations. In the next two sections, we consider issues associated with each of these dimensions.

## 4 Measuring Inflation Expectations

The ability of policymakers to gauge their effect on inflation expectations hinges on the availability of high-quality surveys of households' and firms' expectations. To what extent do existing surveys meet the standards one would expect? The answer depends largely on the type of agent.

Household surveys have long been in existence for most advanced economies. For example, the United States has the Michigan Survey of Consumers and the New York Fed's Survey of Consumer Expectations (SCE). The United Kingdom has the Barclays Basix and Bank NOP surveys. The European Commission organizes a harmonized

survey of households for all European Union countries, although these are implemented by the statistical agencies of member nations. In each case, surveys are done monthly or quarterly using a large (generally greater than a thousand) representative group of households. The Bank of Japan runs the Opinion Survey. Households are asked to provide a point estimate for future price changes or assign weights to different ranges of possible outcomes. Questions are generally phrased in terms of “overall prices in the economy” although some (like the New York Fed’s SCE) emphasize inflation rates of a specific price index. These surveys are generally viewed as being of very high quality due to their large and representative cross-samples as well as their high-frequency and long availability.

In contrast, the availability of surveys of firms in most countries is much more limited (see Table 2). There are few surveys that ask for quantitative inflation expectations of firms and those that do tend not to be nationally representative. The phrasing of questions varies widely, as does the way in which respondents can respond (e.g. point estimates vs. ranges, sizes of bins offered, etc.). In contrast to households, there has been little work done to characterize the sensitivity of firms’ responses to different types of survey questions. It remains unclear how important it is to have a representative sample of firms across industries and size. There is even ambiguity about whether one can or should measure firms’ expectations of aggregate inflation by asking them about their expectations of their own firm’s price changes or unit costs.

**Table 2**
**Selected Surveys of Firms' Inflation Expectations**

Country	Institution	Respondents	Price Definition	Sampling	Freq.	Start date	Open/Bins	Horizon	Question
Canada	Conf. Board of Canada	Firms	Prices in general	Convenience	Quarterly	1997	9	6 months	Do you expect prices, in general, in Canada to increase over the next six months at an annual rate of
Canada	Central bank	Firms	Inflation (CPI)	Quota	Quarterly	1997	4	1 year	The firm's expectation for the average annual rate of inflation over the next two years as measured by the consumer price index (CPI) is:
Czech Republic	Central bank	Firms	Inflation (CPI)	Representative	Quarterly	1999	open	1 and 3 years	What year-on-year consumer price change in per cent do you expect in the next 12 months?
EU Members	European Commission	Firms	Prices for consumers	Probabilistic sample	Monthly	1985	(up/down/same)	1 year	By what percentage would you say that prices will increase for the consumer in the next 12 months?
Iran	Central Bank	Mnfg. firms, ≥100 workers	Inflation	Probabilistic sample	Semian.	2016	open	1 year	What do you think the [yearly] inflation will in be during the next year?
Israel	Ungar and Zilberfarb (1993)	Firms	Inflation (CPI)	Representative	Quarterly	1980	open	1-4 quarters	The cumulative inflation rate (not monthly average), in %, which is expected for the following periods is as follows: The next 12 months
Italy	Central bank	Firms	Inflation	Probabilistic sample	Quarterly	1999	open	1 year	The last [month] consumer price inflation, measured by the 12-month change in the harmonized index of consumer prices was equal to [IT] in Italy and to [EA] in the euro area. What do you think it will be in Italy?
Japan	Central bank	Firms	Prices in general (CPI)	Probabilistic sample	Quarterly	2014	10	1, 3, and 4 years	What are your institution's expectations of the annual % change in general prices (as measured by the CPI) for one year ahead, three years ahead, and five years ahead, respectively?
New Zealand	Central bank	Firms and professionals	Inflation (CPI)	Convenience	Quarterly	1987	open	3 months and 1 year	What annual % change do you expect in the CPI for the:
Poland	Central bank	Firms	Prices	Sector representation	Quarterly	2008	5	1 year	In [month] of the current year, the CPI (inflation) was equal to x% in annual terms. In the enterprise's opinion, during the next 12 months prices:
South Africa	Central bank	Firms and consumers	Inflation (CPI)	Convenience	Quarterly	2000	open	1 year	What do you expect the average headline inflation rate (as measured by the % change in the CPI) to be during the year?
Sweden	Central Bank	Firms with ≥200 workers	Inflation (CPI)	Random	Quarterly	2000	open	1 year	n.a.
UK	Confed. of British Industry	Firms	Prices of competition	Convenience	Quarterly	2008	4	1 year	What has been the % change over the past 12 months in the general level of output prices in the UK markets that your firm competes in, and what is expected to occur over the next 12 months?
Ukraine	Central bank	Firms	Inflation	Random	Quarterly	2006	8	1 year	How do you think the level of consumer prices will change in the next 12 months?
USA	Atlanta Fed	Firms	Individual unit costs	Non-random (regional)	Monthly	2011	5	1 year	Projecting ahead, to the best of your ability, please assign a percent likelihood to the following changes to unit costs over the next 12 months.
USA	Livingston, Philly Fed	Large Firms	Inflation (CPI)	Convenience	Semi-Annual	1946	open	1 year	n.a.
Uruguay	Central bank	Firms with ≥50 workers	Inflation (CPI)	Representative	Monthly	2009	open	1 year	What do you believe is going to be the change in the CPI?
Turkey	Central Bank	Manufacturing Firms	Inflation (PPI)	Sector representation	Monthly	1987	open	1 year	What is your expectation for inflation (producer prices) rate over the next 12 months (as an annual percentage)?

In the next few sections, we provide new results on the extent to which these different factors matter for the interpretation of survey responses, then draw some conclusions about how well currently available surveys across countries actually measure the inflation expectations of firms in those countries. To assess the sensitivity of answers to survey design, we will primarily rely on a sequence of firm surveys done in New Zealand between 2013 and 2017. These surveys are discussed in detail in Kumar et al. (2015) and CGK. Over 3,000 firms were first surveyed in 2013Q4 and three follow-up surveys were done over the next two years on subsets of these firms. A new panel of over 2,000 firms was drawn in 2016Q2 with a single follow-up survey being done on a subset of these firms six months later. To evaluate various elements of survey design, we provided random subsets of firms with different formulations of questions about inflation, allowing us to study how these questions affect responses. In what follows we provide key takeaways from our analysis.

#### 4.1 Point Forecasts vs. Distributions

While there are numerous benefits of having access to an economic agent's distribution of subjective expectations (Manski, 2004), respondents may have a hard time understanding questions about distributions of their beliefs and may exhibit a lower response rate (Kleinjans and van Soest, 2010). We find that managers have high consistency in their responses to questions eliciting point estimates of future inflation<sup>16</sup> and questions eliciting probability distributions of future inflation<sup>17</sup> (see Appendix Table A1). Specifically, the correlation between the point prediction and the mean implied by the reported distribution is about 0.9, which is considerably higher than the corresponding magnitude for household surveys. Thus, although consumers often struggle with answering probability distribution questions (Fischhoff and Bruine de Bruin, 1999, Bruine de Bruin et al., 2000), firm managers answer coherently across the two types of questions and bias is unlikely in the distribution-type questions for this type of economic agents.

#### 4.2 Wording of Inflation Forecast Questions

Currently available surveys of consumers and firms display considerable heterogeneity in the wording of questions used to elicit inflation expectations. The definitions of inflation range from “the change in the prices you pay” to “inflation as measured by the Consumer Price Index”. Few even use the word “inflation”. Although this may seem to be a trivial difference in the wording, Armantier et al. (2013) and Bruine de Bruin et al. (2012) document that the phrasing of inflation questions matters for how households interpret and respond to questions.

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<sup>16</sup> The point forecast is based on the following question: “During the next twelve months, by how much do you think prices will change overall in the economy? Please provide an answer in percentage terms.”

<sup>17</sup> Specifically, participants are asked “Please assign probabilities (from 0-100) to the following range of overall price changes PER YEAR in the economy over the next twelve months for New Zealand: (note that the probabilities in the column should sum to 100).”

In one wave of the New Zealand survey, firms were randomly assigned to answer versions of the inflation expectation questions formulated in terms of “prices overall in the economy”, “overall inflation rate”, and “inflation rate (specifically the Consumer Price Index)”. We find that firm managers do not appear to have systematic biases or exhibit difficulties with interpreting the questions: first and second moments of the responses are similar across the wordings (see Appendix Table A2). Thus, managers’ answers about inflation do not appear to be disproportionately sensitive to the language used in the question.

### 4.3 Expectations of Aggregate vs. Respondent-Specific Variables

While the objective of many surveys is to measure firms’ expectations of aggregate inflation, some surveys attempt to measure these expectations by asking firms to report their projected dynamics of firm-level variables such as their own prices or their own unit costs. For example, the Atlanta Fed’s Business Inflation Expectations (BIE) survey asks firms about their expectations of future changes in their unit costs rather than their expectations of aggregate inflation. This measure is conceptually different from inflation, but it may be associated with similar results in aggregate. To establish whether this difference in the objects of inflation expectation questions is material for measuring aggregate inflation expectations, we asked firms in the New Zealand survey to report their expectations about their future unit costs and expectations about aggregate inflation.

We find (Appendix Table A3) that the mean (median) response about firm-specific variables is consistently lower than the mean (median) response about aggregate inflation. This pattern applies not only to expected changes but also to perceived inflation (that is, inflation that happened in the previous twelve months) and actual changes in firm-level variables (that is, actual change in unit costs or prices in the previous 6 or 12 months). The dispersion of inflation expectations and perceptions tends to be larger than the dispersion in expected or actual changes in firm-level variables. Most importantly, we observe that firm-level responses about unit costs or prices are effectively uncorrelated with their expectations and perceptions of aggregate inflation.<sup>18</sup>

We find similar patterns in the United States when we compare the distribution of responses about unit costs in the BIE survey and the distribution of point predictions about aggregate inflation in the survey of firms that we ran in April 2018 (see Chart 4). Specifically, in the April 2018 wave of the surveys, the BIE responses are generally centered at 2.3 percent (standard deviation is 1.4), while the mean response (after censoring responses greater than 10 percent) of inflation expectations in our survey is

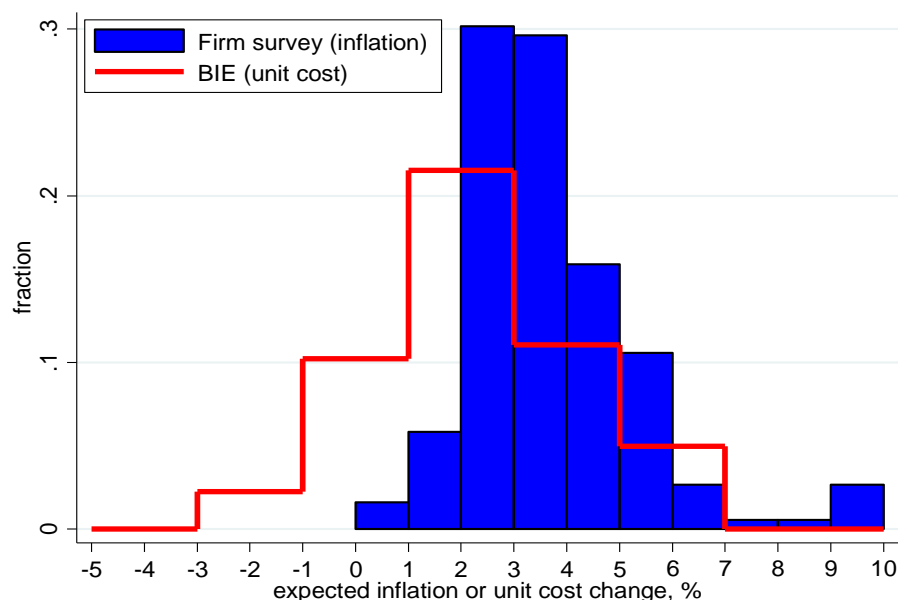
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<sup>18</sup> Interestingly, the BIE had two special questions in the July-2015 and September-2014 waves to elicit firms’ expectations about aggregate inflation so that we can compare responses about aggregate and firm-level variables. Similar to the survey in New Zealand, expected changes in unit costs are lower and less dispersed than changes in the CPI or “prices overall in the economy”. Although the magnitudes of the differences are somewhat smaller, we argue below that some of the compression in the moments is due to the particular survey design of the BIE inflation expectation questions.

3.6 percent (standard deviation is 2.0). That is, the distribution of responses about aggregates is tangibly shifted to the right and is more dispersed.

**Chart 4**

Comparison of Surveys of Firms' Expectations in the U.S



Notes: The chart shows the distribution of responses in the Business Inflation Expectations (BIE) survey run the Federal Reserve Bank of Atlanta and in a survey of firms we ran using a pre-existing nationally representative panel of firms in the United States ("Firm survey"). The BIE survey asks respondents to report their expected change in unit costs (the question is "Projecting ahead, to the best of your ability, please assign a percent likelihood to the following changes to unit costs over the next 12 months."). Possible answers are: "Unit costs down (<-1%)", "Unit costs about unchanged (-1% to 1%)", "Unit costs up somewhat (1.1% to 3%)", "Unit costs up significantly (3.1% to 5%)", and "Unit costs up very significantly (>5%)". Our survey asks respondents to report their point predictions for one-year-ahead inflation (the question is "What do you think will be the inflation rate (for the Consumer Price Index) over the next 12 months? Please provide an answer in an annual percentage rate.").

Our results suggest that whether a survey asks respondents to report firm-specific or aggregate measures of price change may influence both the level and heterogeneity of responses. These differences are important because both moments are informative about how agents form expectations and how successful central banks are in anchoring inflation expectations. Furthermore, we document that asking firm managers about changes in unit costs or prices of their firms can bear little connection to what firms project for macroeconomic variables.

#### 4.4 Sensitivity of Inflation Expectations to the Design of Questions

In the baseline structure of probability questions in our survey of New Zealand managers, we present respondents with a broad spectrum of possible outcomes ranging from "More than 25%" to "Less than -25%" (which is similar to the wide grid of possible inflation outcomes in the Survey of Consumer Expectations run by the Federal Reserve Bank of New York). In contrast, other surveys often present fewer and/or narrower options. For example, an occasional question about core CPI in the



BIE survey has a top bin of “4 percent and above”, while the bottom bin is “zero or less” (that is, price decline).<sup>19</sup> Relatedly, point forecasts are often formulated as multiple-choice questions where the number of options is fairly constrained. For example, the Business Outlook Survey run by the Bank of Canada offers only four options for point predictions of CPI inflation: “less than 1%”, “between 1% and 2%”, “between 2% and 3%”, and “above 3%”. Given considerable variation in point predictions of managers in New Zealand and more generally households in the United States and other countries, such limited scales of possible answers may prime respondents to report predictions in the middle of the provided range or lump responses at the boundaries of the range thus possibly biasing reported inflation expectations.

To assess the quantitative importance of variation in the scale provided in questions eliciting expectations of firm managers, we randomized a set of questions presented to firms. Specifically, the first group of firms is presented with the CPI question in the Atlanta Fed’s BIE format. The second group is presented with a grid as in the New Zealand survey (NZ grid).

For each question and firm, we compute the mean and standard deviation (a measure of uncertainty) implied by the reported density. Then we calculate moments across firms for these two statistics. We find (Appendix Table A4) that using a larger number of bins covering a broader set of possibilities for the core CPI inflation rate yields results similar to those of the percent change in general level of prices (our baseline question about “change in prices overall”). Using the same question in the BIE format produces a mean forecast similar to the mean in the baseline format of the question. However, the cross-sectional dispersion of implied means across firms is considerably smaller than in the NZ grid (1.30 vs. 2.37). Furthermore, the implied uncertainty (measured as the standard deviation of the reported probability distribution) is nearly four times smaller in the BIE format than in the NZ grid (0.26 vs. 0.94). This pattern suggests that the BIE format can overstate the degree of anchoring of inflation expectations in the sense of Kumar et al. (2015).

To understand the source of these differences across the grids as well as the variables used to measure inflation expectations, we plot the average (across firms) densities for the different formats of survey questions. Chart 5 demonstrates that managers assign much greater probability to outcomes outside the range of the BIE grid. Specifically, when we use the NZ grid, managers give 24 percent probability to inflation being greater than 6 percent which is greater than the mid-point of the top bin of the BIE grid. If we cumulate probability across NZ bins to match the top bin in the BIE grid, managers give nearly 50 percent probability of inflation being greater than 4 percent for the NZ grid and 33 percent for the BIE grid. That is, although there is considerable lumping of responses at the top bin of the BIE grid, this lump is smaller than the cumulative probability managers assign on the NZ grid. This pattern is

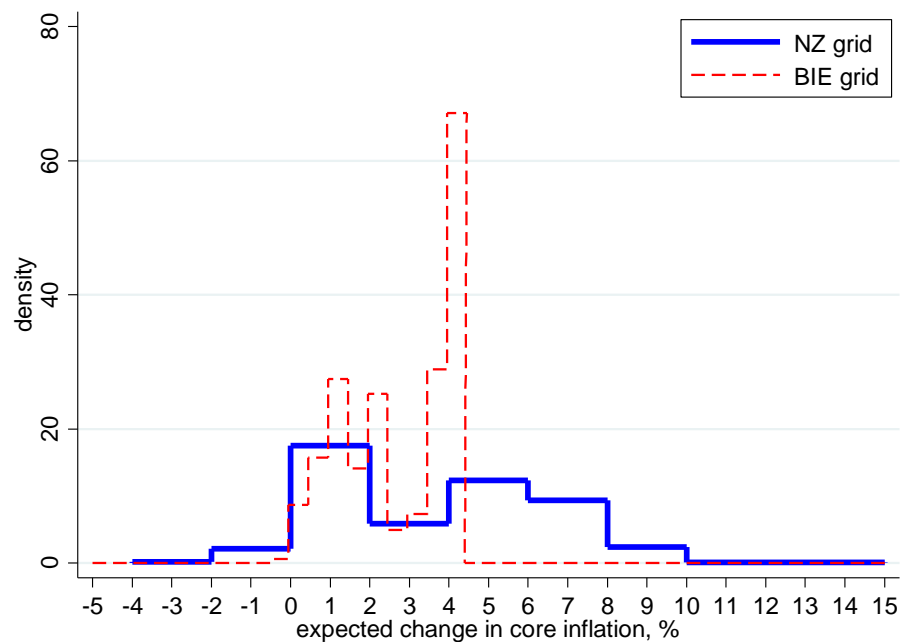
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<sup>19</sup> The wording of the occasional BIE question for core CPI inflation is “Please indicate what probabilities you would attach to the various possible percentage changes to the CORE (excluding food and energy) CONSUMER PRICE INDEX over the next twelve months (values should sum to 100%).” Firms assign probabilities to 10 bins running from “4 percent or more” to “will decline” at 0.5 percentage point increments.

consistent with responses being affected by the menu of options in the BIE survey question and some of the probability mass being shifted toward the centre of the offered menu.<sup>20</sup>

### Chart 5

Effects of Bins on Reported Distributions of Expected Inflation



Notes: The chart report average (across firms) probabilities assigned to expected inflation intervals for different survey designs of the probability distribution questions.

In summary, the distribution of probability questions (or multiple-choice questions for point predictions) should be calibrated to match the distribution of unconstrained point forecasts. If the grid of possible outcomes is constrained or not properly centered, elicited inflation expectations may paint a distorted picture. Specifically, inflation expectations may be less responsive to shocks and may appear more anchored than they actually are.

## 4.5 Designing a Sampling Frame of Managers

A basic question for the design of a survey of price-setters is the sampling frame and the representativeness of the sample of respondents. In household surveys, previous work has documented that expectations differ systematically along different characteristics of individual respondents, such as their age, gender, education, and income. As a result, household surveys aim to create a distribution of respondents

<sup>20</sup> Relatedly, we see that responses on the BIE grid are such that the probability of deflation (in this case only one option: "less than 0%") is almost zero. For the NZ grid, on average probability of deflation is approximately 5 percent. Note that the NZ grid is centered at zero while the BIE grid is centered at 2 percent. As a result, respondents to the BIE grid may be primed to avoid reporting extreme outcomes like deflation.

which is representative along these observable characteristics. With firm managers, it is less clear whether one should want a sample which mimics the population of managers along these same characteristics, or whether one would want a sample which matches the distribution of the characteristics of the firms for which they are employed.

To assess this question, we consider how expectations of manager respondents in the New Zealand survey correlate with both observable characteristics of respondents (age, gender, income, and education) versus the observable characteristics of the firms (age, size, industry, mark-ups, etc.) at which they are employed. We find (Appendix Table A5) that while some of personal characteristics are significantly correlated with respondents' expectations, the predictive power of these characteristics is low ( $R^2 \leq 0.1$ ). In contrast, the explanatory power of firms' variables (along with industry fixed effects) is quite high ( $R^2 \approx 0.8$ ). When we include both firm characteristics and individual characteristics in the regression, much of the explanatory power coming from individual characteristics disappears whereas the firm characteristics continue to have significant predictive power. In other words, there seems to be very little value added in ensuring that respondents mimic the demographic characteristics of managers overall. Instead, a well-designed survey should capture the distribution of firm characteristics among the population of firms in the economy.

## 4.6 How Do Existing Surveys Fare?

These results highlight a few characteristics that well-designed surveys of firms' inflation expectations should exhibit: 1) because firm characteristics matter for expectations, surveys should use stratified random sampling from the universe of firms and have broad coverage of industries and firm sizes, 2) questions on inflation expectations should ask for point forecasts or present a sufficiently broad set of quantitative bins as to characterize the full distribution of beliefs, and 3) questions on inflation expectations should ask about firms' beliefs regarding aggregate inflation, not firm-specific concepts. From the broader literature on survey design, surveys should also have a large number of respondents and should avoid all forms of priming of respondents, e.g. providing them with additional information before asking questions.

How do existing surveys of firms conform to these guidelines? Overall, quite poorly. Table 3 summarizes major surveys of firms' expectations currently available for a range of countries and how they fare along these metrics. Most surveys fail along several dimensions. Many, like the Canadian Conference Board or the Livingston survey in the U.S (now run by the Federal Reserve Bank of Philadelphia), use a sampling frame that is not nationally representative ("convenience sampling"). Many of these same surveys consist almost exclusively of larger firms in the economy, with relatively small cross-sections (50-80 respondents per wave is common). Convenience sampling and relatively small cross-sections also characterize surveys in the Czech Republic, New Zealand, Poland and Sweden. The BIE survey run by the Federal Reserve Bank of Atlanta is limited to the six states that are included in the Sixth District of the Federal Reserve system and does not ask firms explicit questions

about aggregate inflation. The UK survey of firms run by the Confederation of British Industry similarly does not ask firms about their expectations of aggregate inflation and covers only a subset of industries.

**Table 3**  
Properties of Selected Surveys of Firms' Inflation Expectations

Country	Institution	Representative Sample	Heterogenous sample	Monthly or Quarterly Frequency	Large Sample Size (>350)	No Priming	Quantitative Question	Many/wide bins	Distributional question	Aggregate Inflation
Canada	Conference Board of Canada	×	✓	✓	✓	✓	×	✓	×	✓
Canada	Central bank	×	✓	✓	×	×	×	×	×	✓
Czech Republic	Central bank	✓	✓	✓	×	✓	✓	-	×	✓
EU Members	European Commission	✓	✓	✓	✓	✓	×	×	×	✓
Iran	Central Bank	✓	×	×	✓	✓	✓	-	×	✓
Israel	Ungar and Zilberfarb (1993)	✓	×	✓	×	×	✓	-	×	✓
Italy	Central bank	✓	×	✓	✓	×	✓	-	×	✓
Japan	Central bank	✓	✓	✓	✓	✓	×	✓	×	✓
New Zealand	Central bank	×	×	✓	×	✓	✓	-	×	✓
Poland	Central bank	×	✓	✓	×	×	×	×	×	✓
South Africa	Central bank	×	×	✓	✓	✓	✓	-	×	✓
Sweden	Central Bank	×	×	✓	×	✓	✓	-	×	✓
UK	Confederation of British Industry	×	✓	✓	✓	✓	✓	-	×	×
Ukraine	Central bank	✓	✓	✓	✓	✓	×	✓	×	✓
USA	Atlanta Fed	×	×	✓	×	×	×	×	×	×
USA	Livingston, Philadelphia Fed	×	×	×	×	✓	✓	-	×	✓
Uruguay	Central bank	✓	×	✓	×	✓	✓	-	×	✓
Turkey	Central Bank	✓	×	✓	✓	✓	✓	-	×	✓

Notes: Column "Representative sample" indicates whether firms in a survey are representative of the group that is being surveyed. Column "Heterogeneous sample" indicates if a sample of firms covers various types (size, sector, etc.) of firms so that the resulting sample represents or resembles the population of firms in the economy. Column "Large Sample Size" indicates if a survey has more than 350 firms with non-missing responses. Column "No priming" indicates whether a survey does not provide information to firms before eliciting expectations, does not restrict the sample in any particular way (e.g. does not exclude firms that do not understand the concept of inflation), and does not restrict possible responses (e.g. does not present firms with a limited set of possible responses). Column "Quantitative question" indicates if firms are free to report an unrestricted inflation forecast (i.e. responses are not restricted to a binned/range/multiple-choice menu). Column "Many/wide bins" indicates whether a survey allows firms to choose from a wide and detailed range of possible responses if quantitative response are not available. Column "Distributional question" indicates whether a survey elicits a probability distribution for future inflation. Column "Aggregate Inflation" indicates whether a survey asks firms to report an aggregate measure of inflation, changes in prices overall, etc. (rather than firm's unit costs or prices).  
\* last month annual inflation is given to 2/3 of the firms and firms are not allowed to report "extreme" values. \*\* distributional questions are asked in occasional modules.

Another common stumbling block for surveys of firms is "priming" of answers, either by providing respondents with information or using bins that limit the scope of possible answers. The survey of firms run by the Bank of Italy, as described in Section 3.2, provides most firms with information about recent inflation in Italy and the euro area before asking them about inflation. Firms who are provided with this information display much less disagreement and have forecasts that track recent inflation much more closely than firms who are not. The Business Outlook Survey run by the Bank of Canada offers only four options for point predictions of CPI inflation: "less than 1%", "between 1% and 2%", "between 2% and 3%", and "above 3%".

The European Commission reports results of a “harmonized” survey of firms across all members of the European Union. These surveys are run by the national statistical institutes of each member country, but a minimum number of questions were made consistent across countries by the European Commission (EC) and aggregated values of these questions are then provided to the EC by member statistical institutes. Unfortunately, different surveys are used for different industries (e.g. there is one survey for the industrial sector and a different survey for the service sector). In addition, the harmonized survey questions that refer to aggregate inflation are only qualitative in nature (i.e. will prices “go up”, “go down” or “stay the same?”), making them of limited practical use for measuring the level of firms’ inflation expectations.

The Bank of Japan’s “Tankan” survey, which began including questions on aggregate inflation in 2014, covers 10,000 firms on average per wave, making it the largest survey of firms anywhere (Muto, 2015).<sup>21</sup> While the survey asks firms to provide quantitative forecasts of inflation, it gives them the opportunity to respond “I don’t know.” Approximately 20 percent of respondents choose “I don’t know (or have a clear view)” for 1-year ahead inflation forecasts and around 40 percent make that choice for 3-year and 5-year ahead inflation forecasts. The survey of United States firms that we ran in April 2018 similarly gave respondents the option of choosing “I don’t know” and about 55% responded that way. Unfortunately, those who choose “I don’t know” are almost certainly not a random subset from the overall distribution of beliefs, making the resulting mean forecasts a biased representation of actual forecasts of firms. While we cannot quantify the resulting bias at this stage, the high fraction of respondents who select it suggests that this feature should be avoided in future survey designs and instead surveys should nudge respondents to provide e.g. ranges.

To the best of our knowledge, the surveys of firms which best match our desiderata are those in Ukraine and Uruguay. The National Bank of Ukraine runs a survey of around 1,000 firms per quarter (see Coibion and Gorodnichenko, 2015b), selected in a nationally representative way, and these firms are asked well-defined questions about inflation expectations. The central bank of Uruguay also runs a well-designed survey of firms on a quarterly basis. While the cross-section of approximately 300 respondents per wave is somewhat small, it has an extensive panel dimension which can be particularly useful for researchers and has quantitative questions on inflation expectations at different horizons (see Frache and Lluberas, 2017). The fact that no major advanced economy has a survey of firms that compares to those in Ukraine and Uruguay is striking and a major stumbling block to the use of inflation expectations as a policy tool.

## 4.7 Summary and Discussion

Most advanced economies have well-designed representative surveys of households’ inflation expectations. In contrast, most existing surveys of firms’ inflation expectations appear to suffer from fundamental design flaws that call into question the resulting

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<sup>21</sup> The Tankan survey of the Bank of Japan is also exceptional in that it reports an average response rate of 99% (Muto, 2015).

measurements. Whether it be that firms are not asked about aggregate inflation (Atlanta Fed's BIE survey, UK survey), firms are not randomly selected or representative of the broader distribution of firms (e.g. United Kingdom or Sweden), questions about inflation are not quantitative or too restrictive to be informative (e.g. Bank of Canada, European Commission), or any of the other shortcomings described above, few surveys of firms are sufficiently well-designed as to be very informative about the inflation expectations of firms in their respective economies. At a minimum, these limitations in available surveys should give policymakers pause before using them as an explicit guide in policy decisions.

Filling this important measurement gap will require the development of nationally representative firm level surveys by government authorities. Even administratively-run "mandatory" surveys of firms tend to achieve response rates of only 70-80% (see Bloom et al., 2017). Privately administered surveys achieve much lower response rates and still require enormous expenses due to the difficulty of inducing business executives to respond, unlike household surveys. As a result, this gap cannot be filled by academics relying on research grants. Only central banks and statistical agencies have the resources and authority to create the type of large-scale, high-frequency and nationally representative surveys of firms needed to provide high-quality measures of firms' inflation expectations appropriate for policymaking. If Ukraine and Uruguay can create such surveys, we see no reason why major advanced economies cannot do so as well.

## 5 Breaking through the Veil of Inattention

Above and beyond measurement issues, a necessary condition for policymakers to be able to use inflation expectations as a stabilization tool is that economic agents' beliefs respond to the policies and announcements. Indeed, as Blinder (2018) observes, there should be a sender and a receiver for communication to be effective. Since expectations are not directly under the control of policymakers, they should be thought of as indirect instruments that can be moved through the more direct tool of communication strategies. In this section, we review previous experiences with monetary policy announcements and their effects on inflation expectations. Even large monetary policy announcements during and since the Great Recession had little if any discernible impact on households and firms' views about the future. We then provide some suggestions as to how policymakers could revise their communications strategies to more directly and successfully alter the economic expectations of different agents.

### 5.1 Monetary Policy Announcements and Expectations

Monetary policy announcements have effects on financial markets that occur within minutes. Central bankers now often conduct extensive question-and-answer sessions with the media after policy meetings. Forecasters and analysts can be immediately found on the news explaining the potential implications of monetary policy actions.

Does this instantaneous diffusion of news following large policy announcements affect the economic perspectives of households and firms?

In this section, we consider the extent to which consumers, professional forecasters and financial markets in the United States, United Kingdom, and euro area reacted after some important announcements from the monetary authorities during and following the last financial crisis. The objective is to try to evaluate if these announcements had an impact on agents' inflation expectations or other indicators that might indicate that this type of communication has some effect on their behaviour.

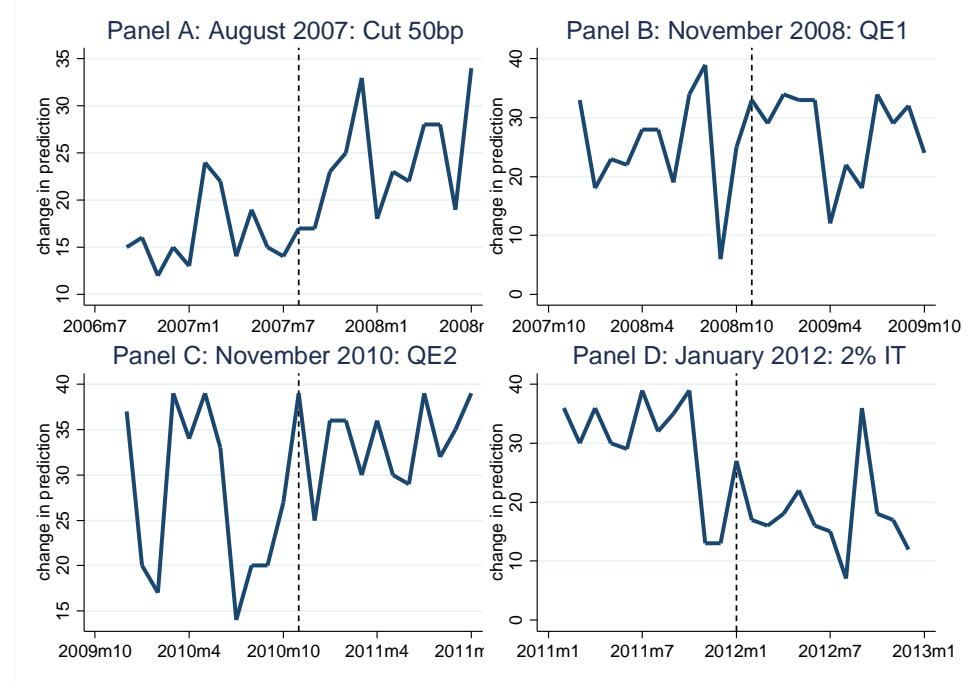
### 5.1.1 The Case of the United States

We focus on four episodes in which the Federal Reserve undertook significant policy actions. The first is the interest rate cut in August 2007. We then consider the announcements of Quantitative Easing (QE) 1 in November 2008 and QE2 in November 2010. Finally, we consider the announcement of the 2% inflation target by the Federal Reserve in January 2012.

We begin with the response of professional forecasters to this news to provide a benchmark for how relatively attentive agents are likely to respond to these policy announcements. Our source of information is the Survey of Professional Forecasters from Bloomberg, in which forecasts can be updated as frequently as daily. We count the monthly changes in predictions from the forecasters to see if they react to this news by changing their analyses. Chart 6 shows the number of changes in the predictions from professional forecasters. We see that in general there is an increase in the number of changes in the prediction of forecasters around these announcements. The changes are particularly striking for QE1, QE2 and the 2% inflation target. This seems to indicate that professional forecasters are reacting to the announcement. In the same spirit, we can assess how financial markets reacted after these changes. We use the TED spread as a measure of credit risk and the 5-year inflation swap to gauge the response of financial market participants. We can use daily data which can better isolate these announcements from other events that might have happened in that period. Chart 7 shows the TED spread and the 5-year inflation swap in a 2-month window around the events. As with professional forecasters, we observe clear reactions in financial markets. 5-year inflation swaps react after these events with QE2 and the inflation targeting announcement yielding particularly large effects. The TED spread shows smaller changes that might be possible considering that these are periods of high uncertainty.

### Chart 6

#### Change in Forecasts in Bloomberg's SPF

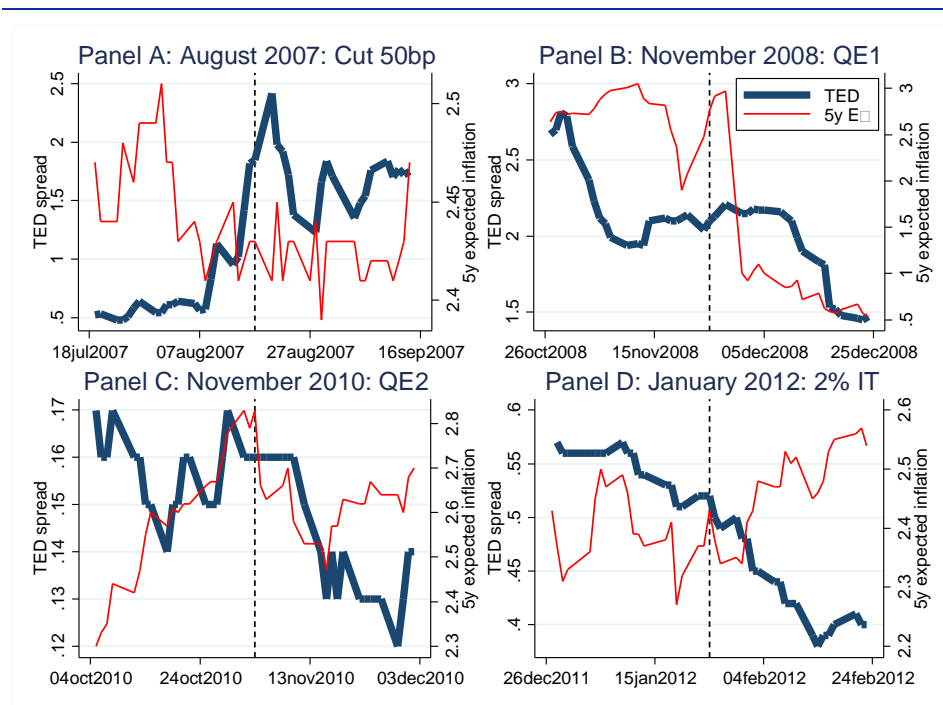


Notes: These charts show the number of changes in predictions made by professional forecasters in a given month according to the survey of professional forecasters conducted by Bloomberg. The vertical lines show relevant events or announcements related to the Federal Reserve. Panel A shows the 50-basis-point cut in the policy rate on August 17, 2007. Panel B shows the announcement of the first quantitative easing policy on November 25, 2008. Panel C shows the announcement of the second quantitative easing policy on November 3, 2010. Finally, Panel D shows the announcement of the 2% inflation target by the Federal Reserve on January 25, 2012.



## Chart 7

### Reaction of Financial Markets to Fed Announcements

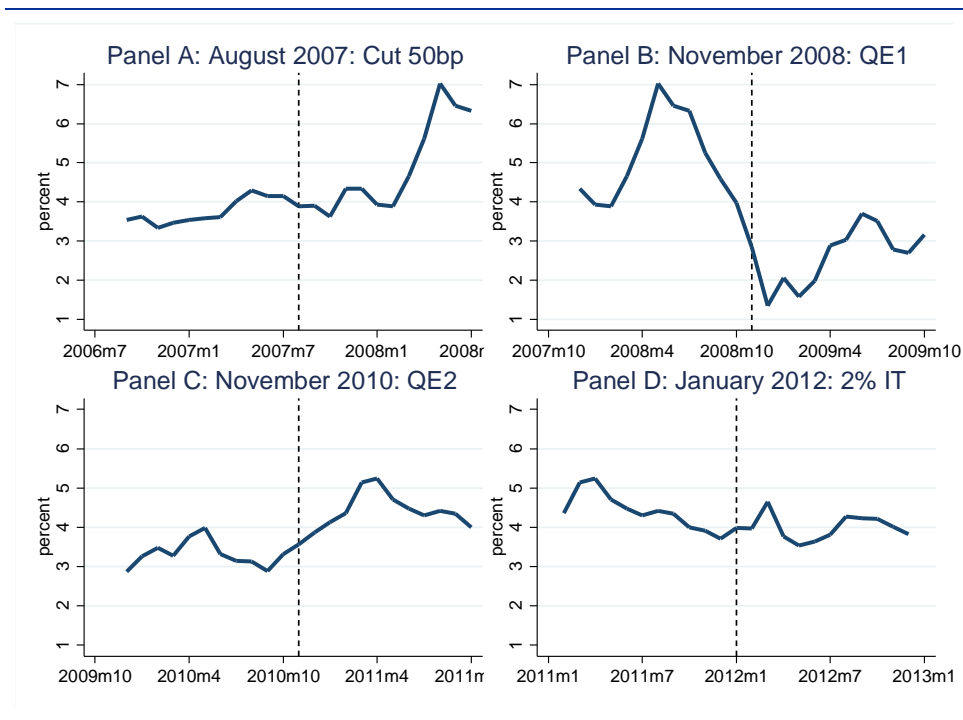


Notes: These charts show the TED spread (black, thick line) and the 5-year forward inflation rate expectation (red, thin line) at a daily frequency. Source: FRED. Panel A shows the 50-basis-point cut in the policy rate on August 17, 2007. Panel B shows the announcement of the first quantitative easing policy on November 25, 2008. Panel C shows the announcement of the second quantitative easing policy on November 3, 2010. Finally, Panel D shows the announcement of the 2% inflation target by the Federal Reserve on January 25, 2012.

The response of the expectations of professional forecasters and financial markets to the inflation targeting announcement is somewhat surprising. As already discussed, these agents are very well-informed when it comes to inflation dynamics and the objective of the central bank, so one might have expected very little effect on their beliefs from the Federal Reserve's formal adoption of a target that had long been already understood in the financial community as an informal target. These movements in expectations therefore represent a lower bound of what we would expect to see for households and firms given how much less informed the latter appear to be when it comes to inflation and monetary policy.

To evaluate consumers' reaction, we use the Survey of Consumers (MSC) conducted by the University of Michigan. Looking at the average response of households in the MSC in Chart 8, we find little visible response to any of the announcements. Binder (2017) similarly notes that household inflation expectations in the United States did not appear to respond in a meaningful way to the Federal Reserve's announcement of an inflation target. Consistent with the general inattention paid by households to inflation in general, this suggests that even the adoption of a formal inflation target on the part of the Federal Reserve did not feed into household inflation expectations and they appear to be, at least in the current environment, largely invariant to monetary policy announcements and decisions.

**Chart 8**  
Inflation Expectations in MSC

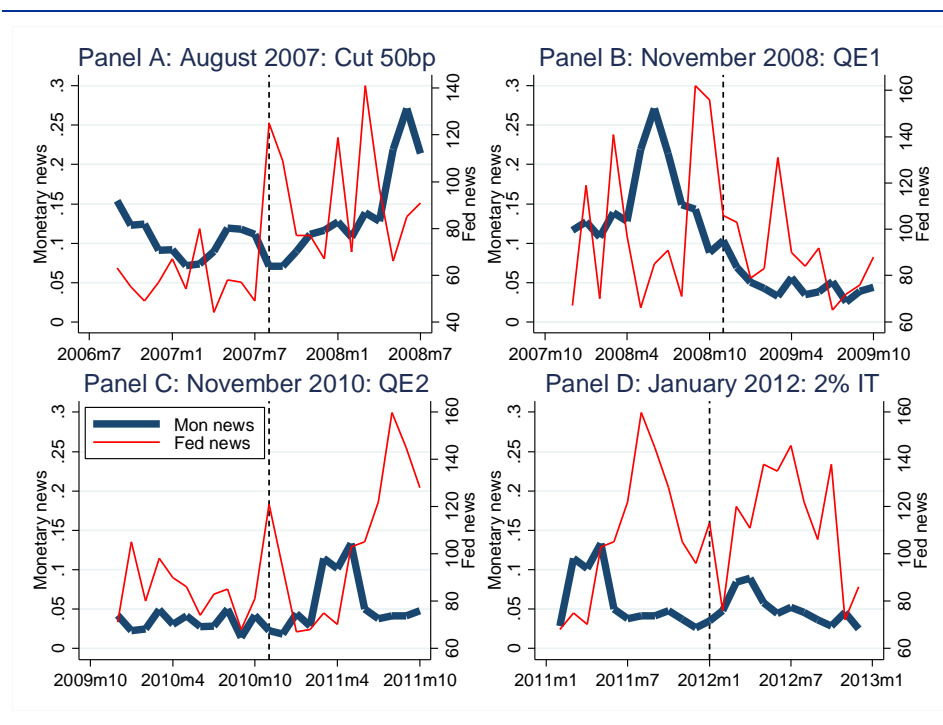


Notes: These charts plot the weighted average for the inflation expectation of consumers in the Michigan Survey of Consumers. Panel A shows the 50-basis-point cut in the policy rate on August 17, 2007. Panel B shows the announcement of the first quantitative easing policy on November 25, 2008. Panel C shows the announcement of the second quantitative easing policy on November 3, 2010. Finally, Panel D shows the announcement of the 2% inflation target by the Federal Reserve on January 25, 2012.

To assess how such inattention to what should be large and visible economic announcements can occur, we consider responses to the following question in the MSC: “During the last few months, have you heard of any favorable or unfavorable changes in business conditions?” We use this question to evaluate how consumers are receiving information about different types of policies. Answers are separated by the type of news. We focus on monetary news to see if announcements are reaching households. To quantify the exposure of these announcements, we use a measure of how the media covered these events. This measure is constructed by counting all the news articles that have the phrase “Federal Reserve” in the New York Times (“Fed news”). We have monthly data for both measures. Chart 9 plots time series of monetary news and Fed news for a 13-month window around the announcements. We can see that these big announcements seem to have been covered by the media (or at least the New York Times), as we see a reaction of the amount of news related to the Federal Reserve. Despite this upsurge of news reports, we see little reaction in terms of households reporting receiving more information about monetary policy. The percentage of households who heard about monetary news changes little and in some cases we even see declines around the main event. Jointly, this indicates that the increased news coverage in major news media sources is either not seen by most households or ignored by them when they read the news.

**Chart 9**

**News Heard by People in MSC and Media Coverage of the Fed**



Notes: The black, thick line shows the share of consumers that say that have heard an economic news story related to monetary policy in the Michigan Survey of Consumers. The red, thin line shows the amount of news articles in a month in the New York Times that contained "Federal Reserve" according to Lexis-Nexis. Panel A shows the 50-basis-point cut in the policy rate on August 17, 2007. Panel B shows the announcement of the first quantitative easing policy on November 25, 2008. Panel C shows the announcement of the second quantitative easing policy on November 3, 2010. Finally, Panel D shows the announcement of the 2% inflation target by the Federal Reserve on January 25, 2012.

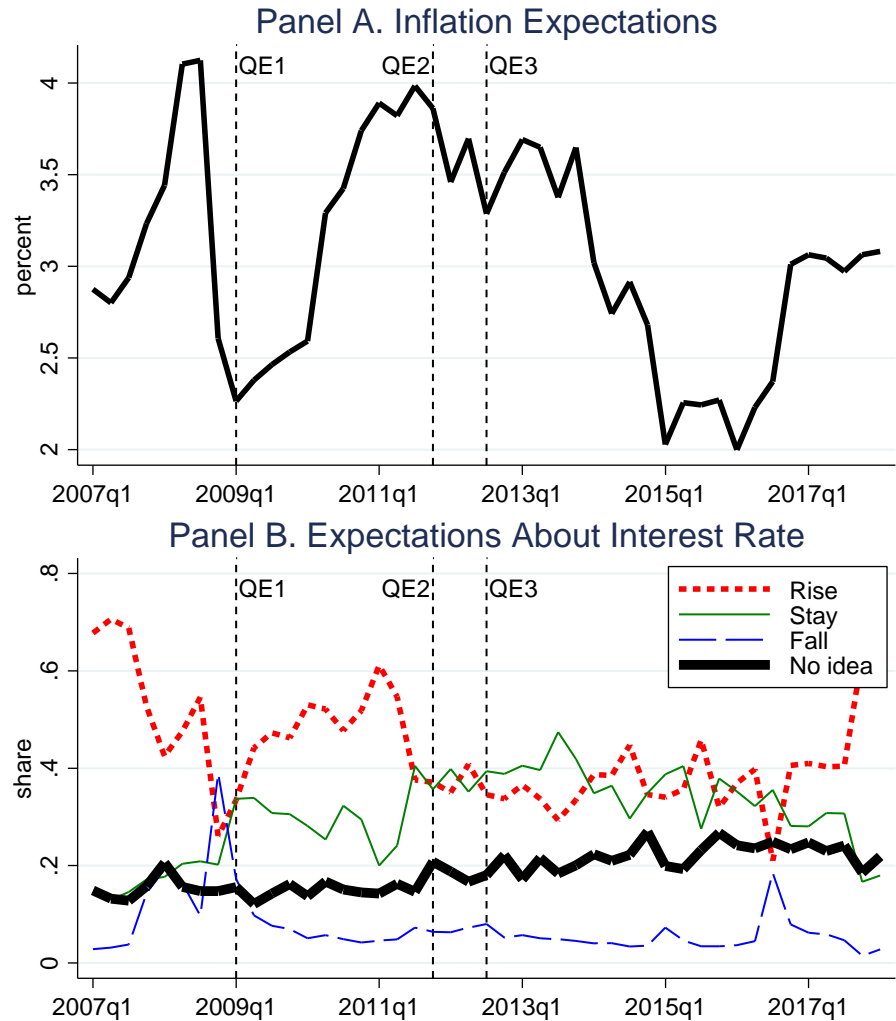
### 5.1.2 The Case of the United Kingdom

Like in the United States, there were a number of notable policy announcements made by the Bank of England following the financial crisis. We focus on the following three: Quantitative Easing in March 2009 (QE1), October 2011 (QE2) and July 2012 (QE3). We use the Bank of England's Survey on Consumer Expectations, a quarterly survey conducted by the Bank of England since 2001 of a representative group of consumers aged 16 years or older. This survey not only includes questions about inflation expectations but also asks respondents about their opinions regarding the work of the Bank of England.

As illustrated in Panel A of Chart 10, there is little indication that inflation expectations rose sharply around the time of these events, much as was the case in the United States. When we examine the evolution of consumers' expectations about the interest rate (Panel B), we also see that there are no changes around the announcements. Between the second quarter of 2009 and 2010, the survey included another question asking respondents whether they had heard about quantitative easing policies. Following the announcement of QE1, we find that the proportion of consumers that declare that they have no idea about the evolution of interest rates remains constant or increases. About 50% of the respondents stated that they have not heard at all about that policy. Less than 20% said that they have heard a lot about it. This shows that

even if this was an exceptional policy, UK consumers seemed to be largely unaware of it.

**Chart 10**  
United Kingdom Case



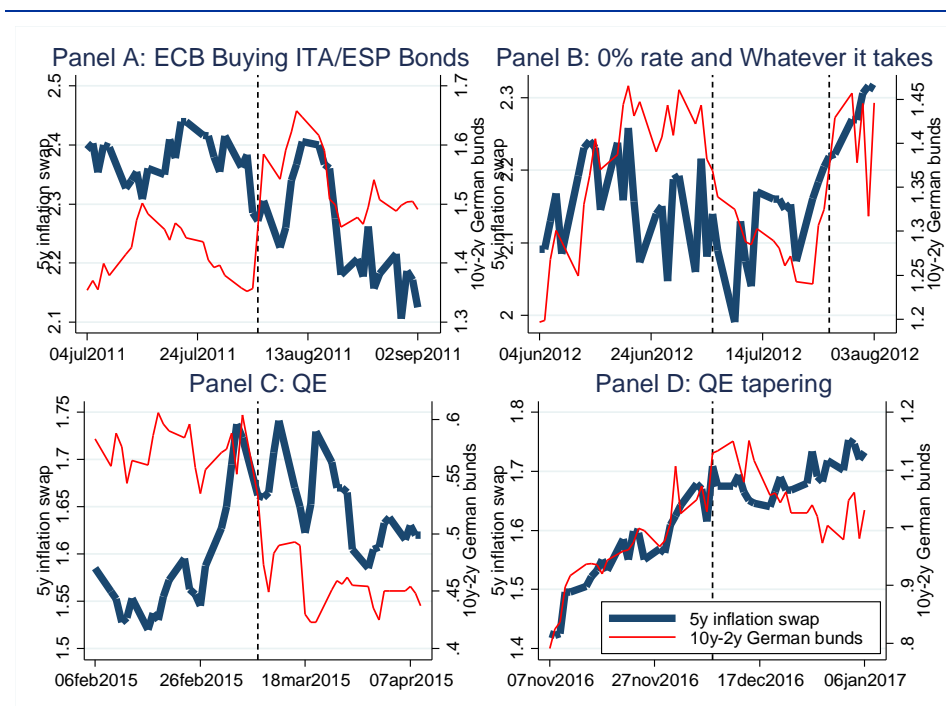
Notes: Panel A shows the weighted average of inflation expectations in the Bank of England/TNS Inflation Attitudes Survey. As respondents have to answer in bins, we take the middle point for each middle bin. For the bin "Go Down" we impute a value of -1 and for "Go up by 5% or more" we impute 6%. Panel B shows the results of the question regarding the expectations of interest rates of respondents in the same Survey. "Rise" adds the ratio of respondents that answer "Rise a lot" or "Rise a little", "Stay" corresponds to the answer "Stay about the same", "Fall" aggrups the answers "Fall a little" and "Fall a lot" and "No Idea" is the ratio of respondents that answers that. QE1 corresponds to the first quantitative easing (QE) policy conducted by the Bank of England in March 2009. QE2 is May 2012 and QE3 is in November 2012.

### 5.1.3 The Case of the Eurozone

Finally, we explore what happened with big ECB policy announcements, focusing on four specific episodes: the purchasing of Spanish and Italian bonds (August 9, 2011), 0% interest rate and "whatever it takes" (July 26, 2012), Quantitative Easing (March 9, 2015), and QE tapering (December 8, 2016). Turning first to financial market responses, we examine how the 5 years inflation swap and the difference between the

10-year and 2-year German bund reacted around these announcements. We use daily data and a two-month window as in the United States. For these variables we see some reactions around the day of these announcements (see Chart 11). In the case of the 5 years inflation swap we see moderate changes the day of the events, especially the day of the announcement of the 0% interest rate. In the case of the German bund spread we see bigger changes around the events, with direction that depends on the type of the news.

**Chart 11**  
Financial Markets and ECB Policy Announcements

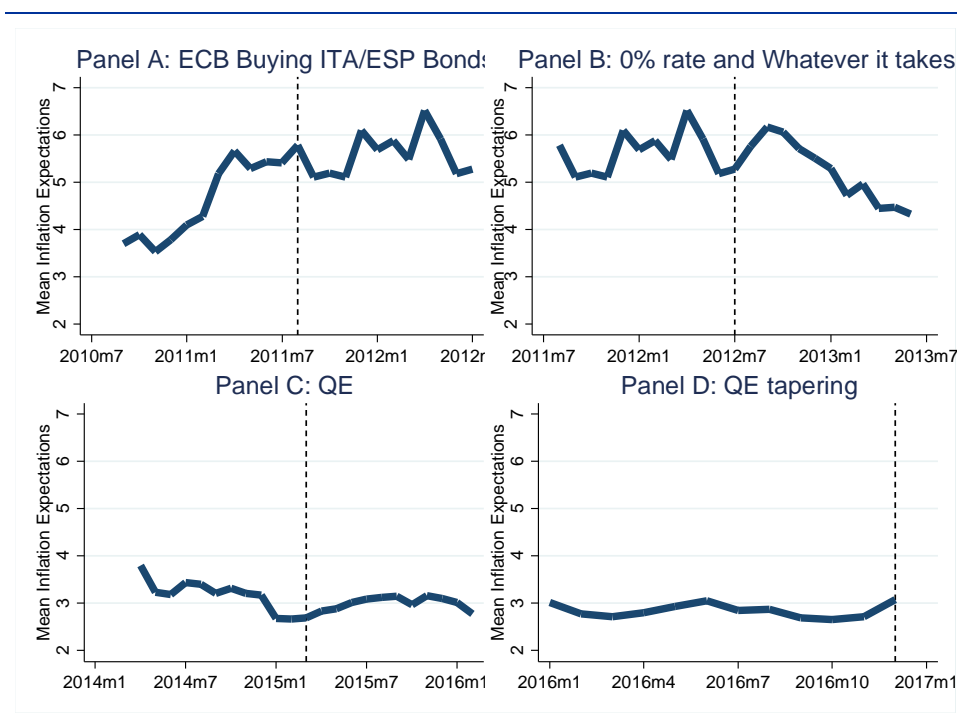


Notes: This panel shows the 5-years inflation swap and the difference between the 10-year German bund and 2-year German bund at a daily frequency. All data are from Bloomberg. Panel A shows the movements around the purchasing of Spanish and Italian bonds on August 9, 2011. Panel B shows the movements around when the ECB set the policy interest rate at 0% on July 5, 2012 and when ECB president Mario Draghi announced that the ECB was prepared to do "whatever it takes" to preserve the euro on July 26, 2012. Panel C plots the movements around the quantitative easing policy conducted by the ECB on March 9, 2015 and Panel D plots around the announcement of the quantitative easing tapering on December 8, 2016.

On the other hand, households' inflation expectations appear to be rather insensitive to the announcements (see Chart 12). For example, the ECB's announcement of its quantitative easing program in March 2015 had no discernible effect on mean one-year-ahead inflation expectations of eurozone consumers, which is similar to the behaviour of US consumers in response to the QE announcement by the Federal Reserve.

**Chart 12**

Households' Inflation Expectations and ECB Policy Announcements

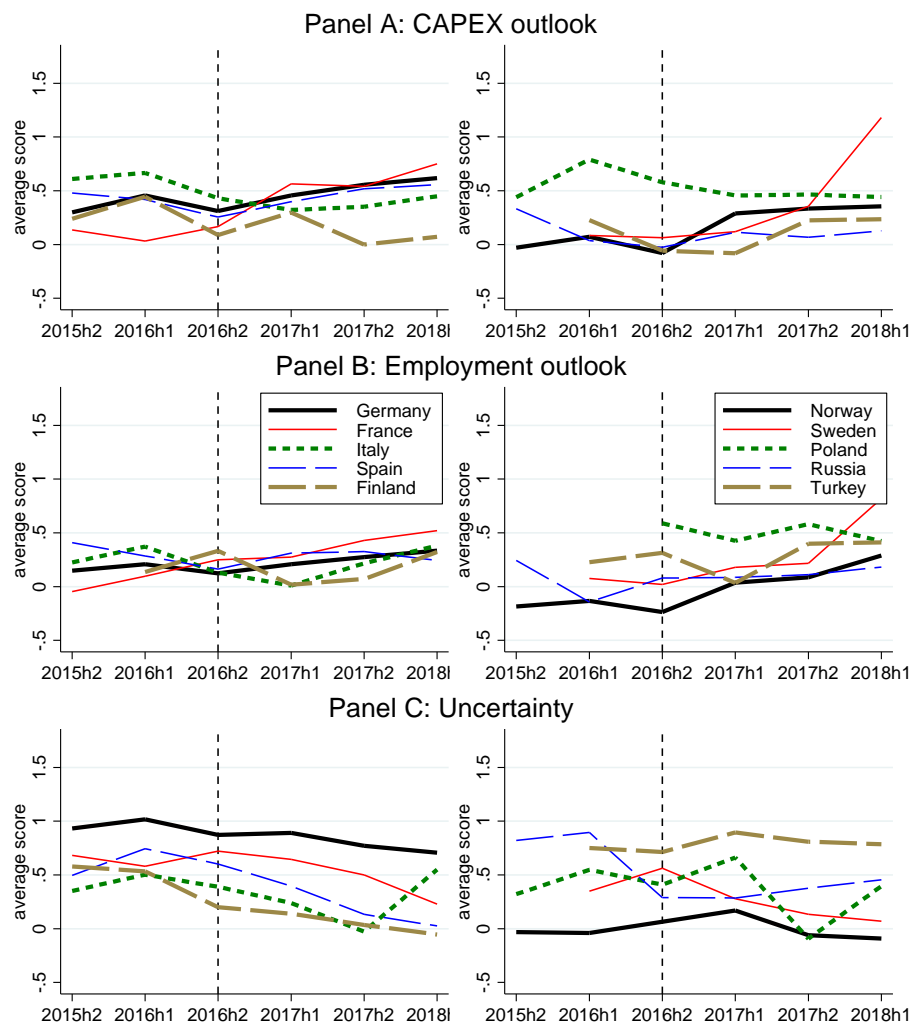


Notes: This chart shows the mean one-year-ahead inflation expectation in the eurozone according to Duca et al (2017). Panel A shows the movements around the purchasing of Spanish and Italian bonds on August 9, 2011. Panel B shows movements around when the ECB set the policy interest rate at 0% on July 5, 2012 and when President Mario Draghi announced that the ECB was prepared to do "whatever it takes" to preserve the euro on July 26, 2012. Panel C plots the movements around the quantitative easing policy conducted by the ECB on March 9, 2015. Panel D plots the movements around the announcement of the quantitative easing tapering on December 8, 2016.

While we do not have access to time-series data on inflation expectations of US firms, we use a unique survey of firms run by Deloitte to study the evolution of firms' expectations in Europe. This survey of Chief Financial Officers (CFOs) across countries in Europe (both within the eurozone and outside of it) begins in 2015S2 and continues on a semi-annual basis thereafter. This time period includes the QE Tapering announcement which had a discernible effect on financial markets. The Deloitte Survey does not inquire as to CFOs' inflation expectations, but it does ask about their expected capital expenditures and employment over the following twelve months as well as how uncertain they are about the economic outlook. As a result, we can assess whether this announcement had any effect on CFOs' other economic expectations. We report mean responses for countries in the euro area for which we have access to the Deloitte Survey (Germany, France, Italy, Spain, and Finland) and selected non-euro countries (Turkey, Poland, Russia, Sweden, and Norway) for comparison. There is little discernible pattern around the time of the announcements (see Chart 13). For most economic variables, firms do not seem to become significantly more optimistic or pessimistic than those outside the eurozone. There is a non-trivial decline in optimism about future capital expenditures, but a similar albeit smaller decline also takes place in non-euro countries, making it difficult to argue that the effect stems primarily from the policy announcement.

**Chart 13**

Expectations of Chief Financial Officers and ECB Policy Announcements



Notes: These charts show the simple country average in the Deloitte Survey of Chief Financial Officers (CFOs) around the announcement of the QE tapering in December 2016. Panel A shows the result to the question that asks about the evolution of CAPEX of the company in the next 12 months. The lines indicate the average score where if they answer "Decrease significantly" we computed -2, if CFOs answer "Decrease somewhat" -1, 0 for "No change", 1 if the answer is "Increase somewhat" and 2 if the CFOs answer "Increase significantly". Panel B shows the average score for a similar question about the number of employees. The coding of scores is the same. Finally, Panel C plots the answer for the question where CFOs were asked to rate the overall level of uncertainty that the firm is facing. It takes on -2 if the answer is "Very low level of uncertainty", -1 for "Low level...", 0 for "Normal level...", 1 for "High level..." and 2 for "Very high level of uncertainty".

In short, across geographic areas, we find little evidence that households and firms respond strongly to monetary policy announcements, even when these receive pronounced coverage in the main media outlets. These results are notably different from what has been previously documented for fiscal policies. D'Acunto et al. (2016), for example, find that an announcement related to increases in value added taxes in Germany had a strong effect on consumers' inflation expectations and on their spending decisions. Similarly, Kueng (2016) finds that spending of high-income households increases strongly in response to announcements that raise their expected after-tax lifetime permanent income in the United States.

## 5.2 Policy Solutions to Break the Veil of Inattention

Given this apparent inattention paid to inflation and monetary policy by households and firms in advanced economies that have experienced low inflation for decades, how can policymakers possibly affect their expectations in order to achieve more stable economic outcomes? Fortunately, a growing literature on the effects of information on agents' beliefs provides a basis for new communication strategies for policymakers.

### 5.2.1 Communication to the Public Can Work

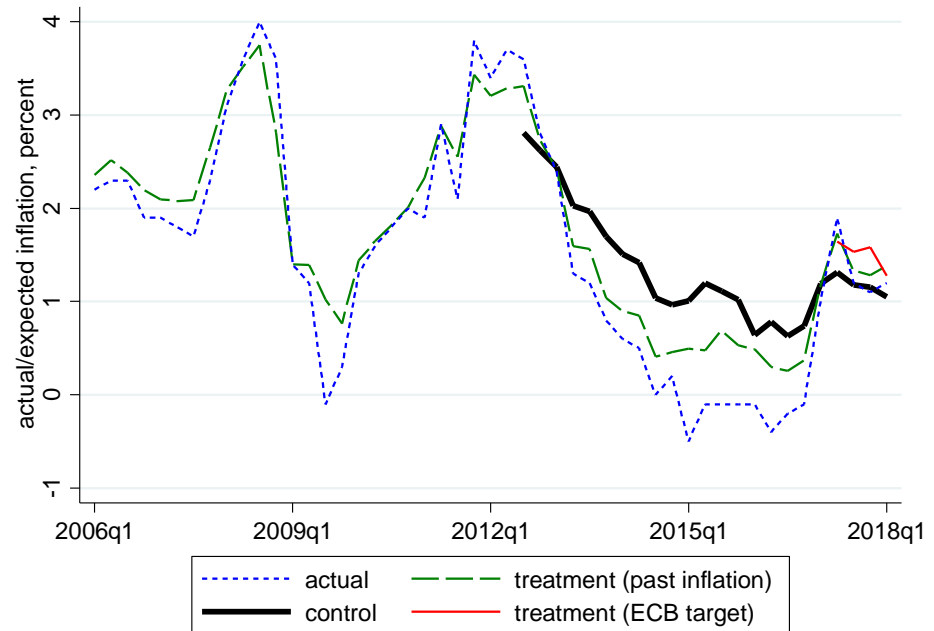
While the veil of inattention may give the appearance that policymakers will never be able to affect agents' expectations sufficiently to affect their economic decisions, recent experimental evidence suggests otherwise. Specifically, a number of recent papers use information treatments to households and firms and find that these treatments have large and immediate effects on agents' inflation expectations. For example, Armantier et al. (2016) use randomized control trials to provide information about professionals' inflation forecasts to households and find that, relative to a control group that received no such treatment, their inflation forecasts respond strongly to the information and in the expected direction. This effect is particularly strong for households whose beliefs are initially further from the mean and who are more uncertain about inflation. Binder and Rodrigue (2017) find a similar result in a separate experiment providing information about recent inflation or about the central bank's inflation target to households.

This strong response of inflation expectations to information treatments is not limited to households. CGK document a similar finding for firms in New Zealand: providing managers with information about inflation or monetary policy can lead to large changes in the inflation forecasts of managers, especially those who are most uninformed. The strength of this effect can also be seen in the unique experiment provided by the Bank of Italy's randomized provision of information about recent inflation to Italian firms. As described in Section 3.2, starting in 2012Q3, some firms in this survey were asked about inflation without being provided any additional information whereas other firms in the survey were first told about recent inflation values. As can be seen in Chart 14, this provision of information to agents led to large deviations in inflation expectations across the two groups of firms depending on recent inflation dynamics in Italy, with treated firms having expectations that tracked inflation much more closely as well as displaying much less disagreement amongst themselves about the path of future inflation. Another experiment in this spirit is described in Frache and Lluberas (2017). They document that Uruguayan firms have to obtain information about recent inflation when renegotiating wages at fixed times during the year. They find that when firms undergo this information treatment, their forecasts of inflation improve significantly relative to firms that do not have to acquire information about inflation that month.



**Chart 14**

**Effects of Bins on Reported Distributions of Expected Inflation**



Notes: The blue, dashed line shows the actual inflation rate in Italy. The thick, black, solid line shows one-year-ahead inflation expectations of firms in the control group. The long-dash, green line shows inflation expectations of the firms treated with recent inflation statistics (that is, firms are told recent inflation rate before firms are asked to report their inflation expectations). The thin, red line shows inflation expectations of the firms treated with the ECB's inflation target (that is, firms are told the ECB inflation target before firms are asked to report their inflation expectations). Source: Coibion, Gorodnichenko and Ropele (2018).

### 5.2.2 Simple Messages Are Better

How strongly agents respond to new information depends on the nature of the information provided to them, the source of that information, and how much they already know. As a result, we should expect some forms of information treatment to be more powerful than others, which is precisely what this line of research has documented. For example, Armantier et al. (2016) find that providing households with information about professionals' forecasts of inflation (which they generally don't know or observe) has larger effects on their inflation expectations than providing them information about food inflation (which they are generally more confident about). Binder and Rodrigue (2017) find that effects on households' beliefs when providing information about recent inflation or the Federal Reserve's inflation target are approximately the same. CGK find similar effects on inflation expectations when treating firms with information about the central bank's inflation target, recent inflation dynamics or the forecasts of professional forecasters. However, providing participants with information about the forecasts of other firms has much smaller effects on their beliefs, consistent with them viewing these as providing less reliable information. CGR find that Italian firms which receive information about recent inflation respond approximately as much to this information as firms which are told about the ECB's inflation target.

If agents' beliefs are so sensitive to information about recent inflation and the inflation target in experiments, why don't central bankers' policy announcements have more discernible effects on the expectations of households and firms, as documented in Section 5.1? One reason is that these agents may not be exposed to this news, a possibility to which we return below. But it could also be the case that the way in which the news is presented to them is not comprehensible to them. To assess this possibility, Coibion, Gorodnichenko and Weber (2018) provide different information treatments to US households, including not just simple statements about recent inflation or the central bank's target (as done in previous work), but also by providing randomized subsets of households with either the FOMC statements or *USA Today's* news coverage of the FOMC announcements or FOMC forecasts. They find that providing households with FOMC statements has no statistically significant marginal effect on agents' beliefs relative to simply telling them about recent inflation dynamics (see Table 4). This is consistent with Hernandez-Murillo and Shell (2014) showing that statements by the FOMC have become increasingly difficult to understand over time and now require a Ph.D. to fully understand.<sup>22</sup> Reading news coverage of FOMC decisions has an even smaller effect on households' inflation forecasts than reading FOMC statements. This suggests that policymakers cannot rely on news media to make their policy decisions and announcements sufficiently clear for the general population to process. Simply providing FOMC forecasts is as powerful as giving recent inflation figures. The current "Fed-speak" approach is not a particularly successful communication strategy with respect to the general public.

At the same time, Table 4 illustrates the potential power of a layered communication strategy that successfully reaches households. Providing information to these agents about recent inflation or the central bank's inflation target moves average inflation expectations (and therefore perceived real interest rates) by around 2 percentage points on average. In contrast, estimates of the effects of quantitative easing and forward guidance point to effects on long-term interest rates of around 50 basis points (e.g. Chodorow-Reich, 2014). The effect of communication treatment on perceived real interest rates is therefore an order of magnitude larger than the types of policies currently used at the ZLB.

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<sup>22</sup> Bulir, Jansen and Cihak (2012) document that other central banks tend to have equally complex communication.

**Table 4**  
Treatment Effects

Dependent variable: revision of one-year-ahead inflation forecast	
Control group	1.350*** (0.233)
<b>Treatment groups (coefficients are relative to control)</b>	
Irrelevant 2% figure	0.265 (0.343)
Past inflation	-1.954*** (0.366)
Inflation target	-1.411*** (0.341)
FOMC inflation forecast	-2.004*** (0.384)
FOMC statement	-2.272*** (0.335)
USA Today coverage of FOMC statement	-0.950** (0.397)
Observations	1,484
R-squared	0.049

Notes: The table reports estimated effects of providing information (indicated in the left column) to households participating in the AC Nielsen Homescan panel. For treatment "Irrelevant 2% figure", households are informed that population in the United States grew 2% over the last three years. The dependent variable is equal to (post-treatment one-year-ahead inflation expectations) minus (pre-treatment one-year-ahead inflation expectations). Pre-treatment expectations are computed as the implied mean of expected inflation distribution over the next year. Post-treatment expectations are elicited as point forecasts. Source: Coibion, Gorodnichenko and Weber (2018). Robust standard errors are reported in parentheses.  
\*\*\*, \*\*, \* indicate statistical significance at 1, 5 and 10 percent levels.

A successful communication strategy that aims to affect the expectations of firms and households should therefore consist of much more accessible messages.<sup>23</sup>

Multi-layered presentation (that is, presentation of the same material in a sequence of messages with different levels of complexity) of a central bank's policies may be a more effective way to reach the public as is shown in randomized control trials (Haldane and McMahon, 2018).

### 5.2.3 Target the Message to the Scenario

In a communication campaign, a central bank has a choice over which message to share with the public. For example, with forward guidance policies, policymakers first make a choice over whether or not to engage in such a policy at different times. They then choose whether to engage in a time-dependent or state-dependent approach.

<sup>23</sup> For comparison, Mervyn King (2007) delivers a representative central banker's view of communications: "Explaining our analysis at some length is a richer source of information for markets than code words or statements about the future path of interest rates. Less weight should be placed on the short statements that are published with the announcements of our decisions because such statements, as we have seen elsewhere, run the risk of becoming monetary policy by code word. They do not help markets understand how we are likely to react to future data." Our results suggest that, when it comes to firms and households rather than financial markets, monetary policy by "code word" may be a much more successful strategy. More elaborate messages, however, can help with a more positive coverage of policy decisions by the media (Berger, Ehrmann and Fratzscher, 2011).

With the former, they face a choice of an expected duration to announce while under the latter they must decide on what state-contingencies to announce. With a layered communication strategy targeting the inflation expectations of households and firms, policymakers would similarly have flexibility over the intensity of the communication campaign as well as the nature of the communication. The growing empirical evidence on how households and firms react to information treatments strongly supports the notion that they respond in a Bayesian manner, i.e. forming new beliefs that depend both on their original belief and the signal they receive. Hence, policymakers can push inflation beliefs either up or down depending on which information they choose to provide. Clearly no policy institution will want to release information that is factually incorrect, but there are different facts that they can choose to emphasize.

To illustrate this point, consider the case of Italy in 2014. Inflation was running below 1% and expectations of firms were around 1.5%. Giving firms information about recent inflation tended to lower their inflation expectations, as is evident from the difference in beliefs between firms that were told this information and firms that were not (see Chart 13). But giving them information about the ECB's inflation target of just below 2% would have tended to raise them. By choosing which information to stress, policymakers can therefore guide expectations in a direction that helps stabilize economic outcomes. Because economic conditions change over time, the message will likely need to change as well.

#### 5.2.4 Repeat the Message

Another lesson from the recent literature using experimental treatments is that the effect of information on households' and firms' beliefs is short-lived. For example, CGK perform an experiment in which firm managers were provided with information about the Reserve Bank of New Zealand's inflation target. As discussed above, this information had a large and immediate effect on the reported inflation forecasts of relatively uninformed managers. However, when these were surveyed again six months later, the beliefs of the treated group were not meaningfully different than those of the control group who did not receive the information. The effect of the information treatment on beliefs had fully dissipated within six months.

Other work has found similar transitory effects of information treatments. For example, CGR use the fact that information treatments to Italian firms vary over time with the level of inflation to assess how long-lived the effects of each information treatment are. They find that while the contemporaneous effects on inflation expectations are large, these fade quickly and appear to have dissipated after around six months, similar to the finding in CGK. Frache and Lluberas (2017) similarly find large forecast revisions each time firms in Uruguay are forced to renegotiate wages and acquire information about inflation. Since this happens every six months on average, this again implies that information treatments on firms have only short-lived effects. Cavallo et al. (2017) also report that the effects of informational treatment for consumers dissipate within six months.

The transitory nature of information treatments on inflation expectations of firms and households implies that policymakers need to pursue a repeated set of announcements when they seek to affect these agents' expectations in a persistent manner. One-time announcements may have immediate and long-lived effects on the expectations of professional forecasters and financial market participants; they have no such effects on other agents' expectations. Policymakers should therefore consider pursuing systematic communication campaigns that repeatedly target the relevant audience when that audience involves firms or households.

### 5.2.5 Take the Message Directly to the Target Audience

In an early contribution, Berger, Ehrmann and Fratzscher (2011) asked, "The commercial success of a private firm crucially depends on its ability to reach its customers and to convey a favorable image of its products and corporate identity – but does the same apply to policy institutions?" After studying media coverage of the ECB's decisions, their answer is a conditional yes with the effectiveness of policy communication being potentially clouded by the media. Indeed, the weak responses of household and firm expectations to significant monetary policy announcements documented in Section 5.1 indicates that relying on traditional media channels to diffuse policy messages is unreliable. First, the media tends to disproportionately cover negative news (Hamilton 2004). Second, many households do not follow standard news outlets. Third, even when they are exposed to media articles on monetary policy, households do not respond strongly to their news content compared to simpler messages, as shown in Table 4. Having a significant impact on the inflation expectations of these agents will therefore require more targeted "marketing" strategies.

There is an extensive history of policymaking institutions developing messages meant to shape the general public's opinion that can help serve as a guide. Public health messages have long advertised the dangers of certain behaviours through aggressive advertising campaigns in magazines, billboards and television. Each year, there are seasonal campaigns to induce people to take the flu shot or, in the case of the United States, to induce people to sign up for health care during "open season". Campaigns like these are not limited to health issues however. For example, following the passage of the 2001 Bush tax cuts, the Internal Revenue Service sent letters to American taxpayers letting them know they would be receiving a check in the mail as a result of the policy and that this check was not considered taxable income. The introduction of the euro to the public was similarly preceded by an extensive publicity campaign by the ECB.

The growth of social media can facilitate this targeted approach. Much like corporate advertising and political messages are now targeted to well-defined audiences that are likely to respond to the information, central banks could pursue ad-based communication strategies that focus on specific groups. Such an approach would avoid working through the news media, which much of the population does not follow closely or does not treat as very informative, as illustrated in Table 4. Ads with clear

narratives could break through this intermediation flow and allow the central bank to directly reach new audiences.<sup>24</sup>

Targeted messages that reach the relevant audience can also help reduce regional disparities in economic activity in a way that aggregate policy actions (like interest rate changes) cannot. This can therefore help mitigate one of the major limitations of common currency areas, namely the inability to “tailor” policy to local conditions. Consider for example the hypothetical case of a currency bloc with one region that is booming (call it the North) and one that is in recession (call it the South), such that aggregate interest rate changes cannot simultaneously stabilize both regions. A campaign that raises inflation expectations in the South but lowers them in the North via targeted messages to each can thereby lower real interest rates in the former while raising them in the latter.

## 6 Conclusion

The onset of the zero-bound on interest rates generated a need for new monetary policy strategies. One such commonly discussed approach is a more active management of inflation expectations. If policymakers can alter agents’ inflation expectations, then perceived real interest rates can be altered even in the absence of changes in nominal interest rates, presumably leading to changes in consumption and investment decisions. Furthermore, shaping inflation expectations of price-setters can have a direct effect on price changes, thus providing another channel to control inflation. Our reading of recent evidence makes us cautiously optimistic about the future of this policy option, although it is not yet ready for full deployment. There is now robust evidence on the causal effect of inflation expectations on the decisions of households and firms, which suggests that this tool has potential. However, we note several caveats. First, the specific mechanisms linking inflation expectations and economic decisions are not yet clearly identified, which we view as a call to academics for continuing this burgeoning research agenda. Second, we lack high-quality surveys of firms’ expectations, which we similarly view as a call for statistical agencies to develop and field new nationally representative surveys of firms. Third, in low-inflation environments, central banks face the inattention of households and firms to monetary policy announcements, which calls for new communications strategies on the part of central banks.

The current era of low interest rates combined with a possible recession in the coming years suggests that the need for non-traditional monetary policies is likely to grow. Limited fiscal space resulting from the last recession will make the issue of having a

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<sup>24</sup> In a recent speech, Haldane (2017) emphasizes the importance of narratives: “[W]hen it comes to assessing the impact of central bank actions on the trust and understanding of the public, little if any attention has been paid to some of the richer informational channels through which news might spread between people. For example, the recent work of George Akerlof and Robert Shiller has emphasized the role of “popular narratives” in shaping the public’s expectations and decisions. Story-telling is the ultimate communications device. History is no more than a sequence of stories. These stories spread word by word, mail by mail, Tweet by Tweet. They obey the same laws of motion as epidemics, with viral spread beyond a tipping point. And in a world of modern media, these popular narrative epidemics are probably spreading further and faster than ever previously. This matters for individuals’ feelings and decisions and, potentially, for macro-economic behavior.”

wide range of non-traditional monetary tools even more pressing, both because fiscal stimuli are unlikely to be forthcoming and growing debt levels are likely to raise new concerns about the solvency of some national governments. Pursuing new research on expectations, fielding new surveys and developing innovative communications strategies are steps that we can take now in anticipation of future challenges to monetary policy.

But the management of expectations by policymakers has scope that extends well beyond getting around the zero-bound constraint on interest rates. Because communication can be targeted to different regions, different industries and different groups, this policy tool can in principle be used to affect economic activity in a much more precise and targeted manner than the bludgeon of nominal interest changes. While central banks have long focused on financial markets and how monetary policy actions affect and pass through the financial system, expectations management represents a policy tool to precisely and directly affect consumers and firms while side-stepping the financial system. While this is unlikely to be a panacea for all of our economic woes, the development of such a tool could be exceptionally useful for economic stabilization, especially when fiscal policymakers are missing in action.

Finally, improved and layered communication strategies would ultimately enhance the credibility of central banks and help protect their independence. It is short-sighted to believe that simply being successful in keeping inflation low and stable is sufficient to ensure that the central bank is credible and its independence insured. If most economic agents are unaware of the central bank's success, then how can it be viewed as having credibility? Yet the irony of the Lucas critique is that successfully generating a low-inflation environment reduces the incentives of agents to track inflation. As they optimally choose to become more inattentive to aggregate inflation dynamics, the central bank will generally can be viewed as less credible over time, not more. A layered communication strategy that directly targets the beliefs of households and firms can therefore serve not only to enhance economic stability but also to sustain the credibility of the central bank and thereby help protect its independence.

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## Appendix

**Table A1**

Point Estimate vs. Mean Implied by the Probability Distribution

	Wave 6			Wave 7		
	(1)	(2)	(3)	(4)	(5)	(6)
	Mean	Median	St.dev.	Mean	Median	St.dev.
Mean forecast implied by the distribution $\bar{F}_{it}\pi_{t+1}$	2.59	1.40	2.48	2.65	1.20	2.69
Point forecast, $F_{it}\pi_{t+1}$	2.75	2.00	2.34	2.74	2.00	2.38
Dependent variable, $\bar{F}_{it}\pi_{t+1}$	OLS	Huber	Quantile	OLS	Huber	Quantile
Regressor, $F_{it}\pi_{t+1}$	0.982*** (0.013)	0.965*** (0.007)	0.966*** (0.023)	1.074*** (0.015)	1.086*** (0.015)	1.024*** (0.009)
Constant	-0.111** (0.052)	-0.010 (0.025)	0.007 (0.058)	-0.297*** (0.062)	-0.336*** (0.058)	-0.119** (0.057)
Observations	2,032	1,987	2,032	1,399	1,371	1,399
R2	0.863	0.930		0.900	0.918	

Notes: The sample is from CGK.  $\bar{F}_{it}\pi_{t+1} = \sum_j \bar{\pi}_j \omega_{ijt}$ , where  $i$  indexes respondents,  $t$  indexes time,  $j$  indexes inflation bins,  $\omega_{ijt}$  is the weight assigned to bin  $j$  by manager  $i$  at time  $t$ ,  $\bar{\pi}_j$  is the midpoint of bin  $j$ ,  $\pi_{t+1}$  is the point prediction. All moments and regressions are computed using employment-based sampling weights. Robust standard errors are reported in parentheses. \*\*\*, \*\*, \* shows statistical significance at 1%, 5%, and 10% levels respectively.

**Table A2**

Responses to Baseline and Alternative Formulations of Inflation Expectation Questions

Variation in the wording	N	Inflation forecast, one-year ahead			Inflation forecast, 5-10-years ahead			Inflation backcast, previous 12 months	
		Mean	St.dev.	Uncertainty	Mean	St.dev.	Uncertainty	Mean	St.dev.
		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
A. "By how much do you think prices will/have change(d) overall in the economy?"	679	3.72	2.55	1.02	3.29	2.49	1.04	3.42	2.22
B. "What will be/have been the overall inflation rate over the next/last 12 months?"	681	3.73	2.54	1.04	3.31	2.50	1.11	3.40	2.27
C. "What will be/have been the inflation rate (specifically the Consumer Price Index) over the next/last 12 months?"	680	3.71	2.53	1.04	3.31	2.46	1.04	3.43	2.26

Notes: The table reports basic moments for inflation forecasts solicited via different wordings (shown in the left column) in the following questions.  
 During the last twelve months, by how much do you think prices changed overall in the economy? Please provide an answer in percentage terms.  
 During the next twelve months, by how much do you think prices will change overall in the economy? Please provide an answer in percentage terms.  
 During the next 5-10 years, by how much do you think prices will change overall in the economy? Please provide an answer in percentage terms.

with the corresponding versions soliciting probability distributions. Uncertainty is computed as  $\sigma_{it} = \sqrt{\sum_j (\bar{\pi}_j - \bar{F}_{it}\pi_{t+1})^2 \omega_{ijt}}$  where  $\bar{F}_{it}\pi_{t+1} = \sum_j \bar{\pi}_j \omega_{ijt}$ ,  $i$  indexes respondents,  $t$  indexes time,  $j$  indexes inflation bins,  $\omega_{ijt}$  is the weight assigned to bin  $j$  by manager  $i$  at time  $t$ ,  $\bar{\pi}_j$  is the midpoint of bin  $j$ . The sample is from CGK.

**Table A3**

Expectations of Future Inflation vs. Future Changes in Own Prices.

	N	Mean	Median	St.dev.	Correlation with expected/perceived inflation
	(1)	(2)	(3)	(4)	(5)
<b>Panel A. Survey of firm managers, New Zealand</b>					
<b>Wave 3</b>					
Expected inflation, 12-month ahead	1,601	4.48	4.00	2.97	1.00
Expected change in own unit cost, 12-month ahead	1,601	2.80	2.00	3.01	-0.01
<b>Wave 6</b>					
Expected inflation, 12-month ahead	2,032	2.75	2.00	2.35	1.00
Expected change in own unit cost, 6-month ahead	2,032	1.27	1.00	1.88	-0.08
Expected change in own price (main product), 6-month ahead	2,032	0.55	0.50	1.11	-0.01
Expected change in own price (main product), 12-month ahead	2,032	0.59	0.50	1.17	-0.04
<b>Wave 7</b>					
Expected inflation, 12-month ahead	1,399	2.74	2.00	2.38	1.00
Expected change in own unit cost, 6-month ahead	1,399	0.46	0.00	1.47	0.02
Expected change in own price (main product), 6-month ahead	1,399	0.35	0.10	0.82	0.02
Expected change in own price (main product), 12-month ahead	1,399	0.21	0.00	0.98	0.09
<b>Panel B. Business Inflation Expectations survey, Federal Reserve Bank of Atlanta</b>					
<b>July 2015</b>					
Expected change in unit cost, 12-month ahead	221	1.98	1.94	1.48	-
Expected change in CPI, 12-month ahead	221	2.59	2.00	2.14	-
<b>September 2014</b>					
Expected change in unit cost, 12-month ahead	190	2.06	2.05	1.59	-
Expected change in CPI, 12-month ahead	190	3.68	3.00	2.84	-

Notes: The table reports basic moments of expected inflation for various survey designs. The sample in Panel A is from CGK.

**Table A4**

Effects of Bin Size and Distribution on Reported Inflation Expectations

One-year-ahead forecast	N	mean	median	st.dev.	uncertainty	Correlation with the change in the general level of prices
	(1)	(2)	(3)	(4)	(5)	(6)
Change in prices overall	2,032	2.59	1.40	2.48	0.92	1.00
<b>Core CPI</b>						
NZ grid (dispersed/many bins)	1,011	2.58	1.40	2.37	0.94	0.90
BIE grid (concentrated/few bins)	1,021	2.26	2.10	1.30	0.26	0.85

Notes: The table compares basic moments of expected inflation across survey designs. Mean in column (2) reports average implied mean expected inflation across firms. Median in column (3) reports the median implied expected inflation across firms. St. dev. in column (4) reports cross-sectional variation of implied means across firms. Uncertainty (column 5) is the average (across firms) standard deviation of reported probability distributions. Column (6) reports correlation between i) the implied mean for change in prices overall and ii) a given alternative measure of inflation expectations. The sample is from CGK.

**Table A5**

Point Estimate vs. Mean Implied by the Probability Distribution

	(1)	(2)	(3)
<b>Firm characteristics</b>			
<b>Log(Age)</b>	0.203***		0.231***
	(0.045)		(0.078)
<b>Log(Employment)</b>	0.600***		0.797***
	(0.108)		(0.127)
<b>Labor's share of costs</b>	-0.009*		0.000
	(0.005)		(0.007)
<b>Foreign trade share</b>	0.013***		0.008*
	(0.004)		(0.004)
<b>Number of Competitors</b>	-0.009***		-0.006
	(0.002)		(0.004)
<b>Avg. margin</b>	-0.002		0.012**
	(0.004)		(0.005)
<b>Manager characteristics</b>			
<b>Age</b>		0.003	-0.002
		(0.008)	(0.005)
<b>Female</b>		0.177	-0.036
		(0.190)	(0.093)
<b>Education:</b>			
<b>Some college</b>		1.018***	0.320***
		(0.257)	(0.112)
<b>College</b>		0.689***	0.087
		(0.198)	(0.108)
<b>Graduate (MA+)</b>		0.033	-0.089
		(0.210)	(0.135)
<b>Tenure</b>		0.074***	0.003
		(0.016)	(0.009)
<b>Income</b>		0.003**	-0.001
		(0.002)	(0.001)
<b>Industry FE</b>	Y	Y	Y
<b>Observations</b>	2,960	1,380	1,371
<b>R2</b>	0.838	0.076	0.901
<b>R2 (industry fixed effects only)</b>	0.812	-	0.872

Notes: The table reports results for the Huber robust regression. The dependent variable is the 12-month ahead inflation forecast from Wave #1 survey. Industry fixed effects are for 3-digit industries. The omitted category for manager's education is "high school diploma or less." Sample weights are applied to all specifications. The sample is from CGK. Robust standard errors (clustered at the 3-digit ANZ SIC level) are reported in parentheses.

\*\*\*, \*\*, \* denotes statistical significance at 1%, 5%, and 10% levels respectively.



# Comment on “Inflation Expectations – a Policy Tool?” by Olivier Coibion, Yuriy Gorodnichenko, Saten Kumar and Mathieu Pedemonte

By Ricardo Reis<sup>1</sup>

## Abstract

This comment makes three points. First, it provides an interpretation of the main findings of the research on survey inflation expectations by households and firms over the past two decades. Second, it discusses the question of how communication policy can affect inflation expectations. Third, it concludes with an analogy between communication about inflation and monetary policy, and communication about dieting and health policy.

## 1

### Introduction

To say that inflation expectations matter for monetary policy is, I think, completely uncontroversial. All respectable central banks invest resources refining measures of inflation expectations in their economies, and then follow these quite closely to ascertain the state of the economy. Yet, when they refer to inflation expectations, many policymakers have in mind the expectations that are reflected in financial prices, or those from professional forecasters. After a speech by Mario Draghi, almost surely there is at least one news report on what happened to the inflation swap rate or the break-even inflation rate. The professional forecasters who follow closely the ECB read the speech carefully and reflect it in their answers to the next round of surveys.

Coibion, Gorodnichenko, Kumar and Pedemonte (2018) ask us to pay more attention instead to the surveys of expected inflation among firms and households. Over the last two decades or so, there has been much academic research on this new and exciting data, which is starting to find its way into the monetary policy process. Research has identified interesting patterns in these data, and this paper surveys what we have learned and what are the open questions raised by the latest work in this research agenda. In this discussion, I will first give my interpretation of the papers surveyed, then provide my answer to the question of whether expectations are a policy tool, and

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<sup>1</sup> A. W. Phillips Professor of Economics, London School of Economics.

finally conclude with an analogy between communication about inflation and about caloric intake.<sup>2</sup>

## 2 Survey inflation expectations: what do we know?

From the literature surveyed by Coibion et al (2018), I take five conclusions.

### 2.1 Survey inflation expectations are consistent with widespread inattention

When people are asked for either what the current inflation rate is, or what it was in the recent past, or what they expect inflation to be, many answers are nonsensical. In surveys of US households, usually around one fifth of respondents expect inflation to be in the two digits, even though it has not been so in almost 40 years. In surveys of firm managers, a large number of respondents state that inflation is, or will be next year, more than 2% above what it is today or what is the announced inflation target. Many people are simply clueless about inflation. They pay essentially no attention to this variable that is the focus of so many economists.

At the same time, and this is a strong lesson from this literature, people are not stupid. They are quite far from it, in fact. While many are clueless, many others exhibit knowledge of the present and expectations about the future that are quite accurate. The noticeable feature of the data is not how informed or how ignorant some people are, but rather the remarkable range of disagreement. People disagree, by a lot, and about not just what will happen in the future, but also about what happened yesterday.

The extent of disagreement that we observe, and the way it changes over time, is consistent with the slow diffusion of information. People catch up to news with long and variable lags, differing in how quickly they do so. When there are large regime changes, most revise their expectations quickly, but following smaller changes in inflation or in monetary policy, the stickiness of information can be very deep. Past experiences can therefore linger, and shocks to the economic environment propagate directly to decisions over many successive months as a result of this information stickiness. In turn, what a person lives through can stay with her for a very long time and shape her future expectations.

Just because people's past experiences affect their present views about the future, they are not oblivious to the present. If you tell someone the current inflation rate, this has an immediate impact over what she expects inflation be over the next year. Moreover, people who live in an environment of high and volatile inflation update their expectations often and quickly to news.

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<sup>2</sup> Given the space limitations, I will constrain myself to the papers surveyed in Coibion et al (2018), and will not reference them individually, but refer the reader to their paper for the citations to the literature. The exception is when I explicitly refer to a study that is not discussed by them.

Two important sources of data are people's shopping experiences and the media. Even if people do not follow Bayes rule strictly, they update prior beliefs in response to news. Likewise, they respond to announcements of future changes, so they are not purely backward looking.

Finally, turning to policymakers and their institutions, many people do not know who the current president of the ECB is, or what are the ECB's mandate or targets. Central bankers should not get too anxious about this. Most people also cannot name a single judge in the European Court or state in which town or country the institution is based in. This is fine, and in some ways, it is as it should be. In a well-functioning economy, people with limited capacity to pay attention should focus in whatever they are productive and count on policymakers to deliver a stable macroeconomic framework, so that they don't need to pay attention to inflation or to monetary policy.

This widespread inattention and stickiness of information are certainly inconsistent with full-information rational expectations. But the facts listed above are also not consistent with models of firms and households that are fully rational but solely have incomplete information about current fundamentals. They are at odds with explanations for the sluggishness of expectations that rely solely on imperfect policy credibility. Finally, the clear forward-lookingness of expectations as well as the malleability of behavior in response to changes in regime rejects the view that people are backward looking or have random animal spirits.

## 2.2 Survey inflation expectations can be measured, with effort

We have been measuring household inflation expectations for decades across countries, using different surveying techniques, and across different circumstances. More recently, researchers have started doing the same for firms' managers. It is not easy to conduct these surveys, both in terms of trying to get subjects to participate, and in terms on making sure that the order or wording of questions does not bias their responses. But, we can do it, and know how to get consistent and reliable answers.

To measure people's uncertainty about the future is also hard, but it can be done reliably by using questions about distributions of different outcomes. It is especially important to be careful about the width of the bins in these questions, and to allow for a wide range of possible outcomes. Just as importantly, the literature has convincingly shown that disagreement is not uncertainty. They are conceptually different, and when we can measure both in the survey data, their correlation is at best weak. A bad and obsolete habit in economic research was to measure the cross-sectional dispersion in surveys of expectations and use it as a proxy for uncertainty about the future. No serious researcher can mix up disagreement and uncertainty today.

One finding from designing the surveys is that the way inflation is worded, whether in terms of the change in the absolute level of prices, the change in the consumer price index, or a core version of it, this does not seem to matter for the answer. Survey respondents give consistent and similar answers when asked about different measures of inflation. This can be discouraging for the many economists (myself included) who obsess at the differences between these measures. But it can be

encouraging from the perspective of the surveys in showing that people are quite coherent in their assessment of the changes in the relative value of the unit of account.

More generally, the way questions are designed matters, especially as people have well known psychological biases that must be taken into account in the survey. The way in which sampling is performed can also have a large influence on the results. But again, there has been great progress doing this to get accurate answers. One important difference to keep in mind is that people are sophisticated enough to give quite different answers when asked about their future individual circumstances as opposed to future aggregate outcomes.

Altogether, the conclusion is that measuring expectations is possible and worthwhile. It takes effort to do it, and it is probably best done by institutions with large and consistent resources rather than by individual researchers. Experience suggests that the surveys deliver consistent and coherent answers.

## 2.3 Survey expectations are correlated with anticipated decisions

Both in the time series and in the cross section, households that expect higher inflation also express a higher willingness to spend. This is consistent with higher expected inflation implying, for a fixed nominal interest rate, a lower real interest rate, and thus a lower return and desire to save. Whether this is the explanation, or some other one, the fact remains that several studies have found this association in the data.

More recent work has found that firms that expect higher inflation sometimes plan to raise the prices of their goods and sometimes plan to raise the wages they pay. Likewise, higher inflation expectations sometimes come with plans to cut investment or hire fewer workers. These facts are less solid, insofar as there are still few studies on the topic, and the answers change in different samples. Perhaps this is to be expected since the theory linking inflation expectations to pricing or hiring says that the predicted effect depends on the nature of the shock, what else is being held fixed, and the behaviour of competitors.

This research strongly suggests that survey expectations of inflation are not just noise, nor are they just inconsequential opinions. Rather, survey inflation expectations are informative for the choices that people make.

## 2.4 Policy announcements affect survey expectations with delays and at low frequencies

Given the widespread inattention, at best, routine policy announcements can only affect the few people that happen to be paying attention at that time. Given the stickiness of information, any effect of these announcements will occur gradually over time, so it can only be detected at lower frequencies. Given the correlation between speeches and actions, as most speeches either announce or explain actions, disentangling the effects of each separately is hard. Finally, given the reverse causality

that arises because some changes in policies are responses to changes in expectations, identification is tricky. All combined, cleanly identifying the effect of policy announcements on survey expectations is a daunting empirical challenge.

Coibion et al (2018) look at time-series plots of expected inflation around a few famous events of policy announcements. In some of them, like the announcements of the start of quantitative easing, it is hard to distinguish what was in the announcement versus the actual policy that was then implemented. In others, like the famous “whatever it takes” Draghi speech, reverse causality is likely present. Of the events considered by the authors, the one that is more suited to study the impact of a policy announcement on expectations is, in my view, the announcement by the Federal Reserve in January of 2012 that it was adopting a 2% inflation target. Arguably, this came with no material change in policy, as the Fed had implicitly been targeting 2% inflation for decades, and it was announced at this date after a prolonged internal debate but not in reaction to recent changes in expectations.

Chart 1 plots the five-year breakeven inflation rate from financial markets and the one-year ahead median expected inflation from the Michigan survey of households around this date. Importantly, and differently from Coibion et al (2018), the plot uses the same frequency for the two measures of expectations over a 24-month period. Staring at this picture, it is hard to detect any difference between the response of these two different measures of expectations to the announcement. Furthermore, if one tries to abstract from the vertical line marking the date of the announcement, it would be hard to guess when the announcement took place, regardless of the measure of expectations that one focuses on. At high frequencies, it is just very hard to know whether policy announcements have an effect on expectations.

At the same time, Chart 2, reproduced from Mankiw, Reis and Wolfers (2004), looks at a much more significant change in policy regime, the significant disinflation pursued by chairman Paul Volcker. The figure plots the distribution of inflation expectations from the Michigan survey starting in 1979 and ending in 1982. At both the start and the end, the distributions take a familiar bell shape, dislocated to the left in the latter period relative to the former one, matching the large decline in inflation. In between though, one sees the slow dissemination of information as the distribution slowly moves, becoming bimodal in between. In turn, research that has compared countries that adopted inflation targets with others concludes that, in the former, survey expected inflation has a lower range of disagreement, and reverts past forecast error more quickly, consistent with expectations being better anchored.<sup>3</sup>

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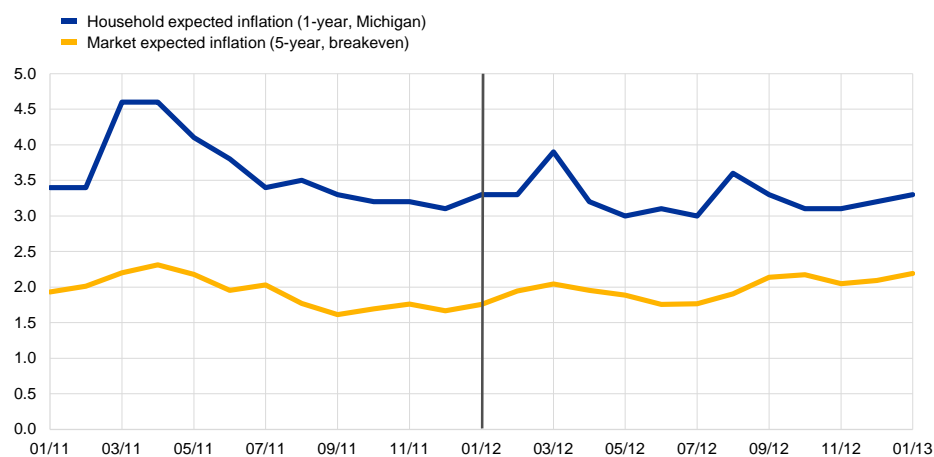
<sup>3</sup> See Capistran and Ramos-Francia (2009) or Crowe (2010).

### Chart 1

#### Inflation expectations around the announcement of the US 2% inflation target

#### Market and survey inflation expectations before and after the January 2012 announcement of a 2% inflation target

(y-axis: inflation; x-axis: date)



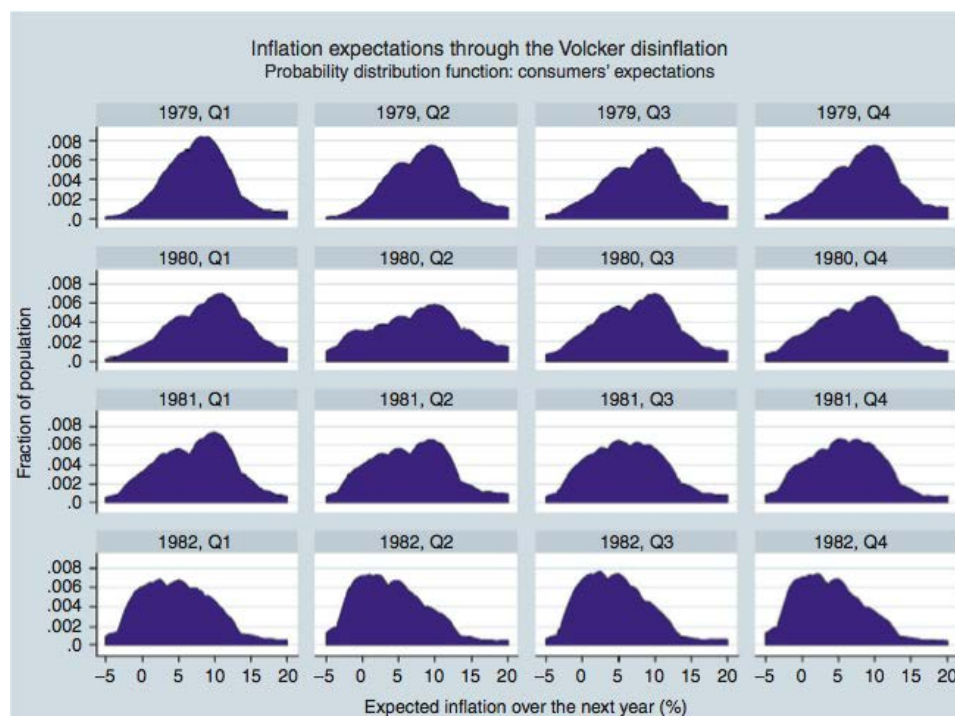
Source: FRED, Saint Louis Fed.

### Chart 2

#### Distribution of US household survey inflation expectations during the Volcker disinflation

#### Probability density function of respondents of Michigan survey

(y-axis: frequency; x-axis: inflation rate)



Source: Mankiw Reis and Wolfers (2004).

Guided by these findings, my prior is that policy announcements and regimes do matter for survey expected inflation, but that this happens at low frequencies that event studies with short windows cannot detect.

## 2.5 Can better communication break inattention?

Studies have found that if I reveal to a survey respondent what past inflation was, or what the inflation target is, then they update their expected inflation for the future. This should not be too surprising, especially given the well-known tendency of survey respondents to try to impress, or at least be responsive, to the interviewer. If I ask you what you expect the population of Portugal to be in 2020, you might say 11 million. If I tell you the population in the latest measures was 10.265 million, then if you are like most people, you will likely revise your forecast down.

Second, some studies have also found that once one tells survey respondents what inflation was, then further giving them monetary policy statements or news reports has little effect on survey expected inflation. This is, of course, consistent with the fact that current or target inflation is a quite good predictor of future inflation in a statistical sense, and with the observation that people with limited attention do not need a very accurate forecast of inflation.

Third, giving people information seems to affect their survey expected inflation for about 6 months. Likely, you will forget quite soon what the actual population of Portugal is. You have more important information to carry in your limited memory, and Portugal's population is not terribly important for you.

From these three research findings, Coibion et al (2018) conclude that monetary policy communication should: target the message to the scenario, communicate through simple messages, and repeat messages often, respectively. Maybe. All of these are sensible recommendations. But I don't think that the evidence provides more than weak support for these policy conclusions. Right now, I just do not know, although how to shape communication is one of the more active and exciting current research areas, and I expect that in a few years, research may be able to make some concrete recommendations.<sup>4</sup>

## 3 Are household or firms' survey inflation expectations a policy tool?

A pedantic answer to this question is: of course not. Expectations are not a policy tool, but rather an endogenous outcome since policymakers do not set or choose them. A similarly easy but not enlightening answer is to say that of course any central banker who has an inflation target of 2% will be seriously concerned if she observes households and firms expecting inflation to rise to 5, 10 and then 20% in successive

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<sup>4</sup> Haldane and McMahon (2018) and Ehrmann and Talmi (2018) are two examples of active work in this area.



years, and will likely change policy in response to this. A more accurate answer that follows from these two observations is that survey expected inflation can be an intermediate target for monetary policy.

A more concrete, and in my view more useful, way of approaching this topic is to ask the question of whether one particular actual policy tool  $c$ , say speeches or other forms of communication by policymakers, can have an effect on survey expected inflation  $\pi^e$ , independently of other policies that should be controlled for  $p$ , and where the ultimate target is actual inflation  $\pi$ . That is, the ultimate target is in the left-hand side of this equation:

$$\frac{\partial \pi}{\partial c} = \frac{\partial \pi}{\partial \pi^e} \times \frac{\partial \pi^e}{\partial c} \Big|_p$$

The research question is to estimate the fraction on the far right: the effect of communication on survey expected inflation, controlling for other policies. (Modern macroeconomic models, that focus on the joint determination of outcomes and expectations, are chiefly about pinning down the value of the first fraction on the right-hand side.) As I discussed above, based on the existing evidence, and acknowledging that the state of knowledge is not sufficiently advanced to permit strong conclusions, communication seems to have a slow and delayed, but significant, effect on survey inflation expectations after controlling for policies. That is, the fraction is not zero. Pinning down its precise value is a great challenge for researchers.

After the fraction is credibly and reliably estimated, a new layer of questions emerges. Communication might affect expected inflation because it reveals information about future policies. If setting interest rates today matters, it is likely that telling people what interest rates will be in the near future should matter as well. Communication might affect expected inflation because it tells the survey respondents what inflation is today, or because it provides information on economic fundamentals. Central banks have large staffs that study economic conditions in great depth and likely produce information that is relevant for people forming expectations. Finally, communication might affect expected inflation independently of policy or information. In this case, communication is about steering “animal spirits”, making people believe what might be convenient for policy. Which of these three channels from communication to expected inflation is the more relevant or, if all, what is their relative weight?

The evidence from financial markets around announcements about forward guidance and quantitative easing suggests that communication affects inflation expectations through the first two channels, that is by revealing information about future policy and current fundamentals. The evidence from professional forecasters is not as decisive, but also supportive, while the effect on survey expectations by households and firms is an open question. That communication will reveal intentions about future policy or knowledge of current fundamentals seems desirable and inevitable.

I am more sceptical (but open minded) about the third channel, partly because it has dangerous consequences. One peculiar version of the question “are inflation expectations a policy tool?” through the third channel is to ask: if the central bank just announced that its inflation target is now 5%, rather than 2% as before, would



expected inflation quickly jump by 3%? My reading of the evidence from hyperinflation is that the answer is no. When inflation is running into the many digits, it is quite frequent for policymakers to announce that they want to drastically lower it, and this has no effect in expectations or actions. Only when the communication is accompanied by fundamental changes in policy, does inflation fall. Hyperinflations also teach the danger of telling politicians that if they just make speeches, but no painful choices, they can have a large effect on economic outcomes. While there are some circumstances where there are multiple equilibria for inflation, between which a communication-induced sunspot can select, these are likely rare. Believing they are present more often leads to useless propaganda that undermines the credibility of the central bank.

Finally, there are two other related issues that are part of this overall question. The first of these is the time horizon of the expectations. It matters whether we think that speeches can affect the expected change in prices between now and one year from now, versus 10 years from now. In terms of the notation, this can be denoted as what is  $T$  in  $\pi_{t+T}$ . Second, taking as given that actual inflation has a persistent component and a transitory component, so  $\pi_t = \pi_t^P + \pi_t^T$ , and taking the latter as reflecting both measurement error and factors that policy can do little about, then the real question is to estimate:

$$\left. \frac{\partial \pi_{t+T}^P}{\partial c_t} \right|_p$$

Households' inflation expectations seem to respond quite strongly to gasoline prices. Both gas price changes, and the response of expectations to them, tend to be short lived. Therefore, even though gas price changes might explain a great deal of the variation in survey expected inflation, policymakers must be careful to extract the signal from the noise, which may require ignoring this component of the variation.

As discussed earlier, the stickiness of information implies that using communication for fine tuning is difficult. Moving expectations at high frequencies is hard. At the same time, inattention makes the maintenance of a stable unit of account easier because this takes place at lower frequencies. The decade between 2008 and 2018 saw an enormous success in the anchoring of inflation expectations. In spite of a series of large shocks, policy experimentation, and significant short-lived changes in inflation, inflation expectations stayed remarkably constant.<sup>5</sup> In a policy regime where the serial correlation of quarterly inflation was close to zero, it is optimal for an inattentive agent to keep expectations of inflation 1 and 5 years ahead constant. In turn, this makes the job of policymakers easier in responding to shocks.

## 4 Inattention about inflation, in perspective

How many calories I ate over the past three months is more important to me than what inflation was during this period. Thanks in part to good monetary policy, inflation in the

<sup>5</sup> See Miles et al (2017) for a discussion.

last quarter has been moderate and not too far from the announced inflation target, so that whatever spending or effort decisions I made, depended little on the exact value of inflation. Calorie ingestion instead has a direct effect on my well-being, as well as on the diet and exercise choices that I made and will make. For many of the readers of this piece, the same probably applies.

Now, if I went and surveyed people on how many calories they ingested in the past three months, my guess is that I would find that many are clueless. Their inattention would apply both to the past as well as to their forecasts of the near future and it would manifest itself in forecasts of both individual and aggregate consumption. People would disagree about these calories expectations, and a wide majority would have trouble stating the medical guidelines for what a healthy diet should be in terms of calories consumed as a function of individual characteristics.

This does not stop us, as a society, from enforcing strict and costly food labelling rules on calories per serving, nor of conducting widespread and expensive campaigns for public health focussed on caloric intake. These are likely useful and important in anchoring choices and even if new public campaigns have a small immediate impact, so that using them to fine tune calorie consumption across seasons of the year would likely fail, we expect that they serve an important role at lower frequencies in guiding people to healthier choices in spite of their inattention.

Central bankers should therefore not be discouraged from learning that the research on survey inflation expectations reveals a great deal of inattention, sticky information, measurement difficulties, and limited success of communication policies. Comparing these to the caloric benchmarks, research seems to be on the right track, and investing more to understand these patterns better seems worthwhile and important. Policy must, as always, be modest about what it can achieve, without losing track of its important role in affecting outcomes.

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# The Case of the Disappearing Phillips Curve

By James Bullard<sup>1</sup>

## Abstract

The slope of estimated Phillips curves across G-7 economies was negative in the 1980s but has been drifting toward zero in the inflation targeting era since 1995. Monetary authorities across these economies have generally improved policy during the inflation targeting era, successfully focusing more closely on keeping inflation near target. This commentary argues that the better monetary policy during the inflation targeting era has led to the flatter empirical Phillips curve. An important policy implication is that policymakers can no longer glean a reliable signal about the future direction of inflation based on resource utilization gaps.

## 1 Empirical Evidence of a Flatter Phillips Curve

In the past 30 years, the empirical Phillips curve has flattened in advanced economies. Chart 1, adapted from an annual report of the Bank for International Settlements,<sup>2</sup> shows the coefficient on a measure of resource slack (unemployment) in a regression of price inflation on resource utilization, using the authors' preferred specification. The coefficient is estimated repeatedly in rolling 15-year samples, and the point estimates, along with 90 percent confidence bands, are plotted in the figure. The sample runs from the 1980s to the present. The data are for a panel of G-7 economies, and the point estimate is a weighted average across economies.

The figure shows that the estimated slope of the Phillips curve was negative and statistically significant in the 1980s but has been drifting toward zero in the inflation targeting era since 1995.<sup>3</sup> The coefficient has not been different from zero in recent years – hence the disappearing Phillips curve that has been widely discussed in financial markets and in monetary policy circles.

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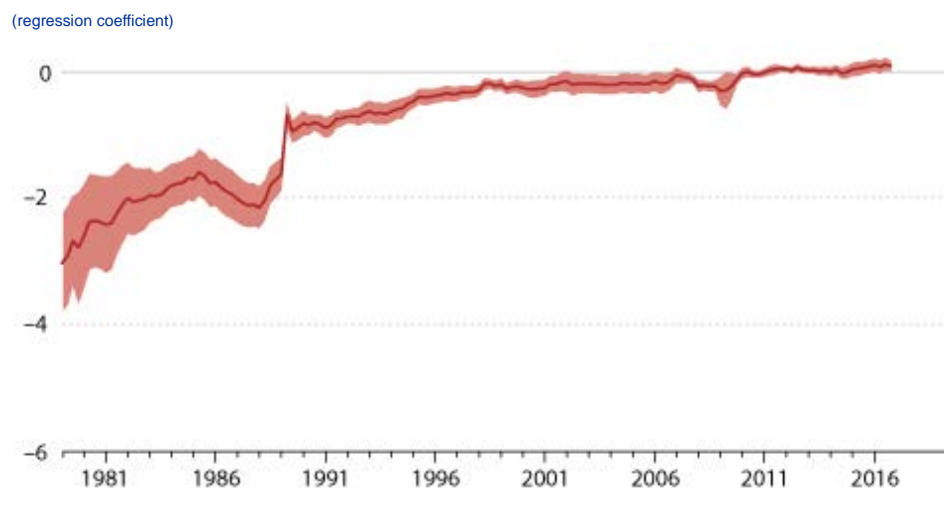
<sup>1</sup> James Bullard is president and CEO of the Federal Reserve Bank of St. Louis. The views expressed are those of the author and do not necessarily reflect the views of the Federal Reserve System, the Board of Governors, or the regional Federal Reserve Banks.

<sup>2</sup> Bank for International Settlements (2017). Also see Blanchard (2016).

<sup>3</sup> It is of course somewhat arbitrary to date the beginning of the inflation targeting era. I use 1995 because that is when US inflation declined to 2 percent and remained close to that level over the next decade. I interpret the United States as having adopted an implicit 2 percent inflation target as of that date, complementing the adoption of inflation targets elsewhere in the global economy.

The empirical phenomenon documented in Chart 1 can be related to the idea that monetary authorities have moved closer to implementing optimal monetary policy during the inflation targeting era.<sup>4</sup>

**Chart 1**  
Time-varying Phillips Curve Slope



Source: Bank for International Settlements (2017).  
Notes: Rolling 15-year window estimates and confidence bands from a panel of G7 economies.

## 2 A Simple Model

I will use a simple and standard model to state my argument, the three-equation New Keynesian model.<sup>5</sup> This model is of course overly simplistic, but the basic mechanisms outlined are present in more complicated models that underlie much of the analysis in modern central banking. The linearized equations include a dynamic IS equation and a structural Phillips curve:

$$y_t = E_t y_{t+1} - \frac{1}{\sigma} [i_t - (\rho + \varepsilon_t) - E_t \pi_{t+1}]$$

$$\pi_t = k y_t + \beta E_t \pi_{t+1} + u_t$$

where  $y_t$  is the output gap,  $\pi_t$  is the inflation gap, and  $(\rho + \varepsilon_t)$  is the natural real rate of interest;  $\varepsilon_t$  and  $u_t$  are a natural rate shock and a cost-push shock, respectively;  $\beta, k$  and  $\sigma$  are structural parameters, all positive. The two shocks are i.i.d. and have variance  $\sigma_\varepsilon^2$  and  $\sigma_u^2$ , respectively. Monetary policy is the choice of the nominal interest rate set according to a standard Taylor-type linear feedback policy rule:

$$i_t = \rho + \varphi_\pi \pi_t + \varphi_y y_t$$

<sup>4</sup> Gillitzer and Simon (2015) relate the flattening of the Phillips curve in Australia to inflation targeting. Blanchard (2017) points to inflation targeting as one of the possible explanations for the disappearing Phillips curve.

<sup>5</sup> For a textbook treatment of the standard New Keynesian model, see Woodford (2003).

In this policy rule, the policy feedback parameters are assumed to be positive. Assuming that the Taylor principle is satisfied,<sup>6</sup> the rational expectations equilibrium indicates that the evolution of the output gap and inflation can be represented as linear functions of the shocks, and that this evolution also depends on the policy parameters in the Taylor-type policy rule:

$$y_t = \frac{\varepsilon_t - \varphi_\pi u_t}{\sigma + \varphi_y + k\varphi_\pi}$$

$$\pi_t = \frac{k\varepsilon_t + (\sigma + \varphi_y)u_t}{\sigma + \varphi_y + k\varphi_\pi}$$

## 2.1 Constrained Optimal Monetary Policy

There are a variety of ways to define optimal monetary policy within this framework. I look for optimal monetary policy within the set of Taylor-type rules in the model. Fix  $\varphi_y$  to any positive value, and then choose the optimal value of  $\varphi_\pi$  by minimizing a quadratic loss function:

$$\varphi_\pi = \arg \min (1 - \beta) \sum_{t=0}^{\infty} \beta^t (\alpha \pi_t^2 + y_t^2)$$

where  $\alpha > 0$  represents the relative weight on the desirability of inflation stabilization compared to output stabilization. This problem states that the policymaker wishes to minimize deviations of inflation and output from longer-run levels by choosing a single parameter, the feedback coefficient on inflation in the Taylor-type monetary policy rule. The policymaker may have preferences for the reduction of inflation variation versus output variation. However, the solution to this problem indicates that the desirability of inflation stabilization versus output stabilization does not matter – the solution is to set the feedback coefficient on inflation to a high value – technically, infinity. This result has a clear interpretation: In seeking to conduct optimal monetary policy in this framework, the policymaker should put more and more weight on keeping inflation close to the inflation target. This seems to broadly match with what has actually happened in G-7 economies since 1995. During the inflation targeting era, inflation has, generally speaking, been lower and less volatile than it was during the 1970s and 1980s. Inflation expectations have also been less volatile.

The inflation targeting era since 1995 also includes the period since the 2007-2009 global financial crisis, which has been characterized by near-zero or negative policy rates in G-7 economies. Policymakers turned toward unconventional monetary policy during this era. I interpret the turn toward unconventional policy as an especially aggressive attempt to continue to keep inflation as close as possible to the inflation target even when the policy rate had been lowered to something near an effective lower bound. In this sense, I think the spirit of the optimal monetary policy – keep inflation close to target – was especially pronounced during this era and fits with the description of optimal policy outlined here.

<sup>6</sup> See Bullard and Mitra (2002) for a generalization of the Taylor principle that applies to this model.

### 3 Empirical Phillips Curve from Model Data

With a concept of optimal monetary policy in hand, we can now regress the model inflation gap on the model output gap and call the estimated coefficient “the slope of the empirical Phillips curve.” Thanks to the simplicity of this model, the slope can be calculated exactly as

$$\gamma = \frac{Cov(\pi_t, y_t)}{Var(y_t)} = \frac{k\sigma_\varepsilon^2 - \varphi_\pi(\sigma + \varphi_y)\sigma_u^2}{\sigma_\varepsilon^2 + \varphi_\pi^2\sigma_u^2}$$

Under the optimal monetary policy defined above, the empirical Phillips curve becomes completely flat, that is,

$$\lim_{\varphi_\pi \rightarrow \infty} \gamma = 0$$

#### 3.1 Empirical Relevance

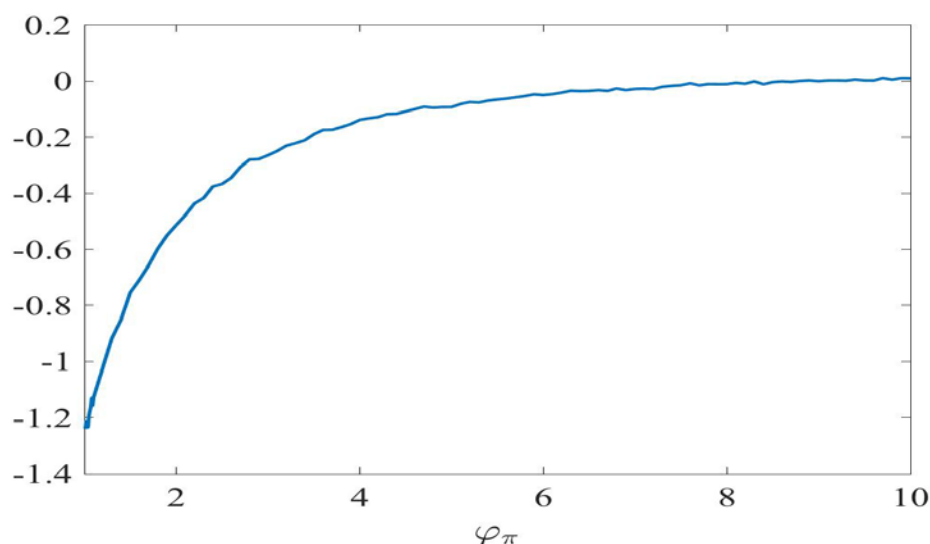
Would this Lucas critique effect be large enough to importantly affect estimated Phillips curve coefficients? To answer this question, I consider a similar model estimated by Lubik and Schorfheide (2004). I use mean estimates for post-1982 data from their Table 3, p. 206, to generate artificial data and regress inflation on the output gap. I use Okun’s law with a coefficient of  $-2.3$  to translate the Phillips curve slope in terms of unemployment. Chart 2 suggests that, at these parameter values, the slope of the estimated Phillips curve would attenuate significantly as  $\varphi_\pi$  increases. According to Chart 1, the slope of the estimated Phillips curve was about  $-1$  as of 1991, but it had increased to zero 20 years later. This is what is also predicted based on the Lubik-Schorfheide estimates in Chart 2.



## Chart 2

### Model Phillips Curve Slope as a Function of the Interest Rate Response to Inflation

(regression coefficient)



Source: Author's calculations.

Notes: Regression coefficient of inflation on the output gap using artificial data from the model in Lubik and Schorfheide (2004). The coefficient has been translated in terms of unemployment using Okun's law.

## 3.2 Related Literature

The argument outlined here has been made a number of times in the literature in various ways following the original Lucas critique from the 1970s. While I will not attempt to survey the literature here, I can give a few examples. Boivin and Giannoni (2006), for instance, argue that monetary policy has been more effective in stabilizing the economy post-1980 by responding more aggressively to inflation expectations. This finding is broadly consistent with the characterization of optimal monetary policy given here. Del Negro et al. (2015) reassess the perceived breakdown in the Phillips curve during the Great Recession – that is, the idea that the sharp decline in real activity at that time was associated with only a modest decline in inflation that several authors had previously argued could not be accounted for by standard DSGE models. Del Negro et al. show that an otherwise standard model with a time-varying inflation target and financial frictions predicts a sharp contraction in economic activity and a modest and protracted decline in inflation in response to financial stress. There would be a structural Phillips curve (like the equation given above), but not necessarily an empirical Phillips curve, during such an episode, similar to the argument given in this note. McLeay and Tenreyro (2018) provide a more rigorous and detailed analysis than provided here of optimal monetary policy and identification issues in the New Keynesian model. They maintain that the Phillips curve cannot be easily identified in the data because optimal policy induces a negative relationship between inflation and the output gap in response to cost-push shocks. Again, there would be a structural Phillips curve but not one that is easily detected in empirical work.

## 4 Implications for Monetary Policymakers

Ultimately, successful monetary policy can push the empirical Phillips curve slope all the way to zero. The model economy discussed above still has a structural Phillips curve; it is only the empirical Phillips curve that is “disappearing.” Today’s G-7 monetary policymakers are unlikely to be able to glean a reliable signal of future inflation based on measures of resource utilization because high quality monetary policy has itself diminished the value of that signal.

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# Fixing the Astrolabe: Global Factors and Inflation Models

By Kristin Forbes<sup>1</sup>

## Abstract

A trend-cycle decomposition shows that underlying price pressures in most advanced economies remain muted and well below inflation targets. Adding more comprehensive controls for global factors, such as exchange rates, global slack, oil prices, commodity prices, and producer pricing competition, can meaningfully improve the ability of simple models to explain inflation. The role of these global factors varies across time, as well as across countries, but has increased over the last decade for CPI inflation. Standard domestic variables, such as domestic slack and inflation expectations, are still important after controlling for global factors. Nonetheless, adding dynamic global factors can meaningfully improve the ability of simple Phillips curve models to understand inflation dynamics.

## 1 Introduction

Prince Henry of Portugal, one of the great navigators of the 15th century, relied on the astrolabe to determine latitude and help guide his ships. How would he have responded if his astrolabe started to over-predict the distance the ships had covered? Would he have kept relying on it to set his course – and assume it was just a temporary glitch that would fix itself? Or tweak the instrument to try to improve its reliability in the future? Or simply give up on the instrument and sail based on the more primitive techniques of looking at landmarks, feeling the wind, and relying on instinct?

This is not unlike the decisions central bankers are being forced to make today. In many countries, models and forecasts have consistently been over-predicting inflation. Are the errors temporary – possibly reflecting the unusual period of a prolonged post-crisis recovery followed by sharp falls in commodity prices? Does the basic framework for inflation models simply need some “tweaking” – such as how we measure slack or inflation? Or will monetary policy be forced to rely less on models and central bankers make decisions based more on the “winds” of current inflation and other key landmarks in the economy?

My comments will tackle this question in four ways. First, I will discuss if inflation is really “off course” by using a different framework than the standard Phillips curve

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<sup>1</sup> MIT-Sloan School of Management, NBER and CEPR. Thanks to Kostas Theodoridis for assistance in the calculation of the trend-cycle components used in the paper. This paper draws heavily on Forbes (2018), which was prepared for 17th BIS Annual Research Conference held in Zurich on June 22, 2018.

approach – a trend-cycle model. Second, I will assess if global factors are important in otherwise standard Phillips curve models. Third, I will examine if the role of these global factors has changed over time. Fourth and finally, I will evaluate how including these dynamic global variables affects the errors in a standard inflation model. I will conclude that adding dynamic global factors can meaningfully improve the ability of simple Phillips curve models to predict and understand inflation dynamics.

## 2 Is Inflation that Low?

A key focus of the conference this year is that inflation has been surprisingly muted given the solid recovery in economic growth, sharp falls in unemployment and closing of output gaps in many major economies. This interpretation of inflation as “too low” is based on a number of models that have a Phillips curve trade-off at their core, i.e. a negative relationship between domestic slack and wage or price inflation. Each of these models, from the simple one-equation Phillips curves to the more complicated DSGE models used by central banks, requires making a number of assumptions. Key decisions include how to measure slack and inflation (as discussed earlier today in Stock and Watson, 2018), how to measure inflation expectations (as discussed in Coibion *et al.*, 2018), the appropriate lag structures to capture delayed effects of different variables, and what supply shocks to incorporate. Given that there are valid arguments for different approaches to these issues, I’ve found it helpful to use a less-structured framework as a cross-check for understanding inflation dynamics: a trend-cycle decomposition. This approach is “atheoretical” and does not require as many definitional or modelling assumptions. Instead, it simply uses the statistical properties of past inflation data to break inflation into two components: a slow-moving trend and shorter term cyclical movements (or a “cycle”) around this trend.

There are several ways to do this type of trend-cycle decomposition, all of which build on the unobserved component stochastic volatility model (UCSV) developed by Stock and Watson (2007). I will focus on a variant called the “ARSV” approach, which was developed in Forbes, Kirkham and Theodoridis (2017) for the United Kingdom. This ARSV approach basically uses the UCSV model of Stock and Watson (2007), but allows the deviations in trend inflation to have an autoregressive component (as suggested in Chan, Koop and Potter, 2013 and Cecchetti *et al.*, 2017). To get a sense of whether inflation is unusually low, I will show you estimates for a selection of countries for the period from 2000q1 to 2017q4, based on quarterly, annualized, seasonally-adjusted inflation data.<sup>2</sup> Forbes (2018) provides additional details, as well as results of this trend-cycle decomposition for a larger set of countries.

Charts 1 and 2 show results for two countries where inflation is close to or above target: the United States and United Kingdom.<sup>3</sup> The black line shows quarterly inflation, with the share identified as “trend” shaded in blue and as the “cycle” in red. In

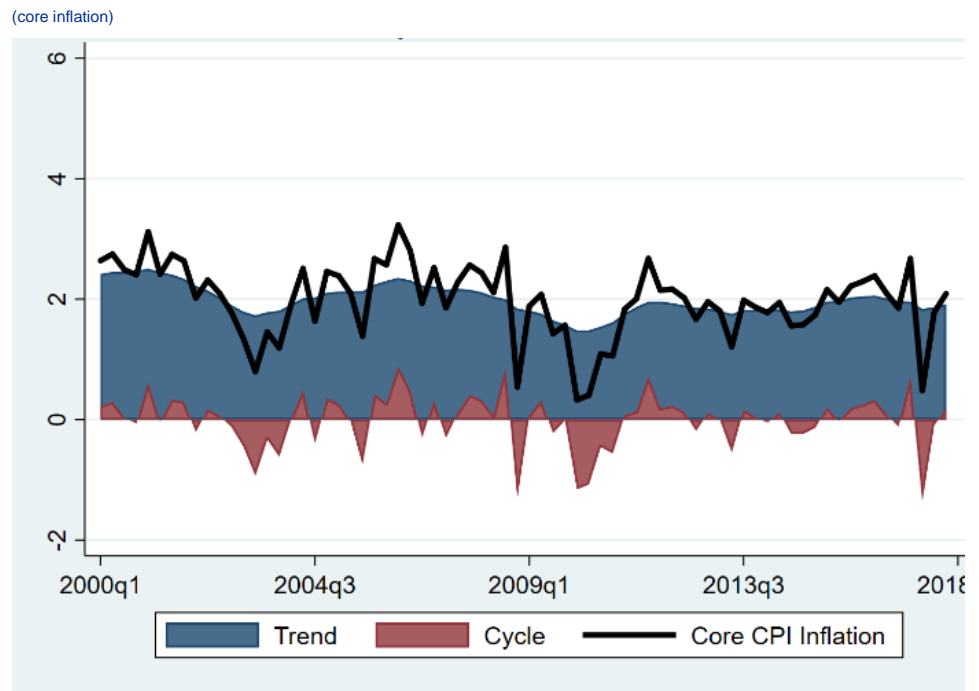
<sup>2</sup> The first 12 observations for each country were used to calibrate the prior information. See Forbes, Kirkham and Theodoridis (2017) for details of this methodology, and Forbes (2018) for details on the sample and statistical properties when applied to the cross-section of countries used below.

<sup>3</sup> I focus on headline CPI inflation for most of the following graphs as inflation targets generally focus on CPI inflation. For the United States, however, I focus on core CPI inflation, which is closer to their target.

both cases, much of the volatility in inflation is driven by the cyclical component, including the surprising weakness in inflation in the United States during 2017 (which was generally not predicted in inflation models). This volatility in inflation, however, generally tracks movements in the slow-moving trend, which was 1.9% for the United States and 2.7% in the United Kingdom in 2017Q4. This slow moving trend also fluctuates – especially in the United Kingdom where the recent waves roughly correspond to fluctuations in sterling. Even in the United States, however, trend core CPI inflation has been below 2% for much of the decade since the global financial crisis.

**Chart 1**

United States: Trend and Cycle Core CPI Inflation

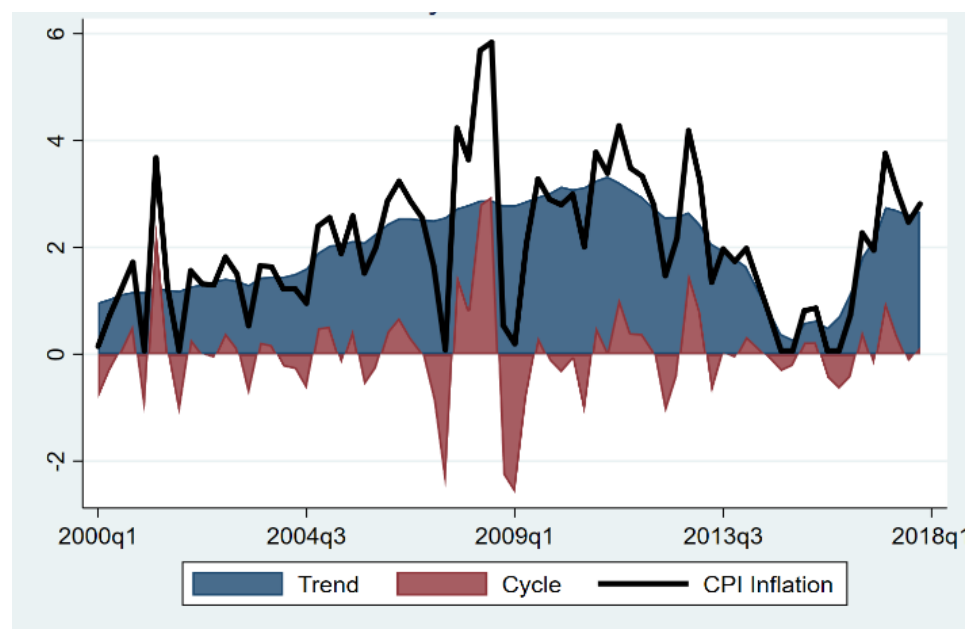


Source: Based on data in Forbes (2018).  
 Notes: Calculated using ARSV model developed in Forbes, Kirkham and Theodoridis (2017).

### Chart 3

#### United Kingdom: Trend and Cycle Core CPI Inflation

(CPI inflation)



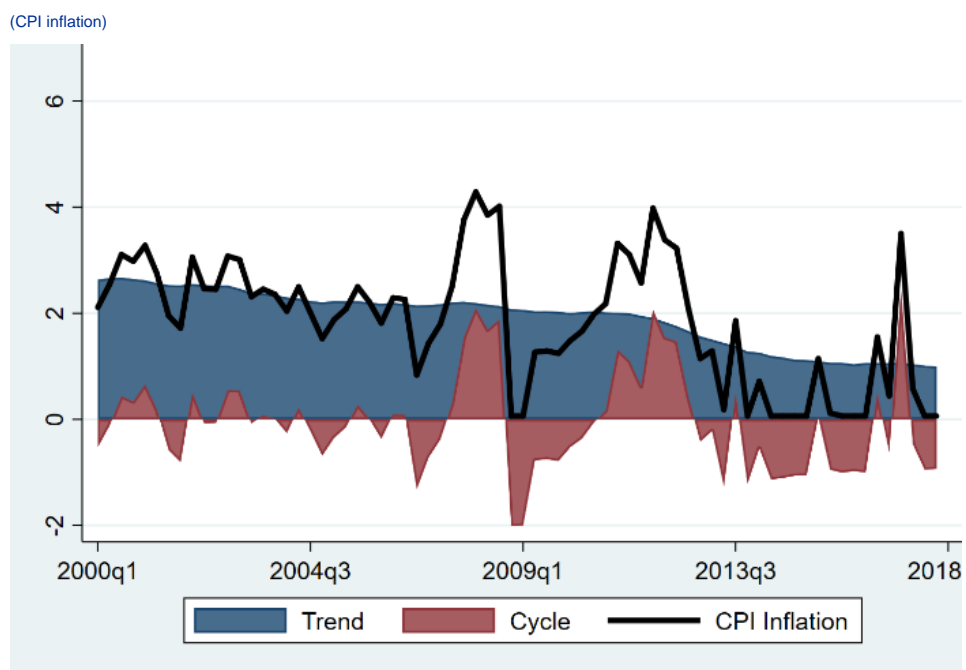
Source: Based on data in Forbes (2018).

Notes: Calculated using ARSV model developed in Forbes, Kirkham and Theodoridis (2017).

Examples of advanced economies where trend inflation is close to or above target, however, are limited. Most of the advanced economies for which data is available have trend inflation in 2017q4 well below their targets (based on this methodology). For example, Charts 3 and 4 show Italy and Portugal, with patterns typical of many countries in the eurozone; trend inflation declines towards 2% after the euro was adopted, followed by sharp cyclical drags in inflation during the global financial crisis (2008-2009) and euro debt crisis (2012-2014), and a decline in trend inflation from around 2012. Trend inflation remains well below the 2% inflation target in both countries at the end of 2017 (at 1.4% in Portugal and 1.0% in Italy). This decline in trend inflation is also shared by most of the “core” euro area countries that have not been the focus of concerns about debt sustainability and where headline inflation has recently increased. For example, Charts 5 and 6 show that trend inflation in France and Germany was also well below 2% at the end of 2017 (at 0.9% and 1.4%, respectively) with a portion of the recent pickup in CPI inflation driven by the “cycle” and therefore less likely to be persistent.

### Chart 3

#### Italy: Trend and Cycle Core CPI Inflation

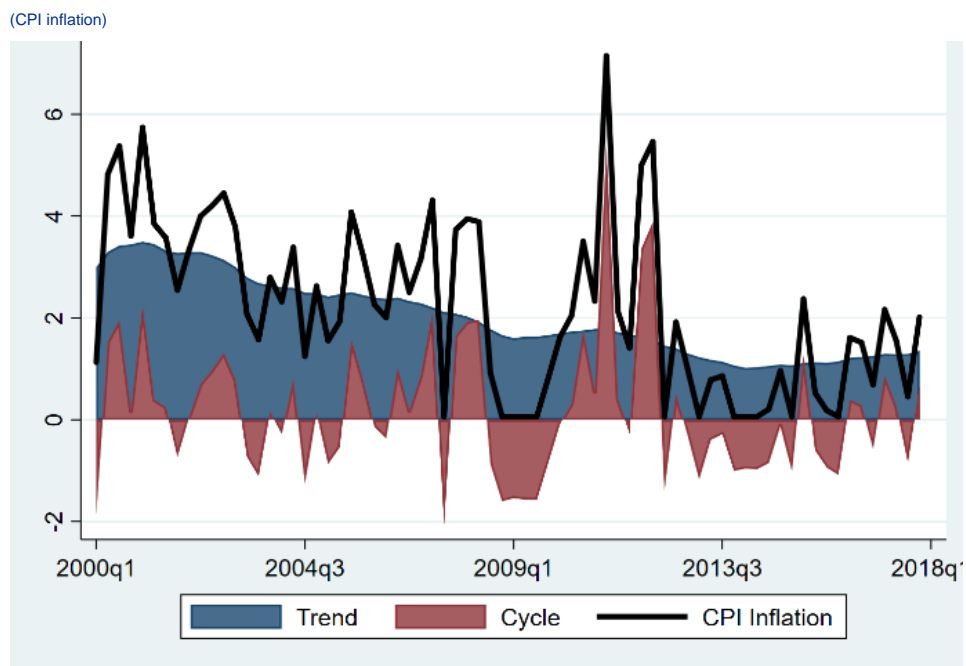


Source: Based on data in Forbes (2018).

Notes: Calculated using ARSV model developed in Forbes, Kirkham and Theodoridis (2017).

### Chart 4

#### Portugal: Trend and Cycle Core CPI Inflation

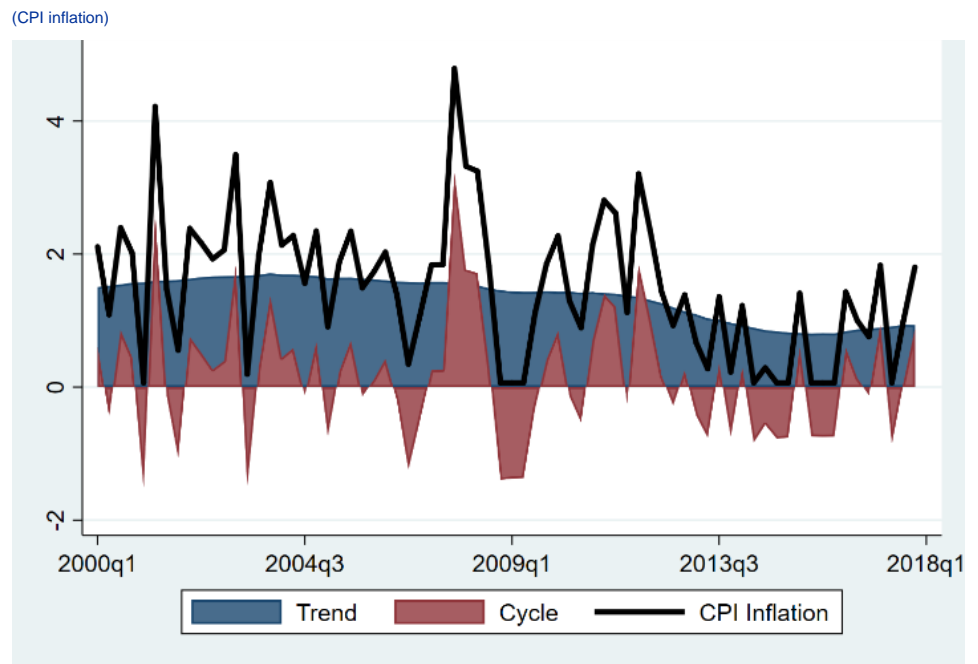


Source: Based on data in Forbes (2018).

Notes: Calculated using ARSV model developed in Forbes, Kirkham and Theodoridis (2017).

**Chart 5**

France: Trend and Cycle Core CPI Inflation

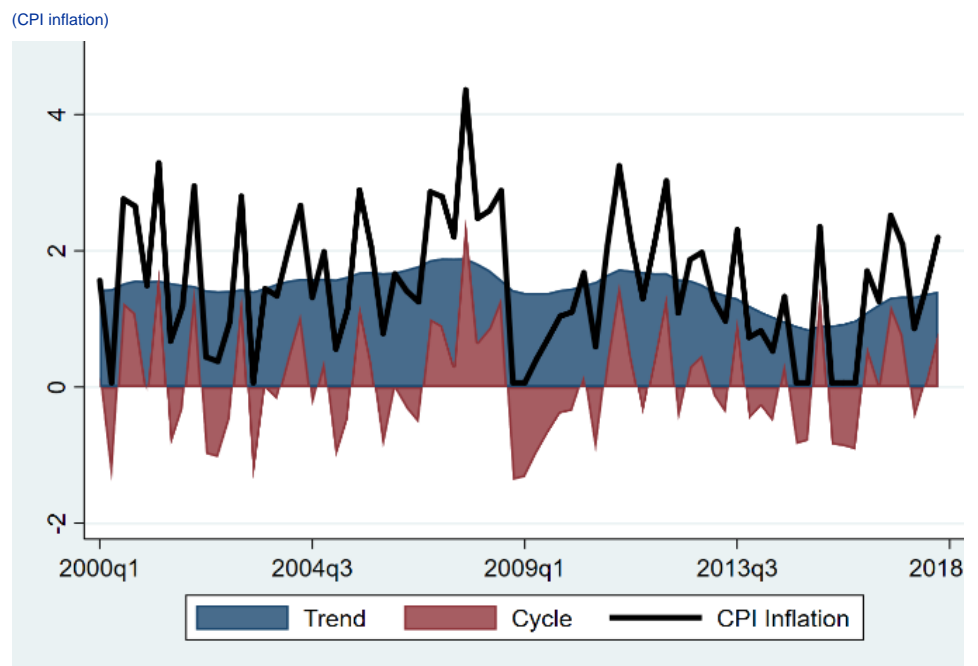


Source: Based on data in Forbes (2018).

Notes: Calculated using ARSV model developed in Forbes, Kirkham and Theodoridis (2017).

**Chart 6**

Germany: Trend and Cycle Core CPI Inflation



Sources: Based on data in Forbes (2018).

Notes: Calculated using ARSV model developed in Forbes, Kirkham and Theodoridis (2017).

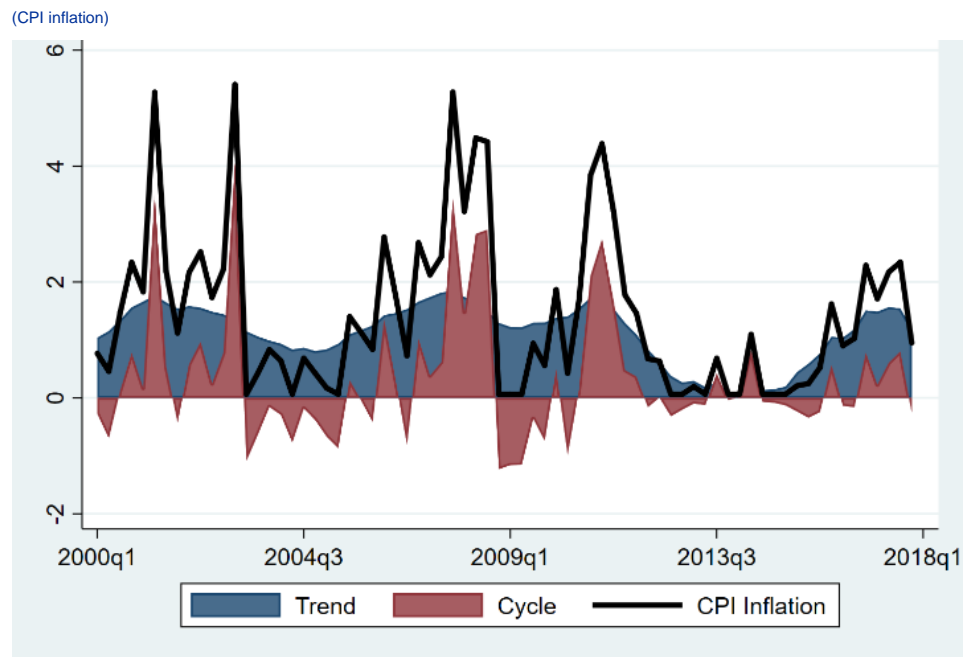
This pattern of weak trend inflation is not just shared by countries in the euro area, but also most advanced economies. As a final example, consider the two countries in



Charts 7 and 8 that currently have unemployment around or below their estimated natural rates, but have struggled to boost inflation to 2%: Sweden and Japan. In Sweden, CPI inflation has picked up sharply from near zero in periods during 2012-2015, but this decomposition suggests that almost half of this rebound is cyclical, so that trend inflation was still only 1.2% in 2017Q4. In Japan, trend inflation has been near zero for almost 15 years, and although it picked up to 0.4% at the end of 2017 – its highest level since 1995q1 – it still has a ways to go to reach 2%.

**Chart 7**

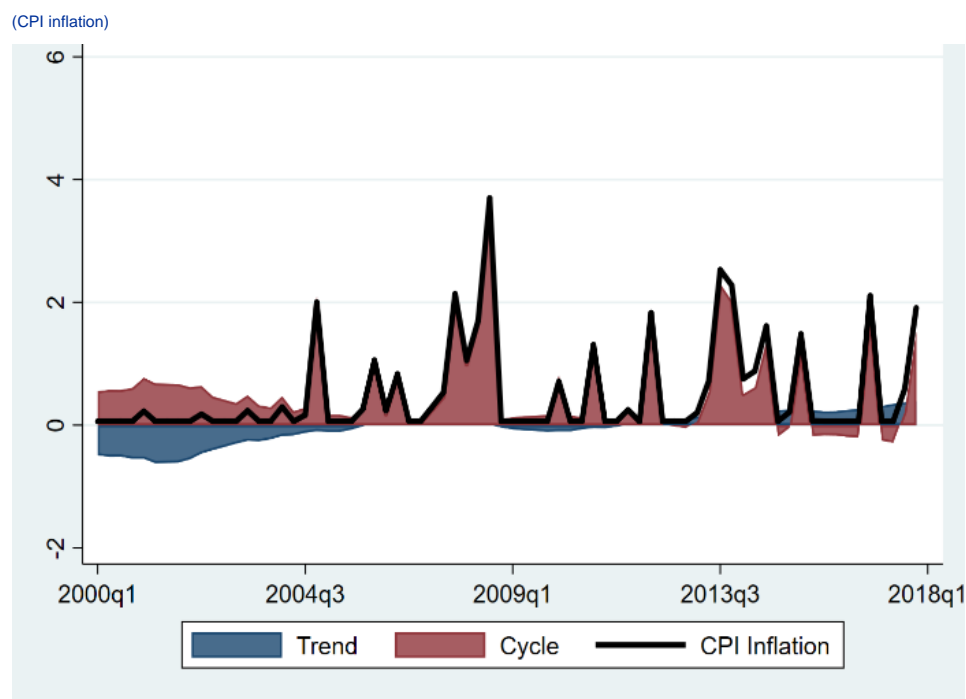
Sweden: Trend and Cycle Core CPI Inflation



Source: Based on data in Forbes (2018).  
Notes: Calculated using ARSV model developed in Forbes, Kirkham and Theodoridis (2017).

## Chart 8

### Japan: Trend and Cycle Core CPI Inflation



Source: Based on data in Forbes (2018).

Notes: Calculated using ARSV model developed in Forbes, Kirkham and Theodoridis (2017).

These graphs show a diversity of country experiences in terms of what share of inflation is explained by movements in the short-term cyclical and slower-moving trend components, as well as how stable (or not) is the slow moving trend. One pattern in most of the graphs, however, is the widespread “softness” in inflation. Even in countries such as the United States, United Kingdom, Sweden and Japan, where output gaps are basically closed (to the best extent that we can estimate them), inflation is not accelerating at the pace one might expect at this stage of the business cycle. Many other countries have experienced solid recoveries and sharp falls in unemployment, and even if there is still some slack (such as many euro area countries), underlying trend inflation still remains muted and well below 2%. Of the 28 advanced economies in the sample for which there is sufficient data to calculate the trend, only 4 had trend inflation either above or within 0.1 percentage points of 2% at the end of 2017 (Australia, Norway, the United Kingdom and United States).

Why are inflationary pressures so muted in advanced economies around the world? Why is there a seeming disconnect between the stage of the economic cycle and inflation?

## 3

### What is Missing from Inflation Models?

There are a number of reasons why inflationary pressures may be muted in advanced economies around the world and inflation generally lower than predicted by standard models. Earlier today, Stock and Watson (2018) suggested that part of the disconnect

results from the measurement of inflation, with measures isolating the cyclical component of inflation showing a stronger link to economic activity. Other papers have suggested that part of the disconnect comes from insufficiently capturing the degree of slack in the economy, such as Albuquerque and Baumann (2017) and Hong *et al.* (2018). Yet other papers have highlighted the role of inflation expectations (such as Coibion and Gorodnichenko, 2015) and the credibility of central banks (Miles *et al.*, 2017) in keeping inflation close to target despite sharp swings in output gaps. Borio and Filardo (2007) suggest that it is important to adjust for global slack, not just domestic slack, an explanation which could be even more important since their analysis was done given the weakness in the global economy since the 2008 financial crisis.

Each of these arguments seems to have merit and at least some empirical support – and there are undoubtedly other explanations. Recent work (Forbes, 2018) suggests, however, that at least part of the disconnect results from an insufficient treatment of changes in the global economy in our standard inflation models. The global economy has changed in many fundamental ways since the original Phillips curve framework was developed, such as through increased trade flows, the greater heft of emerging markets and their impact on commodity prices, and the greater ease of using supply chains to shift parts of production to cheaper locations. In the past, standard inflation models may not have needed comprehensive controls for these aspects of globalization as spillovers from the global economy to domestic prices may have been smaller. The standard approach of simply controlling for domestic slack, and often one “supply shock” (such as oil prices or import prices), could have been “sufficient statistics” to capture any effects of changes in the global economy.

As the global economy has evolved and integration has increased, however, it has become more important to explicitly control for these types of changes related to globalization. For example, greater integration in the world economy may have caused global slack, global price competition, exchange rates, and commodity prices (not just for oil) to have different effects on inflation dynamics than in the past. Moreover, if these types of global factors are becoming more important in the inflation process, this could correspond to a smaller role for domestic factors – such as domestic slack and the bargaining power of local workers.

As a test for the role of global factors in the inflation process, I begin by estimating a standard Phillips curve regression that controls for domestic slack, inflation expectations, and lagged inflation, but then I also add a set of five global variables: exchange rates<sup>4</sup>, the world output gap, oil prices, commodity prices, and a measure of global producer price dispersion (to capture the role of supply chains, as in Auer,

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<sup>4</sup> Exchange rates incorporate a global and domestic component, but as they are usually not explicitly included in Phillips curve regressions, I include them as part of the non-traditional set of “global” variables.

Levchenko and Sauré, 2016).<sup>5</sup> I estimate the model for quarterly CPI and core inflation from 1990 to 2017 for a cross-section of up to 43 countries (largely advanced economies, plus several emerging markets for which data is available).

Table 1 shows the results, replicated from Forbes (2018). The positive and significant coefficients on inflation expectations, domestic slack, and lagged inflation all suggest that the standard domestic variables included in most inflation models still play a significant role in explaining inflation dynamics. The significant coefficients on almost all of the global variables, however, suggest that they are also important. More specifically, exchange rate depreciations, larger world output gaps, higher oil and commodity price inflation, and a greater dispersion in PPI prices (less competitive producer pricing) are all correlated with higher CPI and core inflation.

**Table 1**  
Pooled Phillips Curve Regressions: 1990q1-2017q4

(regression results)

	CPI Inflation	Core Inflation
<b>Inflation Expectations</b>	0.670*** (0.073)	0.462*** (0.052)
<b>Lagged Inflation</b>	0.646*** (0.034)	0.704*** (0.024)
<b>Domestic Output Gap</b>	0.094*** (0.017)	0.084*** (0.012)
<b>Real Exchange Rate</b>	-0.020*** (0.006)	-0.013*** (0.004)
<b>World Output Gap</b>	0.072*** (0.023)	0.043*** (0.012)
<b>World Oil Prices</b>	0.002*** (0.001)	0.001** (0.000)
<b>World Commodity Prices</b>	0.010*** (0.002)	0.003** (0.001)
<b>World PPI Dispersion</b>	0.114*** (0.034)	0.019 (0.028)
<b>Adj. R2</b>	<b>0.55</b>	<b>0.63</b>
<b># observations</b>	<b>3002</b>	<b>3038</b>

Sources: Replicated from Forbes (2018).

Notes: Regressions of quarterly, annualized, seasonally-adjusted inflation for a sample of 43 countries with fixed coefficients over full period.

\*\*\* is significant at the 1% level and \*\* at the 5% level.

It is important to note, however, that although the variables in Table 1 are significant in the pooled cross-section results, when the same model is estimated for individual countries, the coefficients are less often significant, once again reflecting the diversity of country experiences. For example, consider the estimates for CPI inflation for two

<sup>5</sup> Inflation expectations is the 5-year ahead forecast from the IMF's World Economic Outlook. The domestic output gap is measured as a principal component of seven measures of domestic slack. The exchange rate is the percent change in the real exchange rate index relative to two years earlier. The world output gap is reported by the OECD. Oil and commodity prices are measured relative to the CPI or core inflation. The dispersion in producer prices is the change in the quarterly variance in PPI prices relative to four quarters earlier for all countries in the sample. See Forbes (2018) for more details on variable definitions, sources, and summary statistics.

different European nations: Germany and Iceland. For Germany, inflation expectations, lagged inflation and the world output gap are positively and significantly correlated with CPI inflation, but the coefficients on domestic slack and the other variables are not significant (all at the 10% level). In contrast, for Iceland domestic slack, world oil prices, and the exchange rate are all significantly correlated with CPI inflation (with the expected signs), with no significant role for the other variables. The results for the pooled regressions mask these significant differences in the inflation process for different countries. This could also explain why different studies have found different results on the roles for key variables (such as for global slack); the composition of countries in the sample can significantly affect results.

## 4 Changes in the Roles of Different Factors over Time

Not only do the factors which drive inflation vary across countries, but also over time. A number of studies have highlighted the instability in the coefficients in Phillips curve models. The coefficients on the global factors affecting inflation could also change over time, particularly given changes in globalization and the many ways in which this could affect firm price-setting decisions. To test for any instability in the role of the global factors affecting inflation, I re-estimate the same Phillips curve model shown in Table 1, except now estimate rolling regressions over eight-year windows instead of holding coefficients fixed over the full sample.<sup>6</sup> These rolling estimates confirm that in many cases the coefficients on variables in the Phillips curve relationship change over time.

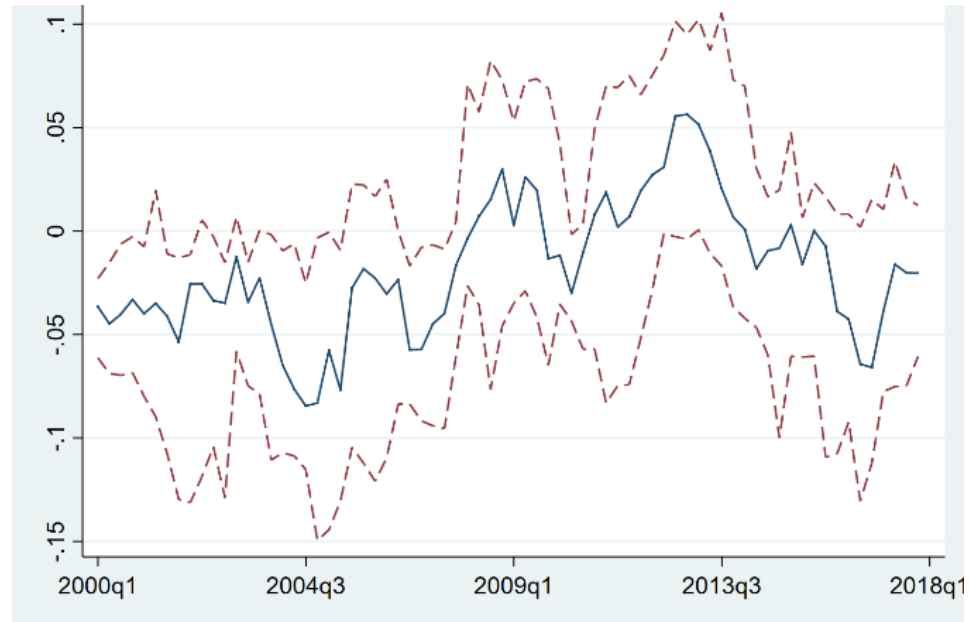
More specifically, Charts 9 through 11 show a sample of these rolling coefficients, focusing on the coefficients on the global variables and domestic slack. Each graph shows the median coefficient estimate when the model is estimated separately for each country for which data is available, with the dashed lines showing the coefficient estimates for the 33% and 66% of the distribution. Chart 9 shows the corresponding coefficients on the real exchange rate; they are negative in the first part of the sample (as expected if depreciations are correlated with higher inflation), with the average coefficient of about  $-0.05$  implying that a 10% depreciation corresponds to roughly a 0.5 percentage point increase in CPI inflation over the following two years. This coefficient, however, becomes smaller and then positive in the period after the financial crisis (albeit becoming negative again more recently). This reduction in pass-through from exchange rate movements to inflation (including the shift to a positive coefficient) could occur if demand shocks were a primary factor causing exchange rate movements over this period, as shown in Forbes, Hjortsoe and Nenova (2015, 2017).

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<sup>6</sup> The regression windows are rolled forward one quarter at a time so that the number of observations remains constant across specifications. I focus on time-varying coefficients in rolling regressions, rather than using Kalman-filter based models with time-varying coefficients, due to the evidence in Albuquerque and Baumann (2017) that this yields the lowest RMSE.

**Chart 9**  
Rolling Coefficients on the Real Exchange Rates

(rolling regression coefficient)

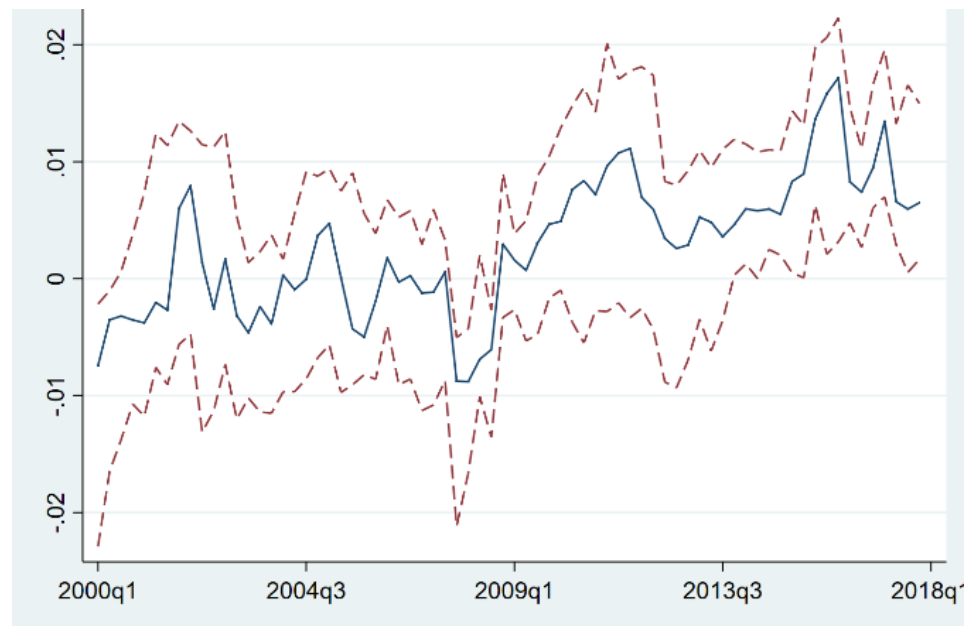


Sources: Based on data in Forbes (2018).

Notes: Median coefficient from rolling regressions from Table 1 using 8-year windows for quarterly, annualized CPI inflation from 1990-2017, estimated separately for each country. Dashed red lines are the 33% and 66% of the distribution.

**Chart 10**  
Rolling Coefficients on Commodity Prices

(rolling regression coefficient)



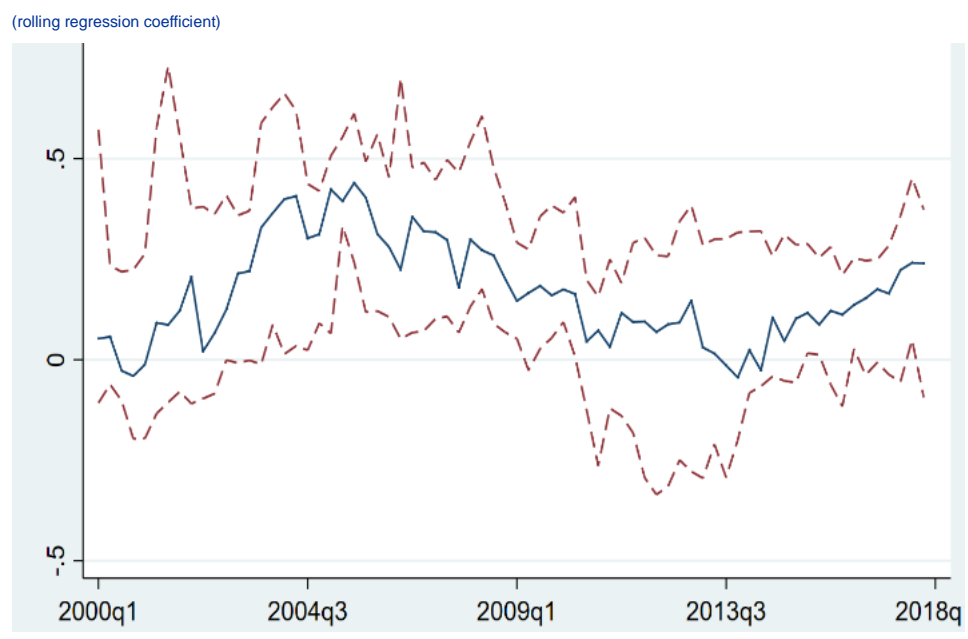
Sources: Based on data in Forbes (2018).

Notes: Median coefficient from rolling regressions from Table 1 using 8-year windows for quarterly, annualized CPI inflation from 1990-2017, estimated separately for each country. Dashed red lines are the 33% and 66% of the distribution. Commodity prices measured relative to corresponding quarterly CPI inflation.

Chart 10 shows the same median rolling coefficients on the variable for relative commodity price inflation excluding energy (with a separate control for oil price inflation). This coefficient on commodity prices also fluctuates over time, but increases after the global financial crisis as well as in the later part of the sample. This suggests that the impact of a given change in commodity prices on CPI inflation has increased over the last decade. Some of the shifts in the coefficients correspond to sharp movements in commodity prices, which would be consistent with nonlinear effects (Hamilton, 2010) and sticky-price models in which firms are more likely to adjust prices after larger price shocks (Ball and Mankiw, 1995). Some of the estimated effects of commodity price movements may also capture changes in growth prospects in emerging markets, a link that has increased over time (see World Bank, 2018).

Also noteworthy are the estimated changes in the median coefficients on the domestic output gap, shown in Chart 11. The coefficient on the domestic output gap was positive during most of the pre-crisis window, but then fell steadily, even becoming negative for part of 2013. This is consistent with the weaker performance of standard Phillips curve models in predicting inflation over much of the crisis and post-crisis period. Over the last few years, however, the coefficient on slack appears to be picking up again, possibly indicating that the traditional relationship between domestic slack and inflation may be beginning to reassert itself.

**Chart 11**  
Rolling Coefficients on Domestic Slack

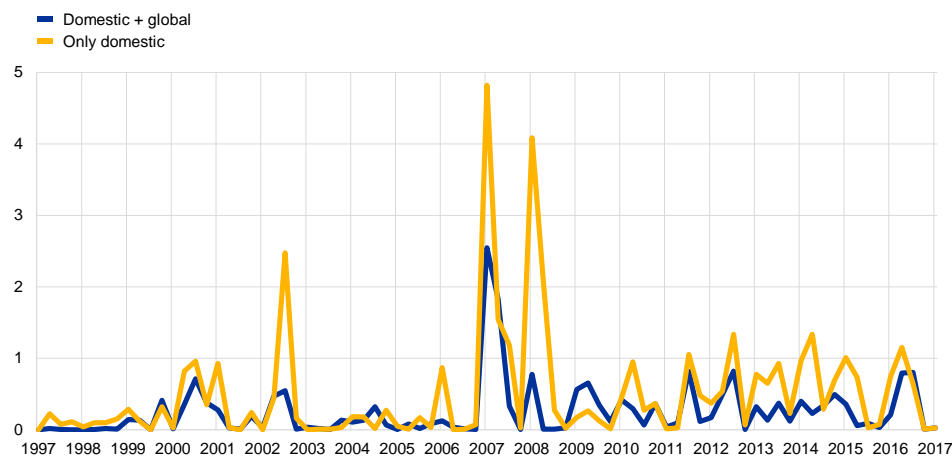


Source: Based on data in Forbes (2018).  
Notes: Median coefficient from rolling regressions from Table 1 using 8-year windows for quarterly, annualized CPI inflation from 1990-2017, estimated separately for each country. Dashed red lines are the 33% and 66% of the distribution. Domestic output gap measured as principal component of seven measures of slack.

## Chart 12

### Fit of Model With and Without Global Variables

(squared deviation of actual from predicted inflation)



Source: Based on data in Forbes (2018).

Notes: Median of squared difference between actual and predicted inflation in model estimated for each country with and without global variables. Regressions for CPI inflation using Phillips curve model in Table 1 with 8-year rolling windows.

## 5 Pulling it all Together: Adding Time-Varying Global Factors to Dynamic Inflation Models

This set of charts suggests that global factors, which have traditionally not been included in simple inflation models, can significantly affect inflation, and that the role of these global factors (as well as domestic factors) can change over time. But can including dynamic global factors meaningfully improve our ability to understand inflation?

To test this, Chart 12 shows the fit of two simple models predicting inflation: one that only includes the traditional domestic variables (inflation expectations, lagged inflation, and the domestic output gap), and the other which also adds the five global variables (exchange rates, world output gap, oil prices, commodity prices, and the dispersion in global PPI pricing). More specifically, I re-estimate the Phillips curve model from Table 1 for each country individually, using the same sample and variable definitions, but instead of fixing the coefficients over the full period, estimate rolling regressions over eight-year windows (as in Charts 9-11). Then I calculate the difference between actual quarterly CPI inflation and predicted inflation using each model, and graph the squared deviation of this “error” for the median country in the sample. The lighter yellow line shows the “error” for the model using only the domestic variables, and the darker blue line shows the “error” for the model using both the global and domestic variables. Including the global variables meaningfully reduces the “errors” (the deviations between actual and predicted inflation), especially in the later part of the period. This shows that adding global variables to inflation models, and allowing their impact to vary over time and across countries, can meaningfully improve our ability to understand inflation dynamics relative to models which only include domestic factors.



While Chart 12 suggests that including a set of dynamic global factors can improve the performance of our inflation models, it does not show which of the global factors are most important. A closer look at the estimates for individual countries, however, suggests a diversity of experiences – as found for the simple Phillips curve estimates with fixed coefficients.<sup>7</sup> Different global (and domestic) factors play different roles in different countries.

Empirical analysis in Forbes (2018), however, finds several results that are consistently robust for the cross-section of countries. In regressions for CPI inflation, the world output gap and commodity prices appear to be important over the last decade, but not the pre-crisis window. In contrast, in regressions for core inflation, there is less change in the role of the global variables over the last decade, although the exchange rate is important over the full sample period.

## 6 Conclusions

To conclude, adding global factors – such as exchange rate movements, commodity prices, oil prices, the world output gap, and the competition in producer pricing – to our basic models can meaningfully improve our ability to understand inflation dynamics. This does not mean “throwing away” our standard domestic variables, such as inflation expectations and slack, which both still play a role. Instead, simply adding these more comprehensive controls for global factors to standard inflation models can go some way towards better understanding why inflationary pressures have been so muted in many advanced economies over the last few years, despite solid growth and sharp falls in unemployment. Although the role of different global factors varies over time and across countries, commodity prices and global slack seem to have become more important to understanding CPI inflation over the last decade. Exchange rate movements have continued to be important in explaining movements in CPI as well as core inflation over the last decade – as well as before.

Finally, back to Prince Henry the Navigator’s faulty astrolabe. Supposedly the Portuguese sailors were responsible for an “innovation” that made the use of the astrolabe more reliable: read the instrument on solid land (or at least a rock or very calm day). This simple innovation of reading astrolabes in a more stable environment made them more accurate. Similarly, a fairly modest innovation to our simple inflation models – incorporating a more comprehensive set of controls for dynamic global factors – could also make our inflation models more accurate.

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<sup>7</sup> See Forbes (2018) for country-specific regression results.

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# The Macroeconomics of Price and Wage-Setting

By Philip R. Lane<sup>1</sup>

## Panel Remarks

In my remarks, I will focus on three questions: (i) how should central banks respond to low inflation?; (ii) how should central banks react to headwind shocks to inflation?; and (iii) how effective have been unconventional monetary policy measures in lifting inflation towards the target level?

I will discuss these questions in the context of the euro area and the monetary strategy of the ECB that has included non-standard elements (negative interest rate, forward guidance, asset purchase programme, targeted long-term liquidity refinancing operations) since the middle of 2014.

The policy package that was initially launched in summer 2014 was a response to the below-target outlook for the inflation rate and the subdued level of aggregate demand in the euro area. If the ECB had not taken decisive action, it is possible to entertain alternative scenarios in which expectations of ultra-low inflation or even deflation took hold. An excessively-tight monetary stance could also have contributed to further recessionary impulses, especially given the vulnerability of highly-indebted groups to adverse feedback dynamics between high lending rates, low aggregate demand and high bank funding conditions in some member countries.

Accordingly, the experience of the last several years is that a phase of persistently-low inflation requires a vigorous central bank response. Praet (2018) estimates that the ECB's package of unconventional measures will add a cumulative 1.9 percentage points to both inflation and output over 2016-2020, which has been achieved through an easing of financial conditions and the anchoring of inflation expectations. Furthermore, the probability distribution of inflation has shifted to the right, with very little weight now attached to deflation scenarios. In the absence of these non-standard measures, the inflation and output outlook for the euro area would be substantially worse.

Let me emphasise that such measures take time to operate, such that the gap between current inflation and the inflation target can only be closed gradually. During an extended period in which inflation is below its target, it is vital that a central bank is energetic and consistent in communicating its commitment to meeting its medium-term inflation target, while also being transparent about the need for patience

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<sup>1</sup> Governor of the Central Bank of Ireland. I thank Robert Goodhead and Shayan Zakipour-Saber for their assistance in preparing these remarks.

during the convergence process. A successful communications strategy also involves publishing as much as possible in terms of the central bank's analysis of the impact of non-standard measures, especially in view of the limited historical track record for such policies.

In addition to the role played by the considerable economic slack that remained after the 2008-2012 crisis years, temporary factors such as a phase of declining oil prices during 2014-2016 and some sectoral relative price movements (such as declines in the price of telecommunications bundles) have also contributed to below-target inflation. Considerable effort is devoted to unpicking pricing dynamics between less-volatile and more-volatile components and between more-cyclical and less-cyclical sectors, even while the target rate is appropriately measured in relation to headline inflation. As temporary and one-off factors fade away, the headline path should align with the underlying persistent component of inflation.

At one level, the distinction between the current headline inflation rate (affected by one-off factors) and the target medium-term inflation rate is well understood, since the practical reality of transmission lags means that central banks must necessarily set policy in relation to the medium term. However, if headline inflation is persistently below the target rate, this runs the risk of de-anchoring inflation expectations and can also lead to slower adjustment towards the target to the extent that there are backward-looking elements in price- and wage-setting. This reinforces the essential role played by a clear and consistent communication strategy that the central bank is intent on achieving its inflation target in the medium term and is acting through its full set of monetary policy instruments to ensure that inflation is on a path that will sustainably converge towards the target.

Returning to the 2014 debate on whether unconventional monetary instruments would prove helpful in tackling low inflation in the euro area, the accumulated evidence since then has proven the value of these measures. In a situation in which there was room for an easing in financial conditions and there was considerable economic slack, the combined impact of the different measures delivered a level shift downwards in the yield curve and a considerable reduction in lending rates. In turn, the easing in financial conditions and the commitment to the inflation target have facilitated a positive but measured pace of credit growth in recent years and a broad-based recovery in domestic activity levels across the euro area, together with a positive contribution from external demand that was especially important during 2014-2015. As noted earlier, the probability distribution for inflation has shifted rightwards and projections for inflation and output are more positive than would have been the case in the absence of these measures.

At the same time, inflation remains below target: as re-confirmed by the Governing Council at last week's meeting, an accommodative monetary strategy will remain in place in order to underpin the ongoing adjustment path for inflation towards its medium-term target.

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# Learning from stubborn inflation

By Charles Wyplosz<sup>1</sup>

## Abstract

In many advanced countries, inflation has stubbornly remained below target in spite of very expansionary monetary policies. Yet, it has been all but steady. The likely explanation is the combination of a flattened Phillips curve, increased sensitivity to external disturbances and well-anchored expectations. Two implications for the conduct monetary policies are drawn. First, central banks ought to recognize that monetary policy is too imprecise to aim at narrow bands. Second, they should communicate more with the broader public and less with financial markets.

## 1 Introduction

Japan has seen its inflation rate fluctuate around zero for more than three decades. Elsewhere among the advanced countries, central banks have visibly struggled to bring inflation up to their common 2% target. A very large literature has been dedicated to explaining the stubbornness of inflation in most advanced countries and the papers presented earlier contribute to this literature in several interesting ways.

Yet, as we meet in mid-2018, inflation is now on the rise, raising the opposite concern that inflation could soon overshoot its target. A quick look at the data reminds us of Friedman (1968) who famously predicted that the Phillips curve would vanish only to explain how to make it come back. Charts 1 and 2 show the growth rates over two decades of consumer prices in the United States and the United Kingdom, and in the euro area and Switzerland, respectively. The first observation is that inflation has not been steady since the Great Financial Crisis. In all four cases, it has been fluctuating more widely than before the crisis. In Switzerland and the euro area, there seems to be a break in the trend around which inflation fluctuates, but not so in the United States and the United Kingdom, where the recovery is having its expected effect, but with a lag that is much longer than we were used to. This has led to much work on changes in the labour market, which has documented the deleterious effects of the Great Financial Crisis. Half a century after Friedman, we are again grappling with the “disappearing Phillips curve”. My reading of what we have learned can be summarized in three points:

- Domestic conditions matter less for inflation, i.e. the Phillips curve still exists but it is flatter than it used to be (for reasons not fully understood).

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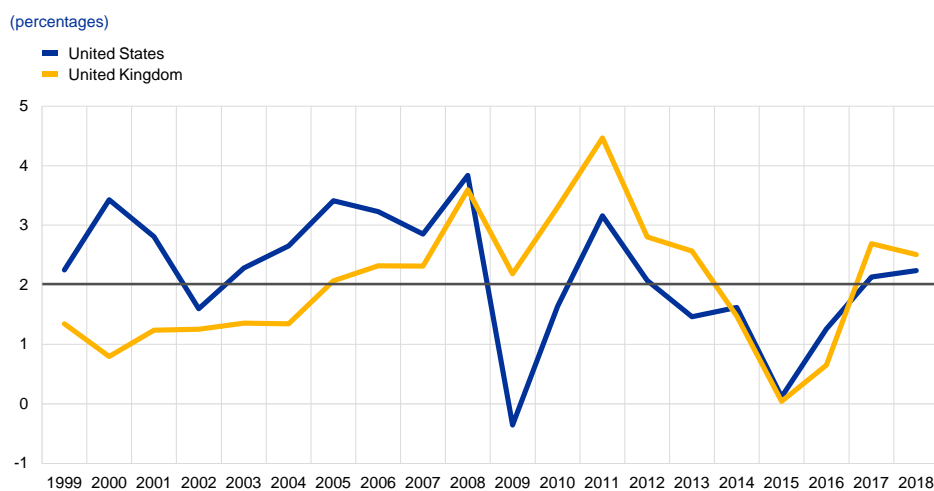
<sup>1</sup> The Graduate institute, Geneva.

- External conditions matter more for inflation, hence it is more volatile (Forbes, 2018).
- The broad public – outside financial markets – does not pay attention to inflation (Gorodnichenko et al., 2018)

These points have important implications for monetary policy.

### Chart 1

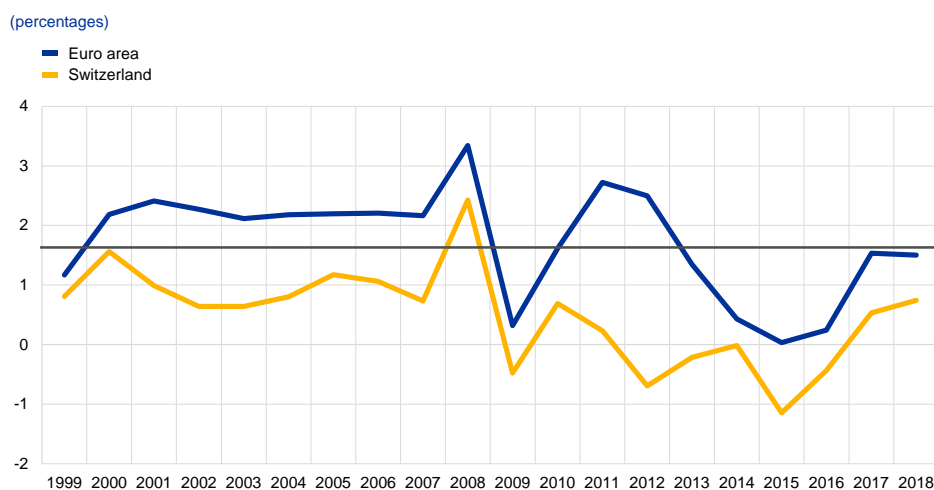
#### Inflation rate in the United States and the United Kingdom



Sources: AMECO on line, European Commission.

### Chart 2

#### Inflation rate in Switzerland and the eurozone



Sources: AMECO on line, European Commission.



## 2 The old Phillips curve

Theoretical support for Friedman's expectations-augmented Phillips curve has been overwhelming. Simply put, we all seem to accept the following equation:

$$\pi_t = E_t(\pi_{t+1}) + \alpha x_t + \beta X_t$$

where  $\pi$  is the inflation rate,  $x$  is a measure of the output or unemployment gap and  $X$  are external factors. The problem is that this equation has not been doing well empirically, neither before, nor after the crisis. Instead, the data seem to like better the following equation:

$$\pi_t = \pi_{t-1} + \alpha x_t + \beta X_t$$

where expected future inflation is replaced by past inflation. Here again, the relevant literature is enormous. Let us assume that the data is right, this latest equation helps us understand what has been happening. First,  $\alpha$  has become smaller, so that central banks must work harder on the output gap to move inflation. Quite possibly it is past gaps that matter. Second,  $\beta$  has become larger, likely a testimony of global trade integration and its long supply chains. This means that central banks have less control of year-to-year inflation (more on that later). Third, and more importantly perhaps, *ceteris paribus* inflation today is what it was yesterday, rather last year. This is annoying for central banks because it means that all their efforts at communication do not stand a chance to have much of an effect. Indeed, over the last years, much has been said about the fact that expectation surveys showed that inflation was well anchored, precisely at the inflation target. Somehow, people trusted the central banks to eventually meet their targets but, in the meantime, they just kept inflation where it was, subject to small effects of the output gap and large external effects.

## 3 First implication: modest aims

During the crisis, the inflation targeting strategy had to be complemented with the recognition that central banks have another responsibility than price stability, namely financial stability. This may require a temporary over-ride of inflation targeting but, in normal times, inflation targeting remains the best strategy on the shelf. The only alternatives are price level targeting and nominal GDP targeting. There is much to say about price level targeting, a strategy recently revived by Bernanke (2017), but it is not the topic of this roundtable. Similarly, nominal GDP targeting raises a number of issues. Realistically, inflation targeting is likely to remain the strategy of choice for most central banks.

Similarly, the use of the very short-term interest rate as the key monetary policy instrument has survived the challenges of the crisis. The main issue is the zero-lower bound, which has become surprisingly prevalent after Japan's long experience. The response, Quantitative Easing, has been the right one and seemingly effective. The Bank of Japan's interventions on the yield curve are another complementary instrument when the interest rate hits the lower bound. The challenge is not to find a

substitute for the short-term interest rate, but to reduce the probability of reaching the zero-lower bound, a controversial issue.

These reassuring observations notwithstanding, the current state of monetary policymaking can be perfected. That the inflation target has remained elusive suggests that the precision of monetary policy is imperfect because the ability of central banks to affect inflation via the output gap is limited and because external disturbances have significant and sometimes long-lasting effect. In addition, the occasional emergence of financial stability concerns requires that central banks pay less attention to price stability, however defined.

Charts 1 and 2 confirm that monetary policy is quite imprecise. The frequent letters from the Governor of the Bank of England to the Chancellor of the Exchequer are another signal pointing in the same direction. What is the problem with missing so often the target? It is not the central bank credibility. The anchoring of inflation expectations to the target shows that, like the Chancellor of the Exchequer, the public well accepts that target misses are not the result of serious policy mistakes. The problem with missed targets is that they stand to weigh on central bank deliberations. It is unhealthy to always be trying to hit an elusive target, and it can lead to policy mistakes, as happened in 2011 in the euro area when the ECB raised its policy rate in the teeth of a serious recession.

One way out of this conundrum is to widen the implicit or explicit margin of tolerance around the implicit or explicit inflation target. In many countries the margin width is of about 2 percentage points. This has been found repeatedly to be too narrow for comfort. It will be objected that wider margins would create risks for financial markets. This objection is very weak. First, at the abstract level, the risk exists and has to be borne. It makes more sense for the markets to live with this risk than to try to impose it on central banks. Second, at the practical level, the markets are well aware that the margins can be broken and, as already noted, they do not seem to be sensitive to such episodes. In the end, recognizing that policy is imprecise is unlikely to have adverse effects on central bank credibility while injecting more serenity in their policy deliberations.

## 4 Second implication: central bank communication

Over the years, central banks have fine-tuned their communication with financial markets. They make carefully crafted statements at well thought-through junctures, they ensure that there is no private information and they pay considerable attention to the impact of their statements on asset prices and interest rates. They are concerned that any change in policy or strategy might be a destabilizing force, even if the effect is likely to dissipate fairly quickly. This concern is understandable, of course. There is no reason to rock the boat, especially if the boat can be unstable.

On the other hand, the previous discussion about the Phillips curve strongly suggests that central banks fail to move inflation expectations. This is my reading of Coibion et al. (2018), along with their finding that the broader public pays very little attention to

central bank communication. The markets are an important channel of monetary policy transmission as they set asset prices and interest rates of various maturities and riskiness. As far as inflation is concerned, however, it is the broader public that sets prices and wages. The risk with emphasis on communication with financial markets is that central banks focus on the intermediate step, the channel of transmission, not on the ultimate impact, wage and price-setting. This may be one reason why empirical Phillips curves include  $\pi_{t-1}$  and not  $E_t(\pi_{t+1})$ , which lies behind both medium-term stubbornness and short-run variability of inflation.

If this analysis is correct, it means that central banks ought to rethink their communication strategies. Their carefully crafted and rather technical communication with financial markets is not understandable to the broader public, including business managers of both large and small firms, trade unions and most agents involved in wage and price-setting. As long as inflation is reasonably low, the broader public does not attempt to understand central bank communication. Wage and price setters focus on relative prices, paying no attention to the trend, i.e. medium-term inflation, which is the policy goal.

A possible implication is that central banks could re-orient their communication strategies. They should be encouraged by the results of Coibion et al. (2018) who find that the broader public responds when directly provided with relevant information. Some central banks, like the Bank of England, make sure that their policymakers routinely address the broader public, including through frequent travel and local meetings. One could even go even further and question the need for extensive communication directed at financial markets. The markets' sometimes-dramatic reactions may result in large gains and losses of individual participants but, in the aggregate, they fade away fairly quickly with no real macroeconomic impact. More uncertainty would lead to more prudent risk management and less dramatic reactions, leaving central bank with a freer hand.

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# Measuring inflation in the modern economy – a micro price-setting view

By Aviv Nevo<sup>1</sup> and Arlene Wong<sup>2</sup>

In this presentation<sup>3</sup> we give an applied micro view on how trends in the modern economy might impact the measurement of inflation. These trends include, for example, globalization, competition, the growth of e-commerce and the sharing economy, and increased use of “big data” and new pricing models. We discuss factors that might explain the low inflation in post Great Recession period. We organize our discussion around two areas. First, we discuss measurement areas including substitution bias that stems from shopping behavior and issues regarding measurement of online prices. Second, we discuss more conceptual issues including cost pass-through, decreased competition, pricing models and consumer heterogeneity.

With regards to the lower-than-expected inflation post-recession, a first order question is what happen to wages. We leave this question for labor economists. Instead, we take as given what happen to wages and ask why it seems that prices went up less. We do not offer an answer to this question. Instead, we discuss several factors that could impact the transmission of wages (and other costs) to measured prices.

We start by studying consumer shopping behavior during, and post, the Great Recession. In Nevo and Wong (forthcoming) we show that during the recession consumer shopping behavior changed. Consumers found ways to save by buying more on sale, using more coupons, buying large sizes, buying generic products and switching to cheaper outlets. This means that “standard” measures of inflation that do not account for these changes will over-estimate inflation during the recession. In the presentation we extend our analysis to the post-recession period and find that many of these shopping activities decreased in the post-recession period. A back of the envelope computation suggest that these decreases could imply that post-recession inflation is as much as 20% higher than measured inflation. An open question is whether the changes in consumer behavior are indicative of a longer-term trend. We do not know the answer to this question, but there is some evidence that there is a long-term change. For example, Neiman and Vavra (2018) show a rise in the concentration across brands in household spending.

A second change in shopping behavior has been online shopping. Online shopping has been increasing at a rapid base, accounting for as much as 10 percent of retail shopping by some measures. It is not clear if these measures include transaction from Uber, Airbnb and many other “sharing economy” applications. Theoretically, there are

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<sup>1</sup> University of Pennsylvania and NBER.

<sup>2</sup> Princeton University and NBER.

<sup>3</sup> [Presentation](#)

reasons why prices online should be different (and exhibit different change rates) than brick and mortar prices. Consistent with this, Goolsbee and Klenow (2018) use a unique data set to show that lower inflation in online prices. A challenge for government agencies is to find a way to consistently incorporate online prices into official price indices.

Switching to more conceptual issues. A key to understanding the impact of changes in the labor market on consumer prices is understanding cost pass-through. An often-forgotten fact is that standard pricing models predict that pass-through should not in general be 100 percent. Theory says that pass-through rates can be either above or below 100 percent, although empirical studies suggest that pass through is typically less than 100 percent. Sometimes much less. This suggests that it should not be surprising that measured inflation increased less than wages.

One might still wonder what changed during the recovery from the most recent recession. Why was pass through different (assuming it was) in this recovery? Have there been long term trends that imply a structural change? We examine several factors that might suggest long term changes. First, we study a trend that has received significant interest recently: a claim that firms' market power has risen (De Loecker and Eeckhout, 2017). This implies two things for pass-through. The measured increase in mark-ups is directly tied to decreasing labor share. So even holding pass-through rates constant, since the labor share is lower, the impact of an increase in wages on consumer prices is lower. Furthermore, while theoretically one cannot show a robust monotonic relationship between competition and pass-through rates, some believe that pass-through decreases with concentration. Under this view, if indeed industries are getting less competitive the pass-through might be decreasing.

Another well-established trend is a more global and complex supply chain (Wei and Xie, 2018). This has two implications for the relationship between wages and consumer prices. First, there is less direct link between local labor and products. Second, there are potentially more levels of intermediates and, if pass-through is less than 100 percent at each level, this leads to an even lower overall pass-through rate.

Finally, the last factor is "big data" and pricing models. The availability of data and a general increase in quantitative analysis, might suggest that firms are more likely to behave according to economic models of pricing and less according to a cost-plus model. This might suggest that pass-through rates have changed over time. Furthermore, the availability of data suggest that price discrimination is much easier to implement. This has two implications for the measurement of inflation. More complex pricing models might suggest low pass-through rates. Maybe more importantly, they raise the obvious question of whose inflation we want to measure. If different consumers are systematically paying different prices, they might also be systematically facing different inflation rates.

Where does this leave us? Unfortunately, without a clear answer to the question of why inflation was lower post-recession. However, it does suggest that to answer these questions we need more data including data on online transactions and consumer specific prices and behavior. It also suggests collaborative research that brings together micro and macro economists is extremely valuable.

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# Comment on “Measuring inflation in the modern economy – a micro price-setting view” by Aviv Nevo and Arlene Wong

By Michael Weber<sup>1</sup>

## Abstract

In their contribution to the 5th ECB Forum in Sintra, Nevo and Wong raise the possibility of decreased competition and new pricing models to change the pass through of shocks into prices. In this discussion, I first want to put the puzzle of low inflation into historical perspective. I will then discuss recent evidence on trends in concentration in retail sectors that in turn affect prices, and argue that changes in the age-structure of the workforce and how individuals form inflation expectations might help understand the low inflation observed in recent years.

## 1 Low Inflation – a Historical Perspective

Low inflation in advanced economies over the last ten years has been a pervasive feature around the world. Chart 1 plots the annualized CPI inflation rate over time in the United States from 1970 until May 2018. We see that realized inflation in the last several years has indeed been below a long term average of 3.94%. But starting in 1970 is clearly arbitrary. When we instead start the sample in 1950 in Chart 2, the historical average comes down to 3.42%. Still, the last years are below the mean. Interestingly, even several periods in the early sample in the 1950s and 1960s are well below the historical mean. Another central stylized fact has been the steady decrease in inflation since the early 1980s. But maybe, the economy has gone through structural changes and the past is a poor benchmark for the recent period. When we start the sample in 1990 in Chart 3, we see a historical mean of 2.43% and the last couple of years do not appear anomalous relative to this more recent period.

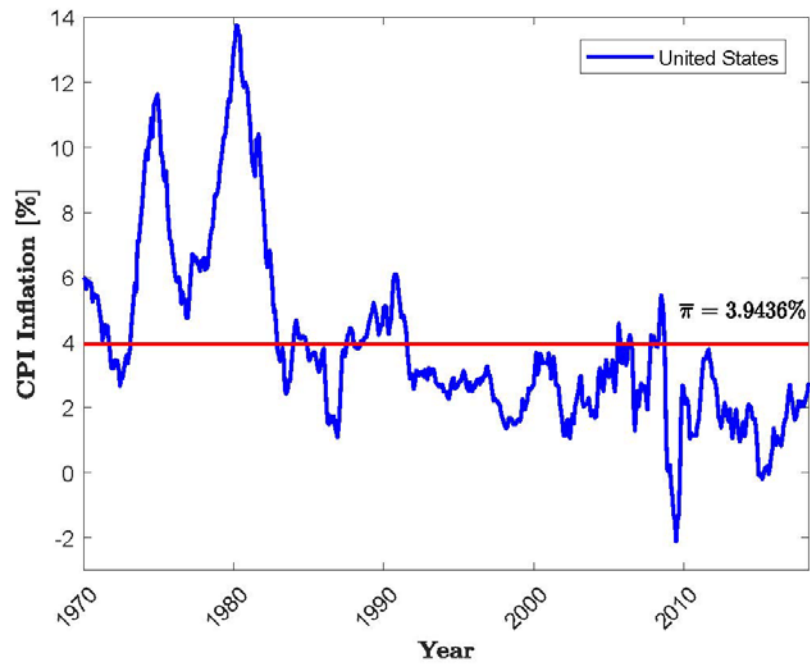
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<sup>1</sup> University of Chicago Booth School of Business and NBER.



**Chart 1**

Consumer Price Inflation Over Time: United States

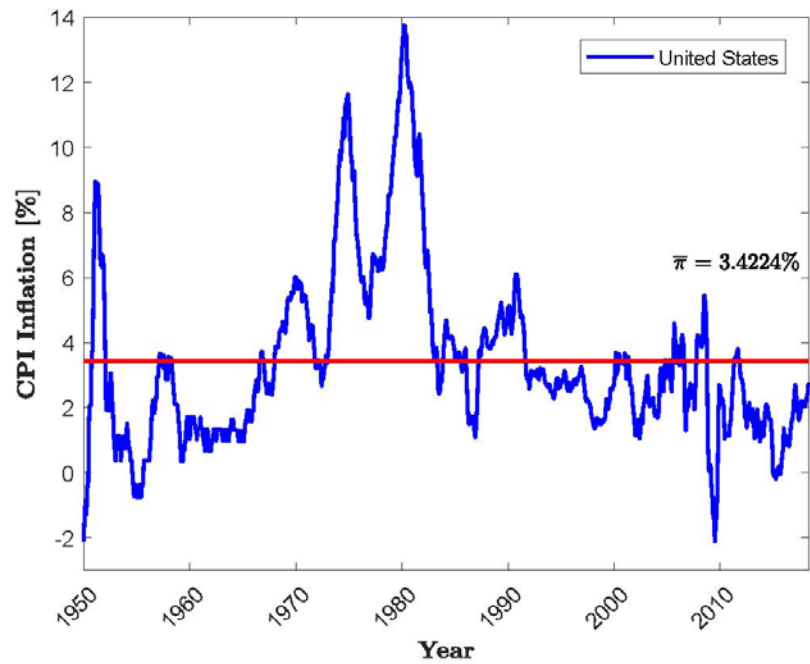


Sources: US Bureau of Labor Statistics.

Notes: Annual US CPI inflation in percent defined as log changes over time in blue and the historical mean in red from January 1970 until May 2018.

**Chart 2**

Consumer Price Inflation Over Time: United States

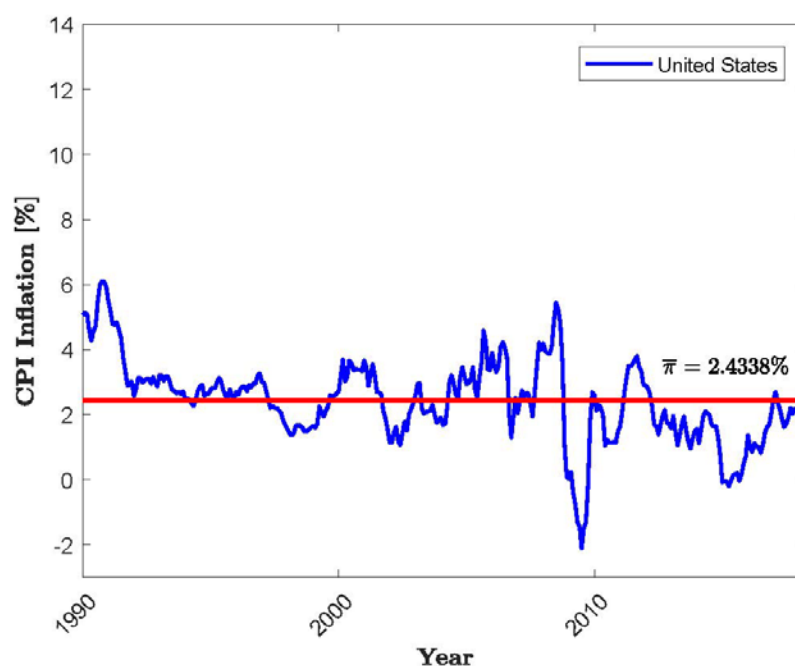


Sources: US Bureau of Labor Statistics.

Notes: Annual US CPI inflation in percent defined as log changes over time in blue and the historical mean in red from January 1950 until May 2018.

**Chart 3**

Consumer Price Inflation Over Time: United States



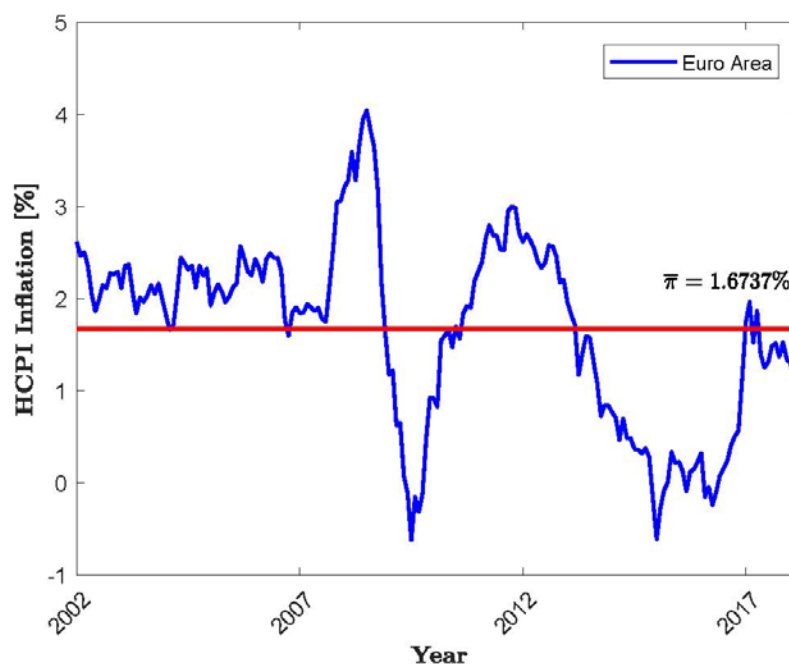
Sources: US Bureau of Labor Statistics.

Notes: Annual US CPI inflation in percent defined as log changes over time in blue and the historical mean in red from January 1990 until May 2018.

Similar results arise for the European Monetary Union, in which we observe in Chart 4 an average inflation rate of 1.67% over a period starting in 2002 and ending in April of 2018. Hence, we could definitely argue that inflation has been low in recent years relative to historical standards, but we have also seen other periods of low inflation in the past. Given the limited amount of data, I would encourage researchers and policy makers to also consider other historical episodes that might shed some light on possible mechanisms and reasons for low inflation.

**Chart 4**

Consumer Price Inflation Over Time: eurozone



Sources: [Eurostat].

Notes: [Annual euro-area HICP inflation in percent defined as log changes over time in blue and the historical mean in red from January 2002 until April 2018].

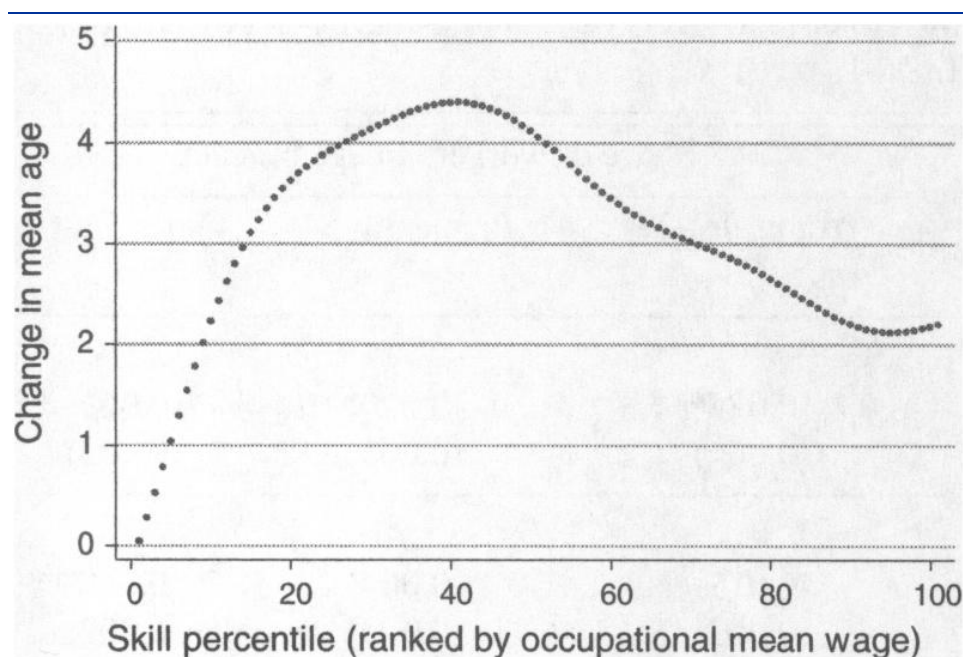
## 2

### Change in the Age Composition of the Labor Force

Inflation has been trending down since the early 1980s. But the overall trends in inflation camouflages a large degree of heterogeneity across industries. In Schoefer, Weber and Yin (2018), we show differential trends across long periods of time in narrowly defined industries. Another central trend in many developed economies that started around the 1980s was the increased usage of computers, robotics, and automation more generally. Autor and Dorn (2009) argue in detail on how these trends result in changes in the age structure of the workforce which differed a lot across industries along the skill distribution. Chart 5 which comes from Autor and Dorn (2009) shows the change in the age structure of the workforce along the skill distribution which they proxy by wage. We see large increases in the age structure for routine, middle-class jobs, whereas low- and high-skilled jobs aged substantially less.

**Chart 5**

Age Structure of Labor Force and Inflation: 1975-1989



Sources: Autor and Dorn (2009).

Notes: Smoothed changes in mean worker age by occupational skill percentile, 1980–2005.

In Schoefer et al. (2018), we ask whether the differential changes in the age structure of the workforce might help explain cross-sectional differences in the inflation trends across industries and whether lower wage growth in industries with a larger share of old workers might drive these patterns, possibly due to weaker bargaining positions.

To test for this mechanism, we use Census Ipums data to create ratios of the hours worked by workers between the age of 55 and 64 over the total hours worked in a given industry (S2A). We can construct the ratio for up to 116 unique industries at five-year intervals and a sample from 1975 until 2015. We then calculate the average annual inflation rate at the industry level using data from the Bureau of Labor Statistics, the industry-specific labor intensity as the ratio of labor costs to value added (INT), and as additional control variables shipping costs (SC) as a proxy for import competition, industry unemployment to proxy for slack (UE), unionization (MEM) to proxy for the power of the labor force in wage bargaining, and commodity price inflation.

In row 1 of Table 1, we see that industries which have a large share of old workers relative to all workers tend to experience lower inflation in the following years. Row 3 shows that this effect is especially pronounced in industries that rely more on labor, as we would expect. This result holds whether or not we exploit within industry variation or within time variation or both and whether or not we control for additional covariates. Economically, the ratio of old to all workers explains a meaningful part of the variation in industry inflation. A one-standard deviation increase in this ratio lowers industry inflation by 0.5 standard deviations. Charts 6 to 8 show in binned scatter plots that this phenomenon holds across sub-periods and the negative association appears especially tight in the last 9 years.

**Table 1**  
Age Structure of Labor Force and Inflation

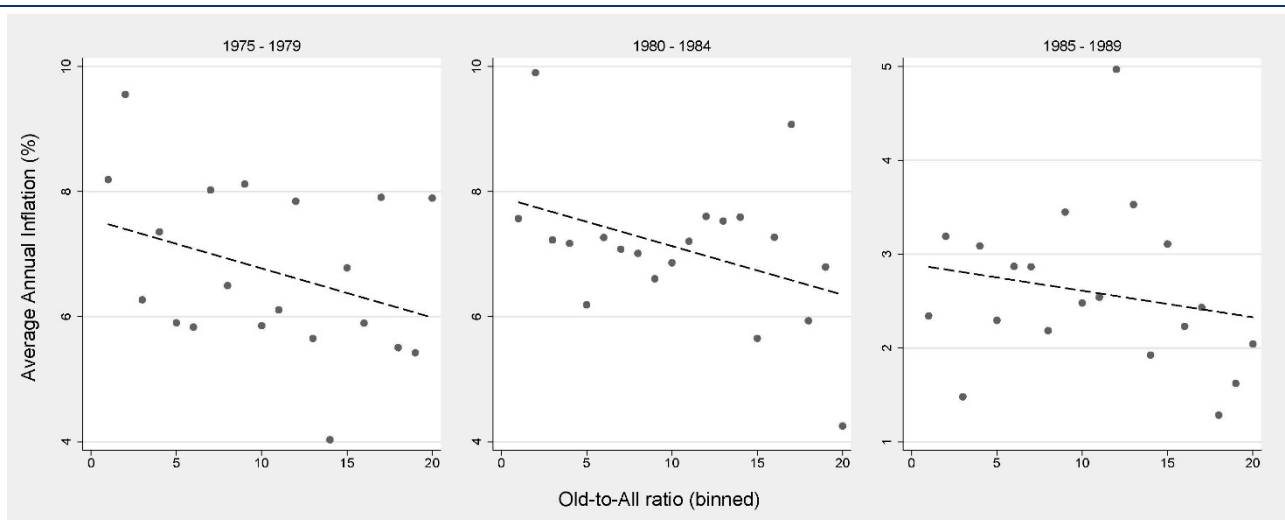
<b>S2A</b>	-0.0603** (0.03)	-0.1389*** (0.03)	-0.3763*** (0.07)	-0.3617*** (0.07)	-0.3680*** (0.07)	-0.2961*** (0.07)
<b>INT</b>				-0.0349** (0.02)	-0.0335** (0.02)	-0.0074 (0.03)
<b>S2A X INT</b>				-0.0014** (0.00)	-0.0015** (0.00)	-0.0023** (0.00)
<b>SC</b>					0.0711 (0.10)	-0.0083 (0.08)
<b>UE</b>					-0.0729 (0.07)	-0.0919 (0.06)
<b>MEM</b>					0.0049 (0.02)	-0.0106 (0.02)
<b>Nobs</b>	825	825	825	825	825	825
<b>R2</b>	0.009	0.2516	0.687	0.6935	0.6954	0.7721
<b>Ind Fixed Effects</b>		Yes	Yes	Yes	Yes	Yes
<b>Period Fixed Effects</b>			Yes	Yes	Yes	Yes
<b>Commodity Prices</b>						Yes

Sources: Schoefer, Weber and Yin (2018).

Notes: This table reports results of regressing average annual inflation at the industry level from the Bureau of Labor Statistics on the ratio of hours worked by workers between the age of 55 and 64 over the total hours worked in a given industry (S2A) from the Census Iperms data. The other controls are the industry-specific labor intensity as the ratio of labor costs to value added (INT), shipping costs (SC) as a proxy for import competition, industry unemployment to proxy for slack (UE), unionization (MEM) to proxy for the power of the labor force in wage bargaining, and commodity price inflation. The sample period is 1975 to 2018. Standard errors in parentheses. \* p<0.10, \*\* p<0.05, \*\*\* p<0.01.

**Chart 6**

Age Structure of Labor Force and Inflation: 1975-1989

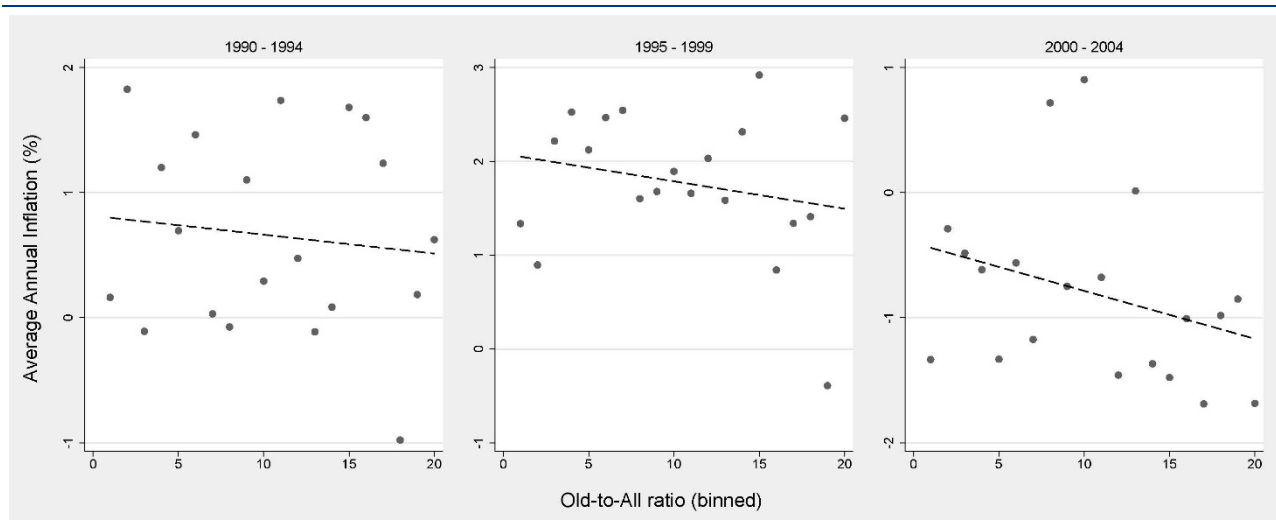


Sources: Schoefer, Weber and Yin (2018).

Notes: Binned scatter plot of the residualized average annual inflation at the industry level from the Bureau of Labor Statistics over a five-year period and the residualized ratio of hours worked by workers between the age of 55 and 64 over the total hours worked in a given industry (Old-to-All ratio) from the Census Iperms data. We residualize the variables with respect to all covariates in column 6 of Table 1.

## Chart 7

### Age Structure of Labor Force and Inflation: 1990-2004

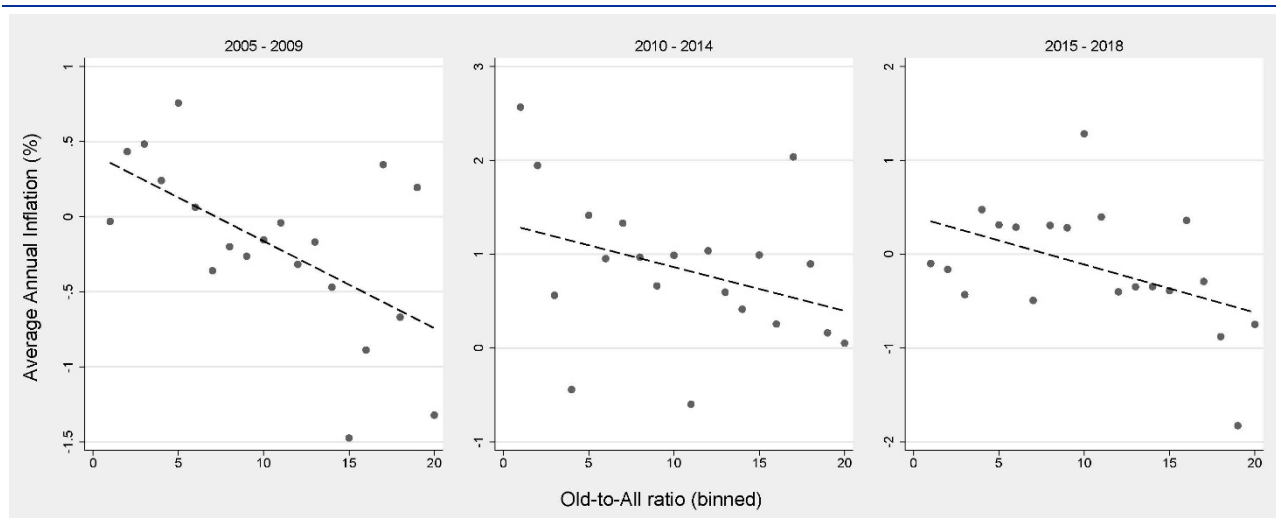


Sources: Schoefer, Weber and Yin (2018).

Notes: Binned scatter plot of the residualized average annual inflation at the industry level from the Bureau of Labor Statistics over a five-year period and the residualized ratio of hours worked by workers between the age of 55 and 64 over the total hours worked in a given industry (Old-to-All ratio) from the Census Ipums data. We residualize the variables with respect to all covariates in column 6 of Table 1.

## Chart 8

### Age Structure of Labor Force and Inflation: 2005-2018



Sources: Schoefer, Weber and Yin (2018).

Notes: Binned scatter plot of the residualized average annual inflation at the industry level from the Bureau of Labor Statistics over a five-year period and the residualized ratio of hours worked by workers between the age of 55 and 64 over the total hours worked in a given industry (Old-to-All ratio) from the Census Ipums data. We residualize the variables with respect to all covariates in column 6 of Table 1.

To study the channel through which the age structure of the labor force affects industry inflation, we study the average wage growth at the industry level. We see in Table 2, industries with a higher ratio of old to all workers have lower average wage growth subsequently, especially in industries with higher labor intensity. Economically, a one standard deviation increase in the ratio of old to all is associated with a 0.3 standard deviation lower wage growth at the industry level.

**Table 2**  
Age Structure of Labor Force and Wages

<b>S2A</b>	-0.0736** (0.03)	-0.1051*** (0.03)	-0.1891*** (0.05)	-0.1792*** (0.05)	-0.1940*** (0.05)	-0.1569** (0.07)
<b>INT</b>				-0.0286** (0.01)	-0.0261** (0.01)	-0.0316 (0.03)
<b>S2A X INT</b>				-0.001* (0.00)	-0.0011** (0.00)	-0.0010* (0.00)
<b>SC</b>					0.1343 (0.08)	0.0876 (0.07)
<b>UE</b>					-0.1252** (0.05)	-0.1382*** (0.05)
<b>MEM</b>					-0.0052 (0.01)	-0.0125 (0.01)
<b>Nobs</b>	825	825	825	825	825	825
<b>R2</b>	0.0184	0.1731	0.6597	0.6646	0.6719	0.7441
<b>Ind FE</b>		Yes	Yes	Yes	Yes	Yes
<b>Period FE</b>			Yes	Yes	Yes	Yes
<b>Commodity Prices</b>						Yes

Sources: Schoefer, Weber and Yin (2018).

Notes: This table reports results of regressing average annual wage growth at the industry level from the Bureau of Labor Statistics on the ratio of hours works by workers between the age of 55 and 64 over the total hours worked in a given industry (S2A) from the Census Ipums data. The other controls are the industry-specific labor intensity as the ratio of labor costs to value added (INT), shipping costs (SC) as a proxy for import competition, industry unemployment to proxy for slack (UE), unionization (MEM) to proxy for the power of the labor force in wage bargaining, and commodity price inflation. The sample period of 1975 to 2018. Standard errors in parentheses. \* p<0.10, \*\* p<0.05, \*\*\* p<0.01.

Hence, change in the age composition of the labor force, possibly driven by trends to automation, increased usage of computers, and changes to import competition might help explain part of the downward trend in inflation over time.

### 3 Trends in Concentration in Retail

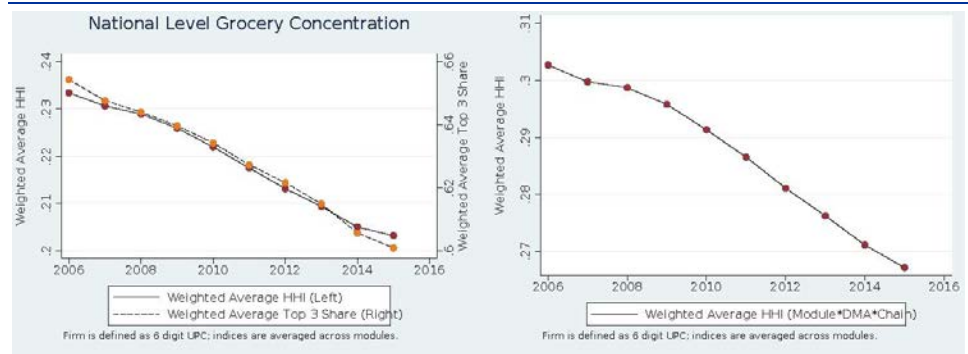
De Loecker and Eeckhout (2017) document increasing market concentration for manufacturing industries over time. Nevo and Wong (2018) discuss how changes of the concentration structure at the industry level might result in lower pass through of shocks to prices and might lead to lower inflation.

Unfortunately, most commonly-used datasets do not contain measures of both industry concentration and output prices. For example, the micro data underlying the producer price index in the United States does allow the calculation of inflation rates at the granular level, but does not contain measures of industry concentration. The Compustat data De Loecker and Eeckhout (2017) use allows them to construct measures of market power, but does not contain any information on output prices. To overcome these hurdles, Schoefer, Weber and Zhang (2018) focus on a subset of household spending, groceries, and use the micro data from the Nielsen retail panel, which allows them to measure jointly concentration and prices.

To measure concentration, Schoefer et al. (2018) first have to define the relevant market. Ideally, the market should consist of products that are close substitutes and spatial partitions that are exposed to similar demand conditions, local shocks, etc. The

authors define market as the product of Nielsen Designated Market Area (DMA) and product modules. Examples are the San Francisco-Oakland-San Jose area for DMA and Chocolate Candy for product module. To measure concentration, the authors construct a standard Herfindahl-Hirschmann index but also a version excluding the specific firm whose price-setting strategy is studied to ensure no mechanical correlation drives the results.

**Chart 9**  
Retail Concentration



Sources: Schoefer, Weber and Zhang (2018).  
Notes: This figure plots average measures of concentration over time for different definitions of markets using the Nielsen Retail Panel. The sample period is from 2006 to 2015.

Interestingly, Chart 9 shows that concentration decreased over the period 2006 to 2015. This is a robust feature in retail for different definitions of market and concentration. Schoefer et al. (2018) then study the correlation between log prices and firm concentration in Table 3, and find another puzzling feature. Firms tend to set lower prices for the main product in markets in which they have a higher market power. The negative correlation holds in the raw data (when they only exploit variation within firm and year), firm, year and DMA or within retail chain, firm and year. The correlations and the trends in concentration certainly require additional research but question the hypothesis that increasing concentration resulted in low inflation, at least for the retail sector.

**Table 3**  
Retail Concentration and Prices

HHI	-0.056*** (0.02)	-0.056*** (0.01)	-0.058*** (0.02)	-0.058 (0.04)	-0.056*** (0.02)	-0.056*** (0.02)
FE	Firm X Year	Firm X Year	Firm X Year X DMA	Firm X Year X DMA	Firm X Year X Chain	Firm X Year X Chain
Cluster	Firm	DMA X Chain	Firm	DMA X Chain	Firm	DMA X Chain
Nobs	16,816,747	16,816,747	12,620,216	12,620,216	16,346,276	16,346,276

Sources: Schoefer, Weber and Zhang (2018).  
Notes: This table reports results of regression log prices in the Nielsen Retail Panel on the Herfindahl-Hirschmann index in a given market absorbing fixed effects at different levels. Standard errors in parentheses. \* p<0.10, \*\* p<0.05, \*\*\* p<0.01.



## 4 Inflation Expectations

The New Keynesian Phillips curve is a central part of many models central banks around the world use for policy analysis. It relates inflation to inflation expectations and measures of slack. So one possibility why inflation might be low is because inflation expectations in the economy are low. In this section, I first want to discuss how individuals form inflation expectations and then move on to discuss why measures central banks implemented to raise inflation expectations might have not been successful.

### 4.1 The Formation of Inflation Expectations

Most central banks focus their attention to movements in core inflation excluding inflation in food and gas prices because they are often transient and volatile. But at the same time, for most households, trips to the gas station and grocery store are among the most salient price experiences. If now households extrapolate from salient prices to overall inflation expectations and make economic decisions in line with those expectations, central banks might make systematic policy mistakes by neglecting movements in those subcomponents.

To study how households form inflation expectations and whether households extrapolate from salient prices to overall inflation, we run in D'Acunto, Malmendier, Ospina and Weber (2018) a large-scale survey on all household members of all panel households in the Nielsen homescan panel. The latter contains all prices and quantities households paid mainly for groceries at the weekly frequency. Another side goal of the study is to understand one of the most pervasive puzzles in individual inflation expectations: across countries, surveys, and time periods, women have consistently higher inflation expectations than men (whose inflation expectations are also upward biased on average).

We asked households in June 2015 questions on inflation expectations, other expectations, as well as who the main grocery shopper is within households. In column (1) of Table 4, we also see in our survey that men have inflation expectations that are lower by 1.32 percentage points on average when we exploit within household variation only. In column (2) instead, we add a dummy variable that takes on the value of 1 if the individual answers to be the main grocery shopper within the household. We see a large shopper effect, that is, the individual within household who does the groceries has inflation expectations that are higher by 1.6% relative to the household members who do not shop for groceries on a regular basis. The last two columns split the sample between men and women and, if anything, we find a larger shopping effect among men than among women.

**Table 4**  
Inflation Expectations, Gender and Grocery Shopping

	All	All	Women	Men
<b>Male</b>	-1.32*** (0.18)	-0.46 (0.32)		
<b>Makes Groceries</b>		1.64*** (0.32)	3.89*** (0.60)	4.89*** (1.06)
<b>Household FE</b>	Yes	Yes		
<b>Nobs</b>	25,595	25,595	17,246	8,349
<b>Adjusted R2</b>	0.95	0.95	0.99	0.99

Sources: D'Acunto, Malmendier, Ospina and Weber (2018).

Notes: This table reports results of regressing inflation expectations at the individual level over the next 12 months on a gender dummy and a dummy which takes the value of 1 if the individual declares to be the main shopper within household. The data comes from the first wave of the Chicago Booth Expectations and Attitudes survey in June of 2015. Standard errors in parentheses. \* p<0.10, \*\* p<0.05, \*\*\* p<0.01.

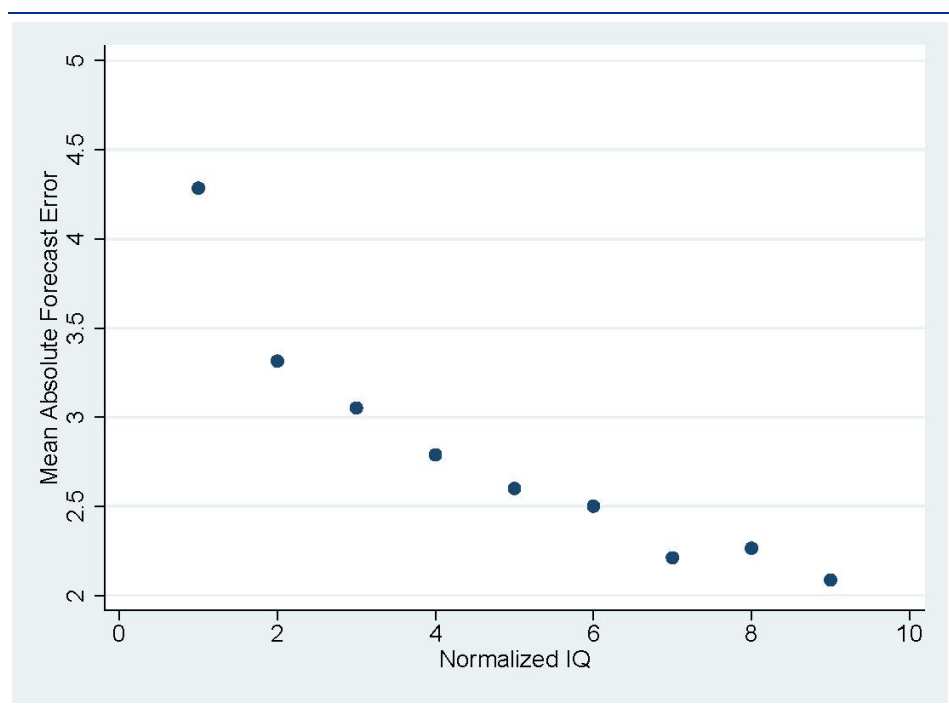
The evidence suggests that we need a better understanding on how individuals form inflation expectations and ignoring salient price changes from policy considerations might result in systematic policy mistakes.

## 4.2 The Adjustment of Inflation Expectations to Policy

In the standard New Keynesian model, promises to keep interest rates low until the end of the liquidity trap generate future inflation, hence agents adjust upwards their inflation expectations today and increase spending due to intertemporal substitution. In the data, instead, Del Negro, Giannoni and Patterson (2015) identify a forward guidance puzzle, that is, these types of measures did not raise inflation expectations. In D'Acunto, Hoang, Paloviita and Weber (2018), we attempt to shed light on this puzzle and try to understand whether individual cognitive abilities matter for the effectiveness of economic policies. In fact, Woodford (2018) argues theoretically that we assume "unrealistic cognitive abilities on the part of decision makers".

**Chart 10**

Forecast Errors for Inflation and IQ



Sources: D'Acunto, Hoang, Paloviita and Weber (2018).

Notes: This figure plots the average absolute monthly inflation forecast error across IQ levels. Forecast error is the difference between the numerical forecast for one-year-ahead inflation and ex post realized inflation. IQ is the standardized test score from the military entrance exam test for all men in Finland. IQ obtains integer values between 1 and 9. The sample period is from March 1995 to March 2015.

To tackle this question, we merge data on IQ for all men in Finland from the Finnish military with the micro data underlying the European Commission consumer confidence survey for Finland and household balance sheets from Statistics Finland. Chart 10 plots the average absolute forecast error by IQ bins. We define forecast errors as the difference between expected inflation and the ex post realized inflation. Normalized IQ is a standardized measure from the military which follows a standardized nine distribution and aims to approximate a discretised normal distribution. We see in the figure forecast errors for inflation are more than twice as large for Finnish men with low IQ than they are for Finnish men with high IQ. But do those differences matter for the effectiveness of economic policies?

In Table 5, we report marginal effects of inflation expectations on the propensity to purchase larger ticket items from the survey. Conditional on a rich set of demographics, we find among men with high IQ who have a score of 6 or above, a positive, statistically significant marginal effect of inflation expectations on spending propensities: men with high IQ who expect higher inflation are 3.6 percentage points more likely to say it is a good time to purchase larger ticket items than men with high IQ who expect constant or decreasing inflation. For men with low IQ we instead find no correlation between spending propensities and inflation expectations. We show these effects cannot be explained by financial constraints or other expectations. Hence, it looks like the central mechanism underlying the transmission mechanism in New Keynesian models is clogged for about half of the population.

**Table 5**  
Inflation Expectations and Spending Propensities

	Men with high IQ	Men with low IQ
<b>Inflation expectation</b>	0.0358*** (0.01)	-0.0096 (0.01)
<b>Demographic Controls</b>	Yes	Yes
<b>Pseudo R2</b>	0.0108	0.0091
<b>Nobs</b>	16,606	16,256

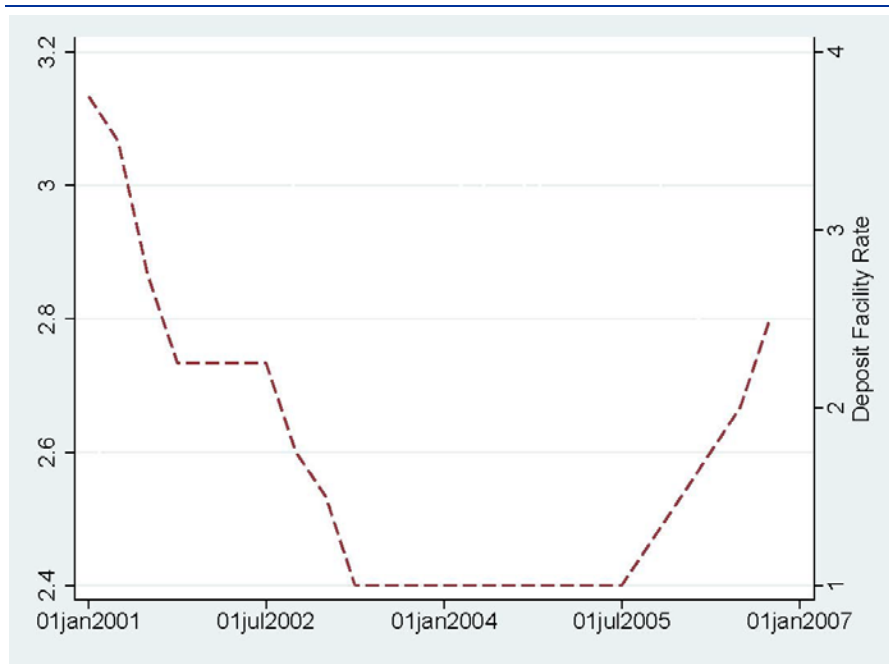
Sources: D'Acunto, Hoang, Paloviita and Weber (2018).

Notes: This table reports the average marginal effects of a multinomial logit regression. Households' readiness to purchase durables is the dependent variable. Inflation expectation is a dummy variable which equals 1 when a household replies that inflation will increase. We use the confidential micro data underlying the official European Commission consumer confidence survey to construct these variables. The surveys ask representative samples of households on a monthly basis whether it is a good time to purchase durables given the current economic conditions. Households can reply that it is a good time, it is a bad time, or it is neither a good time nor a bad time. In this table we study the "it is a good time" outcome. We measure normalized IQ using data from the official military entrance exam in Finland. Standard errors are clustered at the quarter level. The sample period is March 1995 to March 2015 for a total of 21 years. Standard errors in parentheses. \* p<0.10, \*\* p<0.05, \*\*\* p<0.01.

But can we somehow directly assess whether cognitive abilities matter for the effectiveness of economic policy? To analyse this question, we study the differential sensitivity in the propensity to take out loans to changes in nominal interest rates by IQ. Chart 11 plots the beginning of quarter deposit facility rate over time from January 2001 to December 2006. We see larger decreases in rates at the beginning of the sample, then rates constant at 1% and increasing rates in mid-2005. We argue in the paper that the movements in rates are largely exogenous to the Finnish economy.

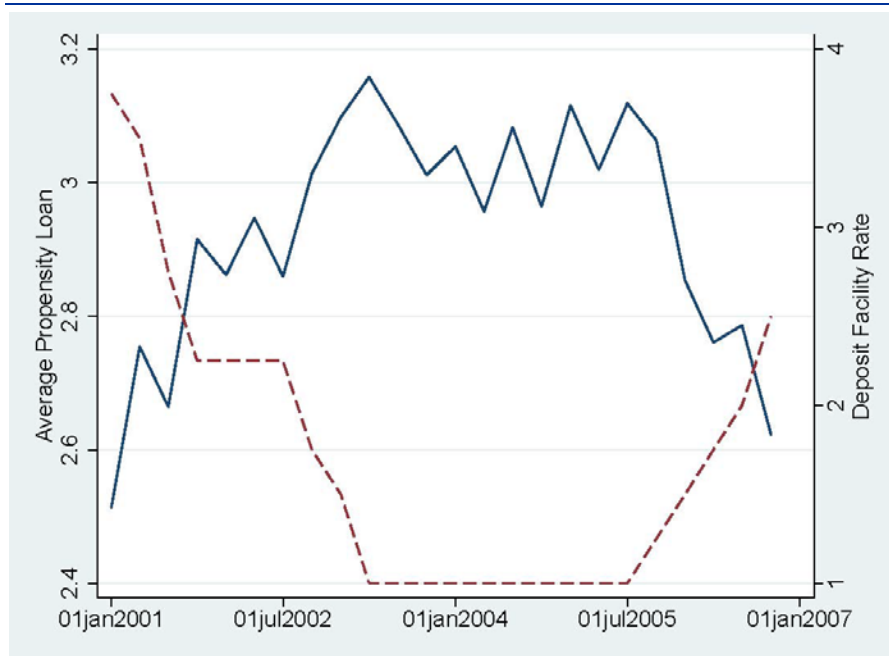
In Chart 12 we now plot the average propensity to take out loans over time for high IQ men. When rates fall, high IQ men increase their propensity to take out loans, and the propensity is flat when rates do not change. When rates start increasing instead, we see their propensity goes down. Conversely, Chart 13, which is on the same scale, documents that low IQ men in Finland do not adjust their propensity to take out loans to changes in interest rates.

**Chart 11**  
Deposit Facility Rates



Sources: D'Acunto, Hoang, Paloviita and Weber (2018).  
Notes: This figure plots the beginning of quarter European Central Bank Facility Rate from quarter 1 2001 to quarter 4 of 2006 on the right y-axis.

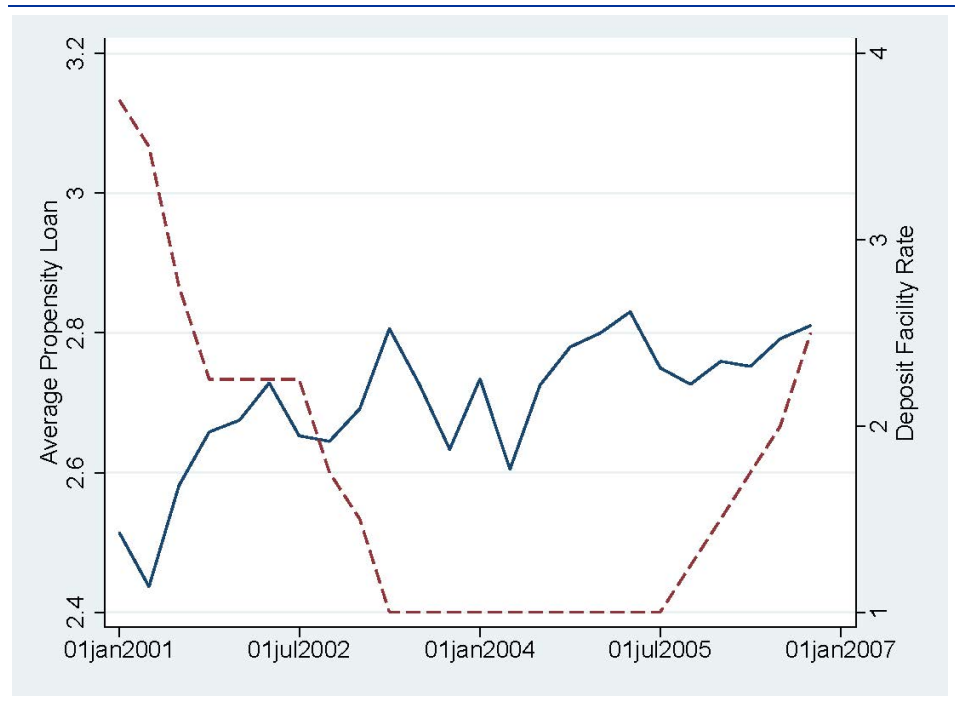
**Chart 12**  
Deposit Facility Rates and Propensities to Take out Loans: High IQ



Sources: [D'Acunto, Hoang, Paloviita and Weber (2018)].  
Notes: This figure plots the beginning of quarter European Central Bank Facility Rate from quarter 1 2001 to quarter 4 of 2006 on the right y-axis and the cross-sectional mean of whether individuals think it's a good time to take out a loan in Finland for men with high IQ. High-IQ men are all men with the highest 3 scores of the 9-point distribution. We use the confidential micro data underlying the official European Commission consumer confidence survey to measure the propensity to take out a loan. Statistics Finland asks a representative sample of 1,200 households whether they think it's a good time to take out a loan. We measure normalized IQ using data from the official military entrance exam in Finland. The sample period is January 2001 to December 2006.

**Chart 13**

Deposit Facility Rates and Propensities to Take out Loans: Low IQ



Sources: D'Acunto, Hoang, Paloviita and Weber (2018).

Notes: This figure plots the beginning of quarter European Central Bank Facility Rate from quarter 1 2001 to quarter 4 of 2006 on the right y-axis and the cross-sectional mean of whether individuals think it's a good time to take out a loan in Finland for men with low IQ. Low-IQ men are all men with the lowest 3 scores of the 9-point distribution. We use the confidential micro data underlying the official European Commission consumer confidence survey to measure the propensity to take out a loan. Statistics Finland asks a representative sample of 1,200 households whether they think it's a good time to take out a loan. We measure normalized IQ using data from the official military entrance exam in Finland. The sample period is January 2001 to December 2006.

These findings suggest that part of the reason why forward guidance did not increase inflation expectations and spending, as most models predicted, might be due to limited cognitive abilities.

## 5 Conclusion

Central banks around the world have implemented many unconventional measures, many aimed at raising inflation expectations but inflation has been low during the recent years relative to historical standards. An increase in the concentration in retail seems an unlikely explanation, whereas changes in the age structure of the workforce and household inflation expectations are promising avenues to help shed light on this puzzle. In D'Acunto, Hoang, Paloviita and Weber (2018), we provide evidence that many households might not understand the implications of some of these measures, such as forward guidance, and hence not adjust inflation expectations and consumption plans which limits the effectiveness and represent a *human friction* to the transmission of economic policy.

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# Productivity Growth, Wage Growth and Unions<sup>1</sup>

By Alice Kügler<sup>2</sup>, Uta Schönberg<sup>3</sup> and Ragnhild Schreiner<sup>4</sup>

## Abstract

This paper reviews trends in labor productivity, wage growth, unemployment and inequality over the past two decades in nine advanced countries. We focus on the two largest countries in the eurozone, Germany and France, which experienced similar increases in productivity over the past 20 years. In France wages grew in tandem with productivity, inequality declined and unemployment remains stubbornly high. In Germany, in contrast, wages largely stagnated (until 2008), inequality increased (until 2010), but unemployment is now at a record low. This paper argues that the divergent development of Germany and France is in part a consequence of an unprecedented decentralization of the wage-setting process in Germany, from the sectoral level down to the level of the firm or the individual. In contrast, the distinctive characteristics of France's system of industrial relations prevented France from a similar downward adjustment of wages.

## 1 Introduction

Nearly ten years after the Great Recession, unemployment rates vastly differ across advanced countries. In Germany, unemployment is now at a record low of 4%. In the United Kingdom and the United States, unemployment rates have returned to their low pre-crisis levels, but wage growth has been sluggish. In France, by contrast, unemployment remains stubbornly high at above 9%. The situation looks even more bleak in Italy and Spain where unemployment rates today are 5 and 9 percentage points higher than prior to the Great Recession (OECD, 2018).

In the first part of this paper, we review trends in labor productivity, aggregate wage growth, unemployment and inequality over the past two decades across nine advanced countries. We look at the four largest countries of the eurozone: Germany,

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<sup>1</sup> Some key ideas laid out in this paper are based on research by Christian Dustmann, Bernd Fitzenberger, Uta Schönberg and Alexandra Spitz-Öner, "From the Sick Man of Europe to Economic Superstar: Germany's Resurgent Economy", published in the *Journal of Economic Perspectives*, 2014. We thank Mimosa Distefano for input on labour market reforms, and Wenchao Jin and Anna Okatenko for help with the UK and French Labor Force Surveys.

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France, Italy, and Spain; two countries that are generally believed to have very flexible labor markets: the United Kingdom and the United States; and the Scandinavian countries: Sweden, Norway and Denmark.

A comparison between the two largest economies of the eurozone, France and Germany, reveals some striking differences in recent developments. Labor productivity has evolved at a similar pace in the two countries, averaging about 1.5% of growth per year over the last 20 years. However, while mean wages have moved in tandem with productivity in France, mean wages in Germany were barely higher in 2008 than they were in 1995. The differences in wage growth are particularly striking at the bottom of the wage distribution. Whereas wages at the 10th percentile of the wage distribution declined by over 10% between 1995 and 2008 in Germany, they increased by nearly 20% in France. Wages at the 90th percentile, in contrast, rose faster in Germany than in France. Since mean wages grew much faster in France than in Germany despite similar productivity growth in the two countries, unit labor costs (i.e. total wage costs divided by labor productivity, a commonly used measure of competitiveness) improved in Germany relative to France and other countries over the same period. Wage growth has picked up in Germany in the post-recession years, and now closely follows that in France. At the same time, the two countries vastly differ with respect to unemployment: whereas the unemployment rate is at a record low below 4% in Germany, it remains stubbornly high at about 10% in France.

The United States and the United Kingdom experienced healthy productivity growth prior to the Great Recession, averaging about 2% per year between 1995 and 2008. In the post-recession years, however, productivity has largely stagnated in both countries. Whereas wages have decoupled from productivity in the United States and the labor share in GDP declined accordingly, wage growth outpaced productivity growth in the United Kingdom until the Great Recession. The two countries further differ with respect to trends in inequality: whereas in the United States wages grew at the top of the wage distribution (but not at the bottom), inequality remained roughly constant in the United Kingdom.

Spain and Italy have experienced virtually no improvements in living standards (measured as CPI-deflated average total labor compensation per hour worked) neither before nor after the crisis, in large part because of stagnating labor productivity (measured as GDP at fixed prices per hour worked). These two countries are further crippled by exceptionally high unemployment rates.

The three Scandinavian countries are generally characterized by robust productivity growth and relatively low unemployment over the past 20 years, both before and after the Great Recession, and (GDP-deflated) wages have grown at a similar rate as productivity.

Based on these country examinations, it is worth noting that the developments in the nine countries do not all confirm common conceptions that labor markets across the globe are experiencing rising wage inequality (e.g. International Monetary Fund, 2015), and a decoupling of wages from productivity, leading to a decline in the labor share in GDP (Schwellnus et al., 2017). Among the nine countries examined, the labor share consistently declined in only two countries over the last 20 years:

Germany and the United States. In these two countries, wage inequality has increased over the same time period. The increase in inequality was concentrated at the top of the wage distribution (i.e. the 90th percentile rose relative to the median) in the United States, whereas it occurred both at the bottom and the top in Germany (i.e. in addition the median rose relative to the 10th percentile). While wage inequality also increased in Sweden over the same period, it remained roughly constant in Norway and, perhaps surprisingly, the United Kingdom, and declined significantly in France.

In the second part of the paper, we revisit possible explanations for the divergent trends in labor productivity, wage growth, unemployment and inequality observed in the nine countries. We focus on the four largest economies of the eurozone, Germany, France, Italy and Spain, and the role of unions in the wage-setting process. In all four countries, the dominant form of collective bargaining takes place at the sectoral level, where trade unions bargain with employer federations over pay, working hours and working conditions. Union wages typically act as minimum wages, and are often differentiated according to occupation, skill, experience or seniority. Despite these similarities, there are also substantial differences. Most importantly, in Germany, union agreements apply to only those firms that belong to an employer federation. Firms' membership of an employer federation is voluntary. Firms can leave the employer association at their own discretion; they can also decide not to join the employer federation in the first place. Firms in Germany therefore are not forced to recognize union agreements. This is in sharp contrast to the system in France, where the state declares sectoral union agreements as binding for all firms in the sector. Similar extension mechanisms exist de facto in Spain and Italy.

After the fall of the Iron Curtain, the German economy was burdened by the high costs of reunification, and firms had the opportunity to relocate production to Central and Eastern European countries where workers are highly skilled and wages are low. Consequently, it became increasingly costly for firms to recognize sectoral union agreements, and more and more firms opted out. Whereas in 1996, about 80% of workers were covered by union agreements (either at the sectoral or the firm level), by 2016 union coverage rates had fallen to 53%. In firms that opt out of sectoral union agreements, wages are then either set collectively at the level of the firm, through negotiations between the firm and the work council (i.e. workers' representatives in the firm), or through negotiations between the firm and the individual worker. The fall in union coverage rates has thus led to a decentralization of the wage-setting process, from the industry level to the firm or even individual level. This decline also contributed to the low wage growth observed in Germany between 1995 and 2008, in particular at the bottom of the wage distribution.

As more and more firms left sectoral union agreements, trade unions were willing to make concessions unheard of in other countries, in order to prevent a further loss in influence. First, trade unions often agreed to so-called opening clauses that allow firms that are in principle bound by a sectoral union agreement nevertheless to pay wages below the union wage, provided that the work council in the firm agrees. Opening clauses lead to a further decentralization of the wage-setting process, by shifting collective bargaining from the sectoral to the firm level and strengthening the

work council's role in the wage-setting process. Second, trade unions in Germany showed extraordinary wage restraint throughout prolonged periods of time over the past two decades, even in periods of increasing labor productivity and declining unemployment. Opening clauses and the wage restraint shown by unions further contributed to the low wage growth observed in Germany between 1995 and 2008. It is important to emphasize that this process of increased wage decentralization occurred outside the political process, without the intervention of the German government, and has not been met with substantial resistance by trade unions or workers.

Following the Great Recession, the decline in union coverage in Germany has slowed down. With unemployment rates at a record low in Germany, trade unions have also become more aggressive in their wage demands. In consequence, wage growth has started to pick up, and now evolves at a similar pace as in France. At the same time, France and Spain have recently moved a step closer to Germany's system of industrial relations, by implementing reforms aimed at shifting collective bargaining from the sectoral to the firm level. These reforms were controversial and have been met with some resistance by both trade unions and workers. Whether they will be successful in improving competitiveness and ultimately in bringing down unemployment in these countries remains to be seen.

## 2 The Facts

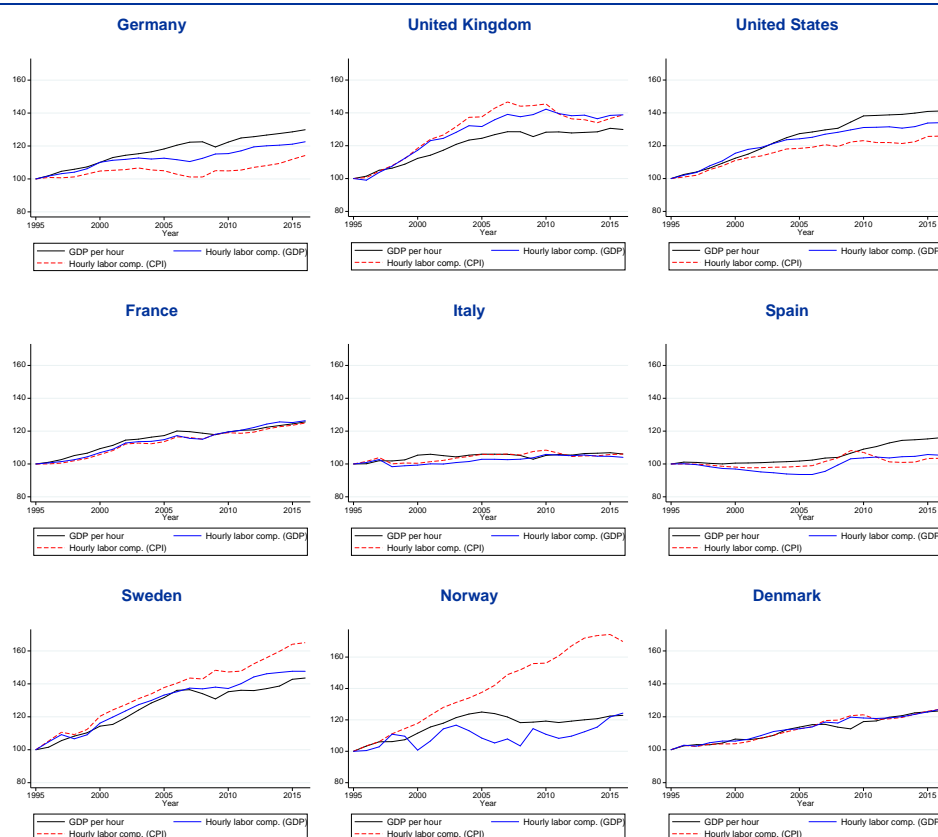
### 2.1 Trends in Labor Productivity

The key determinant of a worker's wage is her productivity. Economic theory emphasizes that firms will continue to hire workers as long as the gains from hiring an additional worker (i.e. the value of the marginal product of labor) exceed the cost of hiring that worker (i.e. her wage). In a competitive labor market, wages should thus be equal to the value of the marginal product of labor. Even in imperfectly competitive labor markets, sustained increases in real wages, and thus improvements in living standards, are possible only through sustained increases in labor productivity.

Chart 1 shows trends in aggregate labor productivity (measured as real GDP per hour worked) and hourly compensation per worker, from 1995 to 2016 for a selected set of countries, and sourced from the OECD Economic Indicators. The nine countries include the four biggest countries of the eurozone: Germany, France, Italy and Spain; two countries considered to have highly flexible labor markets: the United States and the United Kingdom; and the Scandinavian countries: Sweden, Norway and Denmark. Consider first the evolution of aggregate labor productivity in these countries (the solid black line in the chart). Most of the countries considered experienced robust growth in labor productivity in the first half of the period, between 1995 and 2005, averaging 1.7% per year in Denmark; about 2% in France and Germany; about 2.3% in the United Kingdom and Norway; and about 3% in Sweden and the United States. The exceptions are Italy and Spain, which hardly experienced any increase in labor productivity over this period.

**Chart 1**

**Labor Productivity and Total Hourly Labor Compensation Growth, 1995-2016**



Sources: OECD Economic Indicators.

Notes: The graphs plot GDP per hour worked as a measure of labor productivity (black line) and labor compensation per hour worked, deflated using the Consumer Price Index (red line) and the GDP Price Index (blue line) from 1995 to 2016 in nine selected OECD countries. The GDP Price Index reflects changes in the prices of goods and services produced in the country, while the Consumer Price Index measures the retail prices of a fixed basket of goods and services consumed. GDP per hour worked is defined as GDP at fixed prices (deflated by the GDP Price Index) divided by total hours worked of all persons engaged in production. Labor compensation per hour worked is defined as total labor costs – employers’ social security contributions in addition to gross wages and salaries – divided by total hours worked by employees.

The picture is markedly different in the second half of the period, between 2005 and 2016. Labor productivity has nearly stagnated in the United Kingdom after the Great Recession. The United States and Norway likewise experienced hardly any increase in aggregate labor productivity in the post-recession years, and in Sweden, productivity growth has significantly slowed down since the Great Recession. The picture looks somewhat more optimistic in Germany and Denmark where labor productivity growth now is roughly back to its pre-recession trend. In France, labor productivity stagnated between 2005 and 2010 but productivity growth has since then picked up once more, averaging about 1.8% per year. The two Southern European countries, Italy and Spain, have not fared much better in the second half of the period compared to the first. Over the past decade, labor productivity grew by 1% in Italy. The only period during which Spain witnessed considerable growth in labor productivity is the Great Recession years when the unemployment rate shot up to 25% (see Chart 3). The productivity increase (measured here as output per hour worked) is therefore primarily a result of a sharp decline in labor input. The productivity increase further reflects compositional changes in employment, resulting in part from a

particularly sharp decline in employment in the construction sector over this period – a sector with relatively low levels of labor productivity (Bonhomme and Hospido, 2017).

It is beyond the scope of this article to provide a detailed analysis of why labor productivity grew at vastly different rates across countries, and slowed down after the Great Recession in some countries, but not in others. The slow productivity growth in Italy and Spain has been extensively analyzed, and its causes are likely structural (as opposed to cyclical) (e.g. Mora-Saguinetti and Fuentes, 2012; Xifre, 2016; Bugamelli and Lotti, 2018). Possible explanations include a reliance on low-productivity sectors, inefficient regulation that hampers the growth of small and median-sized firms, inefficient public administration, a two-tier labor market in which workers on permanent contracts are reluctant to switch jobs even if they are not well suited for the job, and a rigid labor market more generally. In the United Kingdom and United States, different explanations have been proposed for the sluggish productivity growth following the Great Recession. These include reduced investments and reduced reliance on cheap production inputs imported from China and other emerging markets. The change in the composition of firms is likely to be a further factor: with record-low interest rates, less productive firms that would go bankrupt under higher interest rates stay in business (see Tenreyro, 2018, for the United Kingdom, and Manyika et al., 2017, for the United States). In the United States, the decline in productivity growth in the post-recession years has further been attributed to the slowdown in the growth of sectors that significantly contributed to the robust productivity growth prior to the Great Recession, in particular, information technology, retail and wholesale sectors.

More generally, it is important to emphasize that the aggregate trends in labor productivity depicted in Chart 1 reflect, in part, changes in the industry structure. Both the level and the growth rate of labor productivity tend to be higher in the manufacturing sector than in the tradable and non-tradable service sector (e.g. Wöfl, 2003). All else equal, we would therefore expect low growth in labor productivity in countries, or time periods, that are characterized by large declines in manufacturing. However, a differential decline of the manufacturing sector alone cannot explain why labor productivity growth slowed down following the Great Recession in countries such as the United Kingdom and the United States, but not in Germany. In the United States, the employment share in manufacturing decreased from 23.6% in 1995 to 20.3% in 2008 (when labor productivity grew by nearly 3% per year), then sharply dropped during the Great Recession, after which it stabilized at around 19% (when labor productivity barely increased). A similar pattern is observed in the United Kingdom. In Germany – where the share of workers employed in manufacturing is considerably higher than in the United States (27.3% vs. about 19% in 2016) and the United Kingdom – the employment share in manufacturing continued to decline, in the post-recession years, though at a slower pace.<sup>5</sup> Yet, unlike in the United Kingdom and the United States, labor productivity in Germany continued to increase.

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<sup>5</sup> International Labour Organization, [ILOSTAT database](#).

## 2.2 Trends in Wage Growth

Does real wage growth track labor productivity growth? Or did wages “decouple” from productivity?

Chart 1 depicts, in addition to trends in labor productivity (GDP per hour worked, in fixed prices), trends in total hourly labor compensation, sourced from the OECD Economic Indicators. The compensation measure includes non-wage components of compensation, such as employers’ social security contributions, to provide a comprehensive measure of workers’ wages and benefits and employers’ labor costs.<sup>6</sup> The dashed red line in Chart 1 shows labor compensation deflated by the Consumer Price Index (CPI). The CPI is meant to capture changes in a consumer’s cost of living, and is constructed as the level of retail prices of a fixed basket of goods and services, consumed by a representative consumer, at a specific point in time. The solid blue line depicts labor compensation deflated by the GDP deflator (the same deflator we use to construct the time series on real labor productivity). This index reflects changes in the prices of goods and services produced in the country, and unlike for the CPI, the “basket” for the GDP deflator is allowed to change over time with countries’ production patterns. Differences between the two price indices are likely to mostly reflect changes in terms of trade, i.e. changes in a country’s export prices, relative to changes in its import prices.<sup>7</sup> For simplicity, we will refer to the CPI and GDP deflated total labor compensation as the consumer and producer wage.

Two countries – Germany and the United States – stand out with a noticeable “decoupling” of wages and labor productivity. Over the past two decades, labor productivity rose by about 30% in Germany, whereas the consumer wage increased by only 18%. Over the same period, labor productivity grew by about 40% in the United States, while the consumer wage rose by only 25%. It is worth pointing out that in both countries this decoupling primarily occurred in the years prior to the Great Recession, between 1995 and 2008. Over this period, German workers essentially saw no improvements in their living standards (measured here as the consumer wage) although labor productivity increased by nearly 1.5% per year. Following the Great Recession, consumer wage growth has picked up, and now traces labor productivity growth closely. In the United States, productivity growth outpaced consumer wage growth by about one third between 1995 and 2008. Since 2010, both labor productivity and the consumer wage have largely stagnated. A second point worth emphasizing is that in both Germany and the United States, the decoupling between labor productivity and wage growth is less pronounced when wages are deflated using the GDP price index rather than the CPI. That is, these two countries were somewhat “unfortunate” with respect to their terms of trade in that import prices increased faster than export prices, limiting improvements in living standards to some extent. Yet, in both the

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<sup>6</sup> In the nine countries considered, total compensation (including non-wage components) grew slightly more than wage compensation (excluding non-wage components) over the period considered.

<sup>7</sup> See e.g. Pessoa and Van Reenen (2013) for a more detailed discussion.

United States and Germany, the producer wage also grew at a slower rate than labor productivity, implying that the labor share in GDP declined in these two countries.<sup>8</sup>

In the other countries considered in this paper, consumer wage growth either closely tracks productivity growth (in France, Italy, Spain and Denmark) or outpaces productivity growth (in the United Kingdom, Sweden and Norway) over the past two decades. In these countries, the labor share of GDP either remained constant or increased.

In Sweden and Norway, the consumer wage growth relative to labor productivity growth over the past two decades is particularly striking – consumer wages rose by 20% more than real labor productivity in Sweden, and by a whopping 40% more in Norway. Producer wage growth and labor productivity growth on the other hand, track each other much more closely. The labor share in GDP therefore remained roughly constant over the past two decades in these two countries. Norway, in particular, experienced an extraordinary improvement in its terms of trade, allowing its citizens to enjoy large improvements in living standards that exceed those implied by the increases in labor productivity.

Turning to the United Kingdom, from 1995 up to the Great Recession, the country witnessed a strong productivity growth, of about 2.3% per year, and an even stronger wage growth (both consumer and producer wages) of about 3% per year.<sup>9</sup> Following the Great Recession, between 2010 and 2016, productivity growth and producer wage growth largely stagnated, while consumer wage growth fell by about 4%.

The two Southern European countries considered, Italy and Spain, experienced virtually no improvement in living standards over the past decades, due to nearly non-existent productivity growth.

A closer comparison of France and Germany, the two largest economies in the eurozone, reveals a dramatic difference in the development of competitiveness over the past two decades. Between 1995 and 2016, average labor productivity grew at similar rates in the two countries (except from 2006 to 2007 when labor productivity rose by 3% in Germany but slightly declined in France) – compare the solid blue and green lines in Panel A of Chart 2. Inflation, measured as the Consumer Price Index, also evolved at a similar pace in the two countries (the blue and green dashed lines Panel B of Chart 2). The GDP Price Index (the solid blue and green lines in the chart), in contrast, rose faster in France than in Germany. The two countries further radically differ with respect to aggregate wage growth. In Germany, consumer wages were hardly higher in 2008 than they were in 1995 (the dashed blue line in Panel A). In France, in contrast, consumer wages increased by 18% over the same period (the dashed green line in Panel A). The vast difference in wage growth, despite similar growth rates in productivity, implies that from 1995 to 2008, Germany considerably

<sup>8</sup> Let  $X$  denote GDP in fixed prices,  $Q$  the GDP price index,  $N$  the number of hours worked, and  $W$  the nominal hourly wage. The labor share in GDP can then be defined as  $WN/QX$ . The labor share will decline if labor productivity  $X/N$  (the black line in Chart 1) grows faster than the producer wage  $W/Q$  (the blue line in Chart 1).

<sup>9</sup> If a somewhat longer time period starting in 1988 is considered, labor productivity growth and growth in total labor compensation track each other relatively closely (see for example, Pessoa and Van Reenen, 2013, and Machin, 2016).

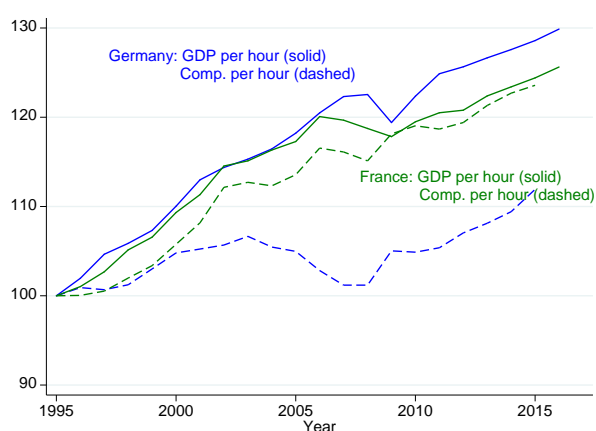


improved its competitive position relative to France (as shown in Panel C) and other European countries such as Italy and Spain. Whereas unit labor costs (computed as the nominal hourly wage divided by labor productivity), a commonly used measure for a country's competitiveness, rose by 18% in France over this period, they remained roughly constant in Germany.<sup>10</sup> In the post-recession years, wages, productivity and in consequence unit labor costs evolved at a similar pace in the two countries.

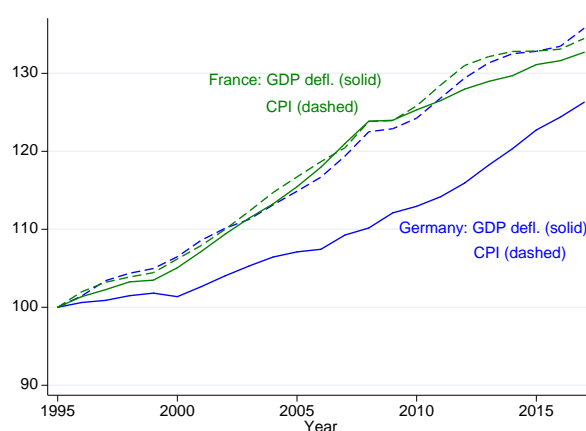
## Chart 2

### Inflation and Growth in Labor Productivity, Hourly Compensation and Unit Labor Costs in Germany and France, 1995-2016

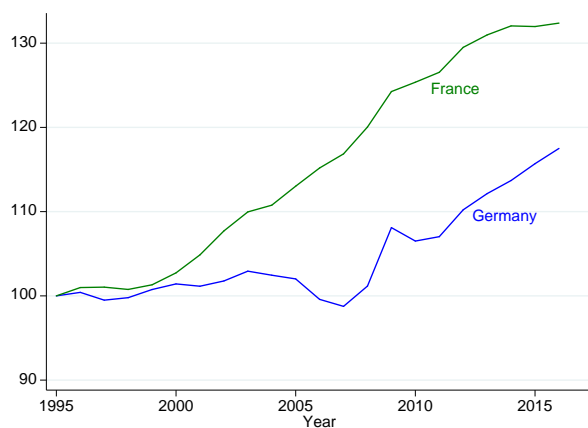
Panel A: Labor Productivity and Consumer Wages



Panel B: GDP Price Index and Consumer Price Index



Panel C: Unit Labor Costs



Sources: OECD Economic Indicators.

Notes: The graphs compare GDP per hour worked as a measure of labor productivity and CPI-deflated total labor compensation per hour worked (Panel A), the Consumer Price Index (CPI) and the GDP Price Index (Panel B), and unit labor costs (Panel C) in Germany (blue lines) and France (green lines) from 1995 to 2016. GDP per hour worked is defined as GDP at fixed prices (deflated by the GDP Price Index) divided by total hours worked of all persons engaged in production. Labor compensation per hour worked is defined as total labor costs – employers' social security contributions in addition to gross wages and salaries – divided by total hours worked of employees. The GDP Price Index reflects changes in the prices of goods and services produced in the country, while the Consumer Price Index measures the retail prices of a fixed basket of goods and services consumed. Unit labor costs are computed as nominal hourly total labor costs multiplied by total hours worked by the employed, divided by GDP (at fixed prices), and measure the average cost of labor per unit of output produced.

<sup>10</sup> Let  $X$  denote GDP at fixed prices,  $W$  the hourly nominal wage,  $N$  the number of hours worked, and  $Q$  the GDP price index. Real unit labor costs and the labor share in GDP are then computed as  $WN/X=W/(X/N)$  and  $WN/XQ$ . It should be noted that differences between Germany and France in changes in the labor share are less pronounced than differences in changes in unit labor costs, since the GDP price index rose faster in France than in Germany.



## 2.3 Trends in Employment

In a next step, we compare trends in unemployment and employment across the nine countries. Trends in labor productivity (GDP per hour worked) and trends in unemployment are interlinked, and should thus be studied in conjunction. The marginal product of labor is generally thought of as following an inversely u-shaped pattern with respect to labor: at lower levels of production, hiring additional workers will increase the marginal product of labor due to gains from specialization, while at higher levels of production, adding labor will reduce the marginal product. At the same time, the relationship depends on the composition of the population of employed workers. In most countries, the unemployed are on average less skilled than the employed. A decline in unemployment may draw mostly low-skilled workers into work, worsening the skill composition of employed workers, and resulting in a decline in average labor productivity. Finally, supply and demand affect the relationship between labor productivity and unemployment. In a context where unemployment is low and where few workers are available for work, firms need to offer higher wages to attract workers compared to a context where unemployment is high and many workers are looking for jobs.

Chart 3 plots the unemployment rate (ILO concept) and the employment rate among those aged 15 or over (including part-time work) over the past two decades in the nine countries considered, sourced from the OECD Economic Indicators.<sup>11</sup> The nine countries vastly differ not only with respect to their levels of unemployment, but also with respect to changes in the unemployment and employment rates over time – showing no sign of convergence. The two countries generally considered to have the most flexible labor markets – the United Kingdom and the United States – show, by international comparison, low unemployment rates of around 5% in the years preceding the Great Recession. In both countries, unemployment rates sharply rose during the Great Recession by 3 to 5 percentage points, but have since then converted back to the low levels seen before the Great Recession. Employment rates show a mirror image. Thus, in the United States and the United Kingdom, the stagnation in labor productivity and wages in the post-recession years went hand-in-hand with a decline in unemployment and an increase in employment.

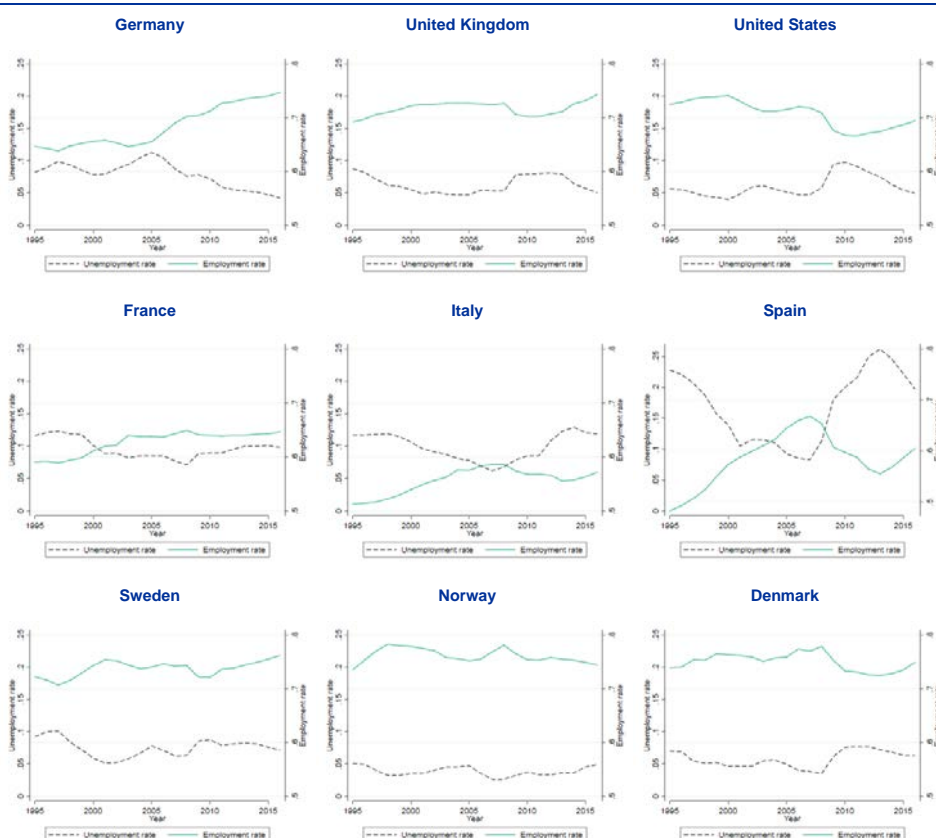
Germany, in contrast, saw persistently high levels of unemployment throughout the mid-1990s and early 2000s, with a peak of 11% in 2005. Since 2005, however, the unemployment rate has continuously declined, and the employment rate has continuously increased, even during the Great Recession. In 2016, unemployment was at a record low level of 4%, a level not seen since the early 1980s. Employment rates were likewise at a record high, about 5 percentage points higher than in the United States, despite the fact that employment rates in the United States exceeded those in Germany by nearly 10 percentage points 20 years ago. Thus, during the post-recession years, Germany saw the best of both worlds: increasing labor productivity and wages, and declining unemployment. It should be noted, however,

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<sup>11</sup> Employed people are those aged 15 or over who report that they have worked in gainful employment for at least one hour in the previous week or who had a job but were absent from work during the reference week.

that much of the rise in employment reflects increases in part-time work rather than full-time work (Burda, 2016; Carillo-Tudela et al., 2018).<sup>12</sup> In addition, the German labor market success came at the cost of increased inequality, as we will discuss in the next section.

**Chart 3**  
Unemployment and Employment Rates, 1995-2016



Sources: OECD Economic Indicators.  
Notes: The graphs plot the unemployment and employment rate between 1995 and 2016 in nine selected OECD countries. The unemployment rate is based on the ILO concept and computed as the number of unemployed people as a percentage of the labor force. The employment rate is the ratio of the employed to the working age population, aged 15 to 64. Employed people are those aged 15 or over who report that they have worked in gainful employment for at least one hour in the previous week or who had a job but were absent from work during the reference week.

Germany's experience sharply contrasts with that of France, Italy and Spain, the other large countries of the eurozone. Even though unemployment in France was not much affected by the Great Recession, it was persistently high at about 9 to 10% throughout the past two decades. The employment rate remained largely flat at 65% between 2004 and 2016 – whereas it increased from about 65% to about 75% in Germany over this period.

<sup>12</sup> Tax-favored part-time jobs in the form of so-called mini and midi jobs increased from around 12% of employees covered by social security at the end of the 1990s to 20% in 2010 (Galassi, 2018). Atypical employment in Germany, defined as employees with fixed-term contracts, the marginally employed, temporary workers and excluding the part-time employed, also increased slightly from around 6% in 1995 to 8% of all employment in 2015 (German Council of Economic Experts, 2018).

Italy and Spain have fared even worse. In both countries, unemployment steadily declined between 1995 and up until the start of the Great Recession – from about 11% to 6% in Italy and from about 22% to 8% in Spain. During the Great Recession, however, it sharply increased to 13% in Italy and 25% in Spain. Although unemployment has started to come down in recent years, it remains much higher than in the years prior to the Great Recession. Among the nine countries considered, Italy and Spain further show the lowest employment rate throughout the past two decades. That is, Italy and Spain are not only crippled by low growth in labor productivity and wages, but also by high and persistent levels of unemployment.

The Scandinavian countries are generally characterized not only by robust productivity and wage growth, but also by relatively high employment rates, above 70% throughout the past two decades – considerably above the employment rates observed in France, Italy and Spain, and of similar magnitude as those observed (today) in Germany, the United Kingdom and the United States. Unemployment is lowest in Norway – at about 5%, and has been persistently low throughout the past two decades, including during the Great Recession. Unemployment has been somewhat higher in Sweden and Denmark, in particular during and after the recession.

## 2.4 Trends in Inequality

Sluggish mean wage growth, observed in Italy and Spain throughout the past two decades, in Germany from the mid-1990s until the Great Recession, and in the United Kingdom and the United States following the Great Recession, takes on an added significance if it is coupled with increased wage inequality. Chart 4 plots CPI-deflated wage growth at three different points of the wage distribution – the 10th percentile, the median, and the 90th percentile – for Sweden and for five countries for which the authors had access to microdata: Germany (using a 10% random sample of social security records from the Employment History dataset of the Institute of Employment Research (IAB)), France (Labor Force Survey), the United Kingdom (Labor Force Survey), the United States (Current Population Survey), and Norway (Employer-Employee Register). Data for Sweden is obtained from Statistics Sweden. With the exception of Sweden, the analysis is restricted to full-time workers aged 20 to 60.<sup>13</sup>

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<sup>13</sup> The wage measure used in Chart 4 differs from the measure of hourly labor compensation used in Chart 1 in that it does not include non-wage components such as employers' social security contributions. In the case of France, the wage measure further excludes employees' social security contributions. Further, the analysis is restricted to full-time workers. In the case of Germany, the sample is restricted to workers covered by the social security system and thus excludes the self-employed and civil servants. Similarly, the sample for Norway excludes the self-employed.

**Chart 4**

Evolution of the 10th, 50th, and 90th Percentiles of the Wage Distribution



Sources: Germany: 10% random sample from the IAB Employment History, daily real wage, observations refer to June 30 of each year. France: French Labor Force Survey, hourly real wage net of employees' social security contributions. United Kingdom: UK Labor Force Survey, hourly real wage. US: Current Population Survey, hourly real wage. Norway: Employer-Employee register made available by Statistics Norway, weekly real wages. Sweden: Swedish Wage Survey provided by Statistics Sweden, monthly real wage adjusted to reflect full-time work.

Notes: The graphs plot CPI-deflated wage growth at the 10th percentile, the median, and the 90th percentile of the wage distribution in six selected countries. With the exception of Sweden, the analysis is restricted to full-time workers aged between 20 and 60, and the wage measure (unlike in Chart 1) does not include non-wage components such as employers' social security contributions. For Germany, the sample is additionally restricted to employees covered by the social security system. Similarly, for Norway, the sample excludes the self-employed. We thank Wenchao Jin, research economist at the Institute for Fiscal Studies, and Anna Okatenko, research economist at the Centre for Research and Analysis of Migration, for providing the figures for the United Kingdom and France, respectively.

In Germany, wage inequality increased dramatically from 1995 to 2007, the wake of the Great Recession. Over this period, the real median wage barely showed any improvements. Real wages at the bottom of the distribution declined by 13%, whereas real wages at the top of the distribution increased by 10%. This trend of increasing inequality has come to a halt following the Great Recession: since 2010, workers across all parts of the wage distribution have seen considerable improvements in their

wage, and wages at the bottom of the wage distribution have increased slightly more than wages at the middle and the top of the wage distribution.

Germany's experience sharply contrasts with that of France where wage inequality has declined over the past two decades. In France, real wages at the 10th percentile of the wage distribution rose by more than 20% between 1995 and 2014, compared to 12% at the median and 5% at the 90th percentile. Differences in the evolution of wages between France and Germany are therefore particularly striking at the bottom of the wage distribution. Between 1995 and 2007, wages at the 10th percentile declined by 13% in Germany but rose by 18% in France. At the 90th percentile, in contrast, wage growth was more pronounced in Germany than in France (17% versus 5% between 1995 and 2014). These trends resulted in one of the most egalitarian distributions of wages observed in France since the 1960s.

Like Germany, the United States experienced an increase in wage inequality over the past two decades. Unlike in Germany, however, the increase was concentrated at the top of the wage distribution: while the median and the 10th percentile in the United States have evolved at a similar pace, the 90th percentile has pulled away from the median, in particular in the last decade. Inequality also rose in Sweden, in particular at the top of the wage distribution. Although the United Kingdom is often thought of as a country where inequality has increased – inequality indeed rose throughout the 1980s (Gosling et al., 2000) – since 1995, wages at the bottom, middle and top of the wage distribution have actually evolved at similar rates. Following the Great Recession, workers at all parts of the wage distribution suffered similar declines in their real wage. Despite labor productivity growth of only about 20%, Norway experienced strong real wage growth of at least 50% at all parts of the wage distribution – in large part because of its favorable development in terms of trade.

In Italy, wage inequality has remained roughly constant between 1993 and 2006 (Naticchioni and Ricci, 2009; Jappelli and Pistaferri, 2010). In Spain, wage inequality is strongly counter-cyclical, but does not follow a clear long-run trend (Bonhomme and Hospido, 2016). In Denmark wage inequality has been relatively stable over the last decades, and is among the lowest among OECD countries (Danish Ministry for Economic Affairs and the Interior, 2017).

It is important to emphasize that the changes in wage inequality depicted in Chart 4 are likely to, in part, reflect changes in the characteristics of employed workers over time. If, for example, the share of college graduates among employed workers increases over time, and if wages of college graduates are generally more dispersed than wages of high school graduates, inequality will rise. Similarly, it may predominantly be low-skilled workers who exit the labor market in times of high unemployment – which will tend to increase wages at the bottom of the wage distribution. Conversely, the record low levels of unemployment in Germany may have drawn predominantly low-skilled workers into work – which would tend to lower wages at the bottom of the wage distribution.

### 3 The Role of Unions in the Wage-Setting Process

Which factors could possibly explain the divergent trends in labor productivity and wage growth, unemployment and inequality observed across the nine countries considered? Clearly, several factors are at play, and a detailed analysis of all possible mechanisms is beyond the scope of this article. In the United States, the decline of the labor share has recently been linked to competitive forces that favor “superstar” firms (Autor et al., 2017; Kehrig and Vincent, 2017; De Loecker and Eeckhout, 2017). Conversely, the sluggish productivity growth in the United Kingdom and the United States in the post-recession years has partly been attributed to low-productivity firms that stay in business because of record-low interest rates, but would have gone bankrupt in times of higher interest rates (e.g. Tenreyro, 2018).

The increase in inequality at the top of the wage distribution observed in the United States and in Germany over the past two decades is typically attributed to skill- or routine-biased technological change that favors high-skilled workers who perform predominantly abstract tasks that are complementary to IT capital (Autor et al., 2003; Autor et al., 2008; Dustmann et al., 2009). Dustmann et al. (2009) further argue that the rise in inequality at the bottom of the wage distribution in Germany is largely accounted for by institutional changes, in particular a decline in unionization.<sup>14</sup> In Italy and Spain, low growth in productivity and wages, coupled with high and persistent unemployment, likely has its roots in structural factors, including a reliance on low-productivity sectors, inefficient regulation, inefficient public administration, a rigid, two-tier labor market, and – in the case of Spain – the boom and bust of the construction sector.

The focus of this paper is on the differential roles that unions play in the wage-setting process in different countries. Specifically, we argue that Germany’s particular system of industrial relations allowed for an unprecedented decentralization of the wage-setting process: while in the early 1990s, wages were predominantly set collectively at the sectoral level, they are now increasingly negotiated at the level of the firm or the individual worker. Coupled with the extraordinary wage restraint that unions showed over long periods throughout the past two decades, this decentralization can in part account for the low mean wage growth relative to productivity growth and the increase in inequality at the bottom of the wage distribution observed in Germany between the mid-1990s up until the Great Recession. In France, by contrast, the system of industrial relations prevented a similar decentralization of the wage-setting process. In consequence, wages grew much faster in France than in Germany, in particular at the bottom of the wage distribution, although labor productivity rose at a similar rate in the two countries. Germany’s improvement in competitiveness (i.e. smaller increases in unit labor costs) relative to France is therefore, at least in part, rooted in the differences in the systems of industrial relations in these two countries. Germany’s increase in competitiveness may also have contributed to its “employment miracle” that brought down unemployment to record

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<sup>14</sup> Goldschmidt and Schmieder (2017) focus on outsourcing as an additional driver of the rise in wage inequality in Germany.

low levels. The Hartz reforms, implemented between 2002 and 2005, may be another factor.<sup>15</sup>

We first briefly highlight key differences in the system of industrial relations across countries, focusing on Germany and France. In a next step, we build the case that the decentralization of the wage-setting process in Germany contributed to the low average wage increases and rising wage inequality, and hence ultimately its improved competitive position.

### 3.1 The Institutional Framework and the Dwindling Importance of Unions

Collective bargaining over pay, working hours and working conditions between trade unions on the one hand, and employers on the other hand, may operate at various levels. In the United States and the United Kingdom, collective bargaining typically takes place (if it takes place at all) at the firm level; that is, the trade union negotiates with a single employer. In Continental Europe and the majority of the Scandinavian countries, in contrast, collective bargaining predominantly takes place at the sectoral level; that is, trade unions negotiate with a number of employers, represented by employer federations.

#### 3.1.1 Firm-Level Bargaining in the United States and the United Kingdom

In the United States and the United Kingdom, unions may seek recognition by the firm if they have substantial membership rates. Often, employers “voluntarily” recognize the union once it seeks recognition by the firm, to avoid a legal process. In case the firm resists union recognition, a ballot of employees typically takes place. If enough employees vote in favor of the union, the employer is forced to recognize the union. Once the employer recognizes the union, union wages usually apply to both union members and non-union members. In general, union coverage rates in the United States rates are low; less than 15% of workers were covered by union agreements in 2000 and 2016. In the United Kingdom, union coverage rates declined from about 36% to 26% over the same period (see Table 1).

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<sup>15</sup> For example, Fahr and Sunde (2009), Klinger and Rothe (2012), and Krebs and Scheffel (2013) conclude that the Hartz reforms increased employment. Price (2017), and Bradley and Kügler (2018) find small positive employment effects, and show that the reforms led to a more pronounced decrease in wages.

**Table 1**  
Trends in Union Coverage

	early 2000s	2014-2016
<b>Countries with predominantly firm-level bargaining</b>		
United States	14	11.5
United Kingdom	36.4	26.3
<b>Countries with predominantly sector-level bargaining</b>		
Germany (OECD)	67.8	56
West Germany (IAB Firm Panel)	70.2	58.3
East Germany (IAB Firm Panel)	56.7	47.8
France	97.7	98.5
Italy	80	80
Spain	82.9	73.1
Sweden	94	90
Norway	70.5	67
Denmark	85	84

Sources: OECD Economic Indicators, and IAB Firm Panel for West and East Germany.  
Notes: The table reports the percentage of workers covered by a collective union agreement in selected OECD countries. It is based on the ratio of employees covered by collective agreements, divided by all wage earners with right to bargaining. For Germany, the table additionally shows the percentage of workers covered by either a sectoral or a firm level agreement based on data from the IAB Firm Panel. Values for the United States, the United Kingdom, Germany, Italy, and Spain refer to 2000 and 2016; values for France and Norway refer to 2002 and 2014; and values for Sweden and Denmark refer to 2000 and 2015.

Both countries have a statutory minimum wage. In the United Kingdom, a nation-wide minimum wage was introduced in 1998. At this time, the ratio between the minimum and median wage was 0.41, and it since increased to 0.45 in 2005 and to 0.49 in 2015. The nation-wide minimum wage in the United States is somewhat less generous with a ratio between minimum and median wage of about 0.37 throughout the past two decades – although some states, and recently cities, have implemented much higher minimum wages. The introduction of the minimum wage in 1998 in the United Kingdom and its subsequent increases may be one reason why wage inequality has stopped increasing since the mid to late 1990s (see e.g. Butcher et al., 2012).

**Table 2**  
Minimum Wage Relative to Median Wages

	1995	2005	2015
United States	0.35	0.32	0.36
United Kingdom	-	0.45	0.49
Germany	-	-	0.47
France	0.52	0.60	0.61
Spain	0.38	0.37	0.37

Sources: OECD statistics.  
Notes: The table reports the ratio between the minimum wage and the median wage of full-time employees for the five out of nine countries which have a statutory minimum wage in place. The statutory minimum wage was introduced in the United Kingdom in 1998 and in Germany in 2015.

### 3.1.2 Germany: Decentralization of the Wage-Setting Process

The German system of industrial relations is not rooted in legislation, nor is it governed by a formal political process. Instead, it is laid out in contracts and mutual agreements



between the three main labor market parties: trade unions, employer federations, and work councils (i.e. workers' representatives in the firm).

The core aspect of the German system is the principle of autonomy of wage bargaining, outlined in the constitution. It implies that negotiations between trade unions and employer federations take place without the government directly exerting influence. As such, union agreements apply only to those firms that belong to an employer federation and that thus recognize union agreements. In firms that recognize unions, union wages apply to all employees, regardless of whether or not they are union members. Firm membership of an employer federation is voluntary. Firms can leave the employer federation at their own discretion; they can also decide not to enter the employer federation in the first place. After opting out of a collective agreement, firms must honor the collective agreement for incumbent employees for a specified period of time, or until a new agreement has been reached at the firm level in cooperation with the work council. At the same time, these firms are immediately free to set wages for new hires (see for example, Carlin and Soskice, 2008, Bispinck et al., 2010, Brändle et al., 2011).

Thus, a key difference between the German system of industrial relations, those in Anglo-Saxon countries, and in particular in a number of countries in Continental Europe, is that the German firms cannot be forced to recognize union agreements. The fact that German firms can vote with their feet and opt out of union agreements altogether fosters negotiations that are usually far more consensus-based and less confrontational than in other countries.<sup>16</sup> Data on strikes are quite revealing in this respect: between 1991 and 1999, Germany lost an average of eleven days of work each year per 1000 employees, and only five days between 2000 and 2007. This contrasts sharply with strike days in France (73 and 103 days over the same time periods) and Italy (158 and 93 days). Even in the United States the number of days of work lost due to strikes per 1000 employees was higher than in Germany (40 and 32 days), despite much lower union coverage rates (Lesch, 2009).

The fact that firms cannot be forced to pay high union wages begs the question why nevertheless many firms choose to do so. One important reason is for firms to save the transaction costs of negotiating wages with each worker individually. Adhering to sector-wide union wages also makes the wage-setting process transparent. Sector-wide union wages may also be considered as “fair payment” or a “social norm”, and it may be costly for firms to deviate from this norm.

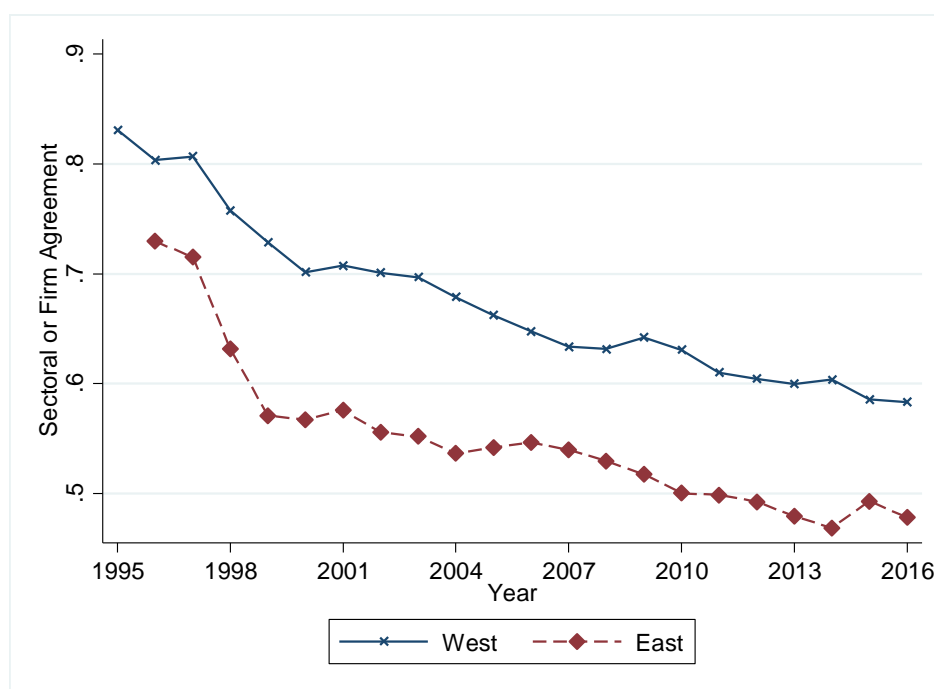
Since the early to mid-1990s, Germany has witnessed an unprecedented decline in union coverage rates. In 1995 (the first year for which reliable data are available from the Institute of Employment Research (IAB) Firm Panel): 83% of West German employees were covered by union agreements, 72.2% by a sectoral level agreement and 10.9% by a firm level agreement (see Chart 5). By 2016, union coverage rates in West Germany had fallen to 58%. This decline is primarily driven by firms opting out of sectoral agreements (rather than by larger growth rates of firms that do not recognize

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<sup>16</sup> The consensus-based nature of negotiations is further encouraged by the representation of employees in boards, another component of the institutional framework that is unique to Germany.

union agreements). Chart 5 further highlights that union coverage rates are higher in West than in East Germany, and that in both West and East Germany, the decline in union coverage rates was particularly dramatic in the mid-1990s and the early-2000s when aggregate wage growth was particularly sluggish, and wages at the bottom of the distribution dropped sharply. The decline has slowed down substantially since 2010 – after which aggregate wage growth, including at the bottom of the wage distribution, has picked up once more.

**Chart 5**  
Union Coverage Rates in West and East Germany, 1995-2016



Sources: IAB Firm Panel.  
Notes: The chart depicts the share of workers covered by either a sectoral or a firm level agreement in West and East Germany.

The fall in union coverage rates has led to a dramatic decentralization of the wage-setting process in Germany, from the industry level to the level of the firm, or even to the individual worker. In addition, wages have become increasingly dependent on the specific economic conditions of the firm through so-called “opening” or “hardship” clauses, even among those firms that continue to recognize sector-wide union agreements. As part of the overall sectoral agreement, firms may use opening clauses to deviate downward from collectively agreed industry-wide standards. Trade unions often agreed to such deviations in order to prevent further firm opt-outs of the sectoral agreements. At first, these opening clauses focused on hours of work, but later they also affected wages. Initially, the opening clauses were only temporary to avoid bankruptcy, but later they were also implemented to ensure competitiveness in more general terms. A firm that makes use of an opening clause negotiates the details concerning pay and working time agreements with the work council. As a consequence, the role of work councils in industrial relations has become increasingly important over the past two decades.

In terms of prevalence, Brändle et al. (2011, Figure 1) report that among industry-wide collective contracts in German manufacturing, less than 5% involved opening clauses for wages in 1995, but this had risen to about 60% by 2004. According to a survey of work councils in 2005, about 75% of firms bound by a sectoral agreements used opening clauses (Bispinck 2007; Bispinck et al., 2010). Take-up rates are somewhat smaller according to the IAB Firm Panel. In 2011, 41% of firms covered by a sectoral agreement were aware of the existence of an opening clause in their industry. Of those, 71% made use of the opening clause. Deviations from the industry-wide agreements in terms of working time are the most common form of opening clause used, but deviations in terms of pay are also widespread.

To summarize, since the mid-1990s Germany has undergone a dramatic decentralization of the wage-setting process, from the sectoral level to the level of the firm or the individual worker. This development is due to firms opting out of sectoral agreements on the one hand, and due to deviations from industry-wide standards through opening clauses among firms bound by sectoral agreements on the other hand. As we argue in Section 3.2 below, this decentralization contributed to low average real wage growth relative to productivity growth, and hence an improvement in competitiveness (measured as a relative reduction in unit labor costs) throughout the mid-1990s and mid-2000s. It is important to emphasize that this process happened without the intervention of the German government. It was only in 2014 that the German government deviated from the principle of autonomy of wage bargaining and introduced a statutory minimum wage that applies to all workers and firms in the economy. The minimum wage was initially set at €8.50 per hour and came into effect in January 2015. The ratio between minimum wage and median wage of 0.46 is substantially higher than that in the United States (0.36), similar to that in the United Kingdom, and substantially lower than the one in place in France (0.61), as shown in Table 2. Recent research suggests that the introduction of the minimum wage in Germany boosted wages in particular at the lower end of the wage distribution (e.g. Ahlfeldt et al., 2018).

### 3.1.3 Industry-Level Bargaining in Southern European Countries

As in Germany, collective bargaining in France predominantly takes place at the sectoral level. The two countries, however, differ in one key aspect: whereas in Germany negotiations between trade unions and employer federations take place without the government directly exerting influence, the government plays an active role in the wage-setting process in France. Most importantly, the French government declares virtually all collective agreements negotiated between trade unions and employer federations to be binding. That is, union agreements apply to all firms in the sector, regardless of whether a firm belongs to an employer federation. This sharply contrasts with the system in Germany where the recognition of union agreements is left to the firm's discretion. In consequence, union coverage rates in France have been close to 100% throughout the past 15 years (see Table 1). In addition, the French government sets a wage floor through a statutory minimum wage that is binding for (nearly) all workers and firms in the economy. The minimum wage is set a high level by international standards: the ratio between the minimum wage and the median was

0.56 in 2000 and 0.61 in 2015 – substantially higher than in the United Kingdom, Germany and in particular the United States. Increases in the national minimum wage follow an explicit legal rule, are indexed to the change in the inflation rate as well as to the increase in the blue-collar base wage rate, and allow for an additional governmental discretionary increase (Fougère et al., 2016). Minimum wage increases directly affect the wages of about 10-15% of workers, and sectoral agreements build on changes in the minimum wage, which cannot be undercut. The high minimum wage, as well as the extension of union agreements to all firms and workers in the economy, may well have contributed to the strong wage growth throughout the past two decades, in particular at the bottom of the wage distribution (see Chart 4). At the same time, the high minimum wage and the extension of union agreements to all firms may be in part responsible for the persistently high unemployment (see Chart 3).

It is interesting to note that recently, the systems of industrial relations in Germany and France are somewhat converging. Germany introduced, for the first time in its history, a statutory minimum wage in 2015 – albeit not at a level as high as that in France. The Hollande government made a first step in introducing German-style opening clauses in France in 2014, and in 2018, president Macron went a step further with his reforms aimed at liberalizing the labor market. We discuss this point in more detail in Section 4.

In contrast to France, the governments in Italy and Spain do not explicitly intervene in the wage-setting process by extending agreements negotiated between trade unions and employer federations to all firms in the sector. Yet, de facto, union agreements apply in most sectors to all firms. Union wages are considered as “fair payment” and in Italy, workers can go to court to sue firms for higher pay. Whereas in Italy union agreements are binding only for workers on permanent contracts, they apply to all workers, including those on fixed term contracts, in Spain. In both countries, union coverage rates have remained roughly constant at about 80% since 2000 (see Table 1). Spain, but not Italy, further has a statutory minimum wage. The ratio between the Spanish minimum and median wage of 0.37 is, however, low by international standards.

Similar to France, Spain introduced some reforms in 2012 (“Law 3/2012”) that partially decentralized the wage-setting process, from the sectoral to the firm level. To better reflect the economic situation of the firm, firms were given more flexibility to modify sectoral union agreements. The reform further introduced the possibility for firms to opt out of a collective agreement, provided that workers’ representatives agree. Italy, in contrast, has not yet made a major attempt of shifting the wage-setting process from the sectoral to the firm level. Instead, Italy’s reform efforts – in particular “Monti’s Legge Fornero” introduced in 2012 and “Renzi’s Jobs Act” introduced in 2014 – have so far primarily concentrated on making it easier for firms to hire workers on fixed-term contracts (which leads indirectly to a decentralization of the wage-setting process as union agreements only apply to workers on permanent contracts). In addition, the reforms eased some of the restrictions regulating the firing of workers on permanent contracts.

### 3.1.4 Collective Bargaining in Nordic Countries

Union coverage rates in the Nordic countries are high, with around 70% of the work force covered in Norway, around 80% in Denmark and around 90% in Sweden (see Table 1). Even though the government does not explicitly declare union agreements to be binding for all firms in the sector, the social norm is such that most firms in the sector recognize the agreements. Generally, employer federations and unions closely cooperate and take the general economic situation into account when negotiating. The outcome of the sectoral wage-setting is a minimum wage increase that can be supplemented by further wage increases negotiated at the firm level, which would take into account a firm's profitability and productivity (e.g. Norges Offentlige Utredninger, 2013, for Norway).

## 3.2 The Case of Germany: Wage Decentralization and Aggregate Wage Growth

As emphasized in the previous section, Germany – as the only one of the nine countries considered – witnessed an unprecedented shift of wage-setting from the sectoral level to the level of the firm or the individual worker. This decentralization occurred because more and more firms opted out of union agreements, and because trade unions agreed to so-called opening clauses that allow firms that recognize a union nevertheless to pay wages below the industry-wide standards. In this section, we argue that this decentralization of the wage-setting process was an important factor behind Germany's low growth of wages relative to productivity, and the strong wage declines at the bottom of the wage distribution throughout the mid-1990s until the mid-2000s.

### 3.2.1 The Role of De-Unionization

There is ample evidence that unions raise wages, in particular for workers at the bottom of the wage distribution. In Germany, workers who are employed in firms that recognize a sectoral-wide agreement earn 25% higher wages on average than workers who are employed in firms that recognize neither a sectoral nor a firm level agreement, according to the IAB Firm Panel linked to social security records (LIAB), for 1995 to 2012.<sup>17</sup> This large wage differential reflects in part differential characteristics of the two types of firms: firms that are bound by sectoral union agreements are on average larger and operate more often in high-wage industries such as manufacturing and mining than firms bound by neither a sectoral nor a firm-level agreement. However, even conditional on firm size and industry, workers in unionized firms earn up to 15% higher wages than in non-unionized firms.

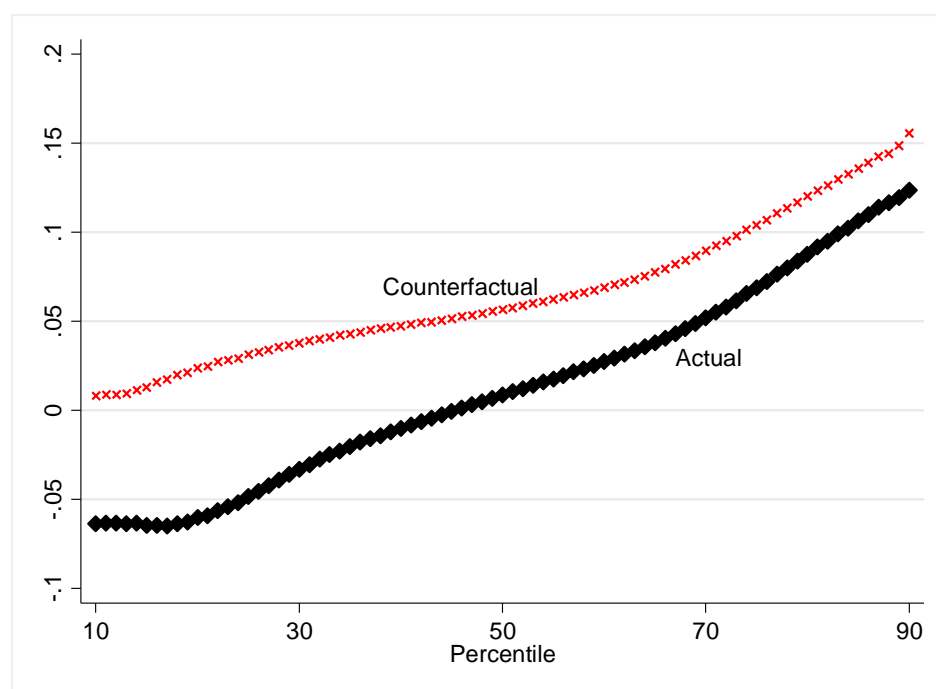
It is therefore natural to ask: to what extent did the decline in union coverage rates contribute to the low wage growth observed in Germany, and hence its improvements

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<sup>17</sup> The sample is restricted to full-time workers aged 20 to 60.

in international competitiveness, in particular in the years prior to the Great Recession? We investigate this question in Chart 6. The chart first depicts the observed wage growth between 1995 and 2012 along the wage distribution (the black line). The chart highlights the sharp increase in inequality observed in Germany over this period. Whereas wages at the bottom of the wage distribution declined by more than 5% (the 10th percentile), wages at the top (the 90th percentile) rose by about 12%. The chart further plots the “counterfactual” wage growth that would have occurred if unionization rates had remained at their 1995 levels. To construct this counterfactual wage growth, we use the reweighting approach developed in DiNardo et al. (1996). The chart indicates that wages would have been between 3 and 6% higher in 2012 if unionization rates had not declined. The chart further highlights that counterfactual wage growth exceeds actual wage growth throughout the entire wage distribution, but the difference is particularly pronounced at the lower end. These results should be interpreted with some caution, as they are based on strong assumptions, including the assumption that the wage differential between unionized and non-unionized firms does not change for different levels of unionization. Nevertheless, the findings indicate that declining union coverage rates at least in part account for the low wage growth observed in Germany. It should further be noted that the specific timing of the de-unionization process roughly coincides with the timing of real wage stagnation: the decline in union coverage rates has slowed down since 2010 (see Chart 5), after which wage growth, in particular at the bottom of the wage distribution, finally picked up again (see Charts 1 and 4).

**Chart 6**  
**Actual and Counterfactual Real Wage Growth Along the Wage Distribution, 1996-2012**



Sources: IAB Firm Panel merged to social security records from the IAB Employment History data file (LIAB; social security records refer to June 30 of each year).

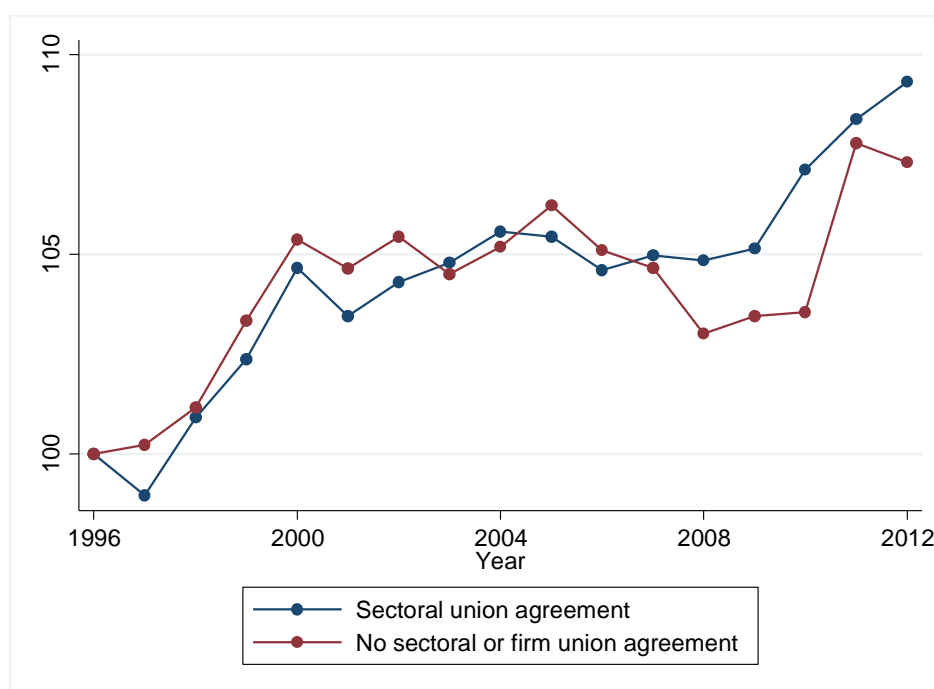
Notes: The chart plots actual and counterfactual real wage growth (CPI deflated) between 1996 and 2012 along the wage distribution. Counterfactual wage growth refers to growth that would have occurred if union coverage rates had remained at their 1996 levels. This counterfactual wage growth is calculated using the reweighting approach by DiNardo et al. (1996). The sample is restricted to full-time workers aged between 20 and 60.

### 3.2.2 Aggregate Wage Growth in Firms Bound by Sector-Wide Agreements

While the opting out of firms from sectoral agreements played an important role in explaining Germany's low wage growth, it only tells part of the story. Chart 7 highlights that wages barely grew more among firms that are bound by a sectoral agreement compared to firms that are neither bound by a sectoral nor by a firm level agreement between 1996 and 2012.

**Chart 7**

Real Wage Growth in Firms Bound by Sectoral Union Agreements and in Firms Not Bound by Union Agreements



Sources: IAB Firm Panel merged to social security records from the IAB Employment History data file (LIAB; social security records refer to June 30).

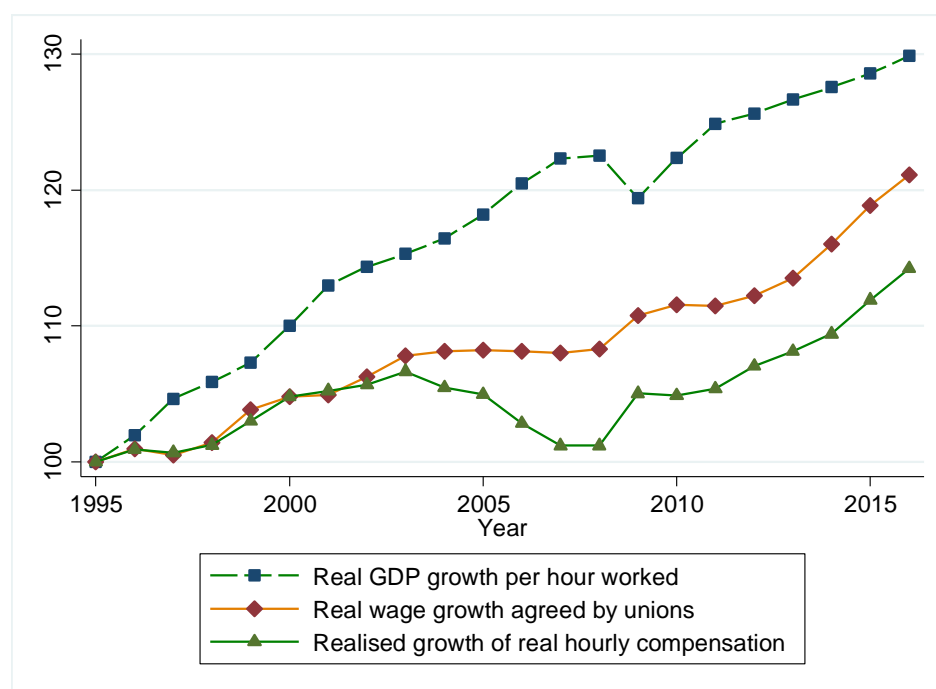
Notes: The chart plots (CPI-deflated) wage growth in firms that are bound by a sectoral union agreement and in firms that are neither bound by a sectoral nor by a firm union agreement.

The similar wage growth in firms bound and not bound by sectoral agreements may in part be because the characteristics of firms not subject to a sectoral agreement have improved over time, as more and more firms opted out of such agreements. Another reason for the low aggregate wage growth in firms covered by sectoral agreements are opening clauses, which allow firms to deviate downward from collectively agreed industry-wide standards. As discussed above, opening clauses have led to a shift of the wage-setting process from the sectoral to the firm level even among firms that recognize sectoral agreements, and have significantly strengthened the role of work councils in industrial relations.

A second reason for the low wage growth that occurred also in firms not bound by sectoral agreements is the extraordinary wage restraint shown by trade unions over the past two decades. Chart 8 plots wage increases accepted by trade unions

(cumulative and CPI-deflated, obtained from the Tarifarchiv of the Wirtschafts- und Sozialwissenschaftliches Institut (WSI), the red line) in conjunction with realized total hourly wage compensation (also CPI-deflated, as in Chart 1, the green line) over the past two decades. The chart first highlights that real wage increases agreed upon by trade unions and employer federations exceed realized wage increases throughout the entire period. One reason for this is that union agreements apply only in firms that choose to recognize them; and a second reason is that even firms that recognize union agreements often have some room for downward adjustments from the sectoral agreements, through opening clauses. Chart 8 further shows that in eleven out of 21 years, trade unions accepted zero real wage increases, as nominal wage increases were just equal to the (CPI) inflation rate. The period between 2003 and 2008 is particularly remarkable. Over this five-year period, wages negotiated between trade unions and employer federations did not increase in real terms – even though productivity increased by six percentage points and unemployment declined from 9.6% to 7.5%. Realized real wages substantially declined, and Germany improved its competitive position – measured as smaller increases in unit labor costs (see Chart 4) – relative to France (and a number of other European countries) primarily over this period. The first significant increase in real union wages occurred from 2008 to 2009 when the Great Recession hit and labor productivity declined. However, this large increase was once again followed by three years of no or small increases. After 2010, when unemployment rates were at a record low, union wage demands have picked up considerably.

**Chart 8**  
 Union Real Wage Growth and Realized Real Wage Growth in Germany, 1995-2016



Sources: Cumulative wage increases agreed between trade unions and employer federations: WSI Tarifarchiv. Realized hourly wage growth and GDP per hour worked: OECD Economic Indicators.  
 Notes: The chart depicts GDP per hour worked as a measure for labor productivity (as in Chart 1; the blue squares), and realized growth in total labor compensation per hour (CPI deflated, as in Chart 1; the green triangles). The chart further shows the cumulative wage increases (CPI deflated) agreed between trade unions and employer federations in sectoral union agreements (the red diamonds).



### 3.2.3 Which Factors Contributed to Wage Decentralization in Germany?

Why did German firms opt out of sectoral union agreements, starting in the early to mid-1990s? Several factors are at play. The German unification provided an unprecedented challenge to the German economy and was in part responsible for Germany's dismal performance throughout the 1990s and early 2000s. Moreover, after the fall of the Iron Curtain, moving production to Central and Eastern European countries – where workers were highly skilled and wages were low – became a possibility for German firms. It thus became increasingly costly for firms to pay high union wages.<sup>18</sup> Finally, East German firms were considerably less likely to recognize union agreements than West German firms, which may have made it more socially acceptable also for West German firms to opt out of union agreements.

Why did trade unions agree to opening clauses and wage increases much below productivity increases, even in times of falling unemployment? In part, unions explicitly agreed to accept lower wages to foster employment growth in the 1990s in response to the new economic realities. But at least as important, Germany's system of industrial relations allows firms to walk away from unfavorable union agreements and indeed, more and more firms did just that. German trade unions were willing to make concessions unheard of in other countries in order not to become further marginalized. At the same time, wage moderation practiced by trade unions is not only an expression of weaker bargaining power, but also reflects unions' objective to contribute to the creation of jobs by restraining wage growth (Wolf, 2000).

Why did the same shifting of the wage-setting process from the sectoral to the firm or individual level not happen in other countries? On the one hand, Germany was considerably more affected by the fall of the Iron Curtain than other countries, not only because of the reunification, but also by being geographically close to the former communist countries in Central and Eastern Europe. Equally important, the German system of industrial relations proved to be much more flexible than many would have expected, by allowing for more decentralized wage-setting without the intervention of the German government. Moreover, the decentralization process – and ultimately the low aggregate wage growth and the increase in inequality – was relatively consensus-based, and it was, at least to some extent, supported by trade unions and works councils. In contrast, the industrial systems of France, Italy and Spain do simply not allow for the same inherent options of flexible adaptation as the German system. There is considerably less scope for a similar decentralization of wage-setting within their systems of industrial relations where union agreements are, either explicitly by the government or de facto by courts, enforced upon most firms in the economy. In these countries, greater wage flexibility will require government interventions – a process that has proved to be politically costly, and that has been met with considerable resistance in the population.

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<sup>18</sup> In line with this argument, Burda (2000) predicted that the EU-accession of Central and Eastern European countries would lead to a reduction of labor market rigidities in the old EU member countries (including Germany).

## 4 Conclusion and Discussion

The economies of Continental European, Nordic and Anglo-Saxon countries have evolved differently over the past two decades.

The two Anglo-Saxon countries considered in this chapter, the United States and the United Kingdom, experienced labor productivity and wage growth throughout the mid-1990s until the mid-2000s. In these countries, unemployment sharply increased during the Great Recession. Both productivity and wages have largely stagnated since the Great Recession, but employment is now back to pre-crisis levels. The three Scandinavian countries, Norway, Sweden and Denmark, are generally characterized by robust productivity and wage growth, as well as relatively low unemployment throughout the past two decades. Neither Italy nor Spain experienced significant improvements in living standards over the past two decades, in large part due to stagnating labor productivity. These two countries are also crippled by exceptionally high unemployment rates that even today are considerably higher than just before the Great Recession.

A comparison between France and Germany reveals some striking differences in recent developments. Labor productivity evolved at a similar pace in the two countries over the past two decades, increasing by about 1.5% per year. Yet, wages evolved very differently. Whereas consumer wages increased roughly in tandem with productivity in France, in Germany consumer wages were no higher in 2008 than they were in 1995. Differences in wage growth between the two countries are particularly striking at the bottom of the wage distribution. In consequence, Germany substantially improved its competitive position – measured as smaller increases in unit labor costs – relative to France (and many other countries) over this period. At the same time, unemployment is now at a record low in Germany (4%) whereas it remains stubbornly high, at about 10%, in France.

We have argued in this paper that the low wage growth in Germany – and hence its increased competitiveness – is in part a consequence of an unprecedented decentralization of the wage-setting process that started in Germany in the mid-1990s, from the sectoral level down to the level of the firm or even the individual worker. This process was made possible by Germany's unique system of industrial relations that allows firms to opt out of sectoral union agreements, and to set wages collectively at the level of the firm instead, through negotiations between the firm and the work council, or individually, through negotiations between the firm and the individual worker.

Starting in the early 1990s, firms have increasingly made use of this option, and union coverage rates dropped from above 80% in 1996 to 58% in 2016. In order to prevent further loss of influence, trade unions responded by showing exceptional wage restraint even in times of robust productivity growth and declining unemployment. Trade unions also agreed to so-called opening clauses that allow a firm bound by sectoral agreements nevertheless to pay wages below the sector-wide union wage, provided that the firm's work council agrees.

Is the increased decentralization of the wage-setting process also responsible for Germany's "employment miracle", and the current record-low unemployment rates? Or are the so-called "Hartz Reforms" of the labor market, implemented by the government under Gerhard Schröder in 2003, responsible, as argued by some economists (see for instance, Rinne and Zimmermann, 2012, 2013)? Among other things, the Hartz reforms allowed for new types of employment with lower tax and insurance payments (mini and midi jobs), and reduced and limited unemployment benefits, in particular of the long-term unemployed. While it is impossible to answer this question conclusively, one possibility is that both increased wage flexibility and the Hartz Reforms contributed to the rise in employment rates. On the one hand, high wage floors may prevent firms from creating low wage jobs; on the other hand, workers have few incentives to accept low wage jobs when unemployment benefits are relatively high.

More generally, it is questionable that it is in a country's interest to improve its competitiveness through low wage growth over a long time period, especially if it goes hand in hand with increasing wage inequality. However, if trade unions play an important role in the wage-setting process and generally demand high wages, some wage restraint over a limited time period may be a beneficial response to economic shocks or to more long-term unfavorable economic developments. The process of wage restraint occurred in Germany in a remarkably consensus-based way, given that it kept real wages for the average German worker almost constant over a fifteen-year period. However, the periods of low wage growth seem to have come to an end, as wage growth has significantly improved in the post-recession years, in particular at the bottom end of the wage distribution. At the same time, the decline in union coverage rates has considerably slowed down, and after years of extraordinary wage restraint, wage demands of trade unions have picked up once more. Moreover, for the first time in its history, the German government deviated from the principle of autonomy of wage bargaining by introducing a statutory minimum wage that applies to all workers and firms in the economy, with only a few exceptions. The introduction of the minimum wage helped to bring up wages, in particular at the bottom of the wage distribution (e.g. Ahlfeldt et al., 2018).

At the same time, there is some evidence that the systems of industrial relations in France and Spain are moving a step closer to that of Germany. The past two French governments have implemented labor market reforms that aimed at shifting the determination of wages and working conditions away from the sector, to the level of the firm. In 2014, Hollande approved a reform that essentially introduced German-style opening clauses that allow firms to pay wages below the sector-wide union wage, in case the firm faces economic difficulties. In 2018, Macron went a step further, by allowing firms to bargain with trade unions or works councils over wages and working conditions regardless of the firm's economic situation, provided that worker representatives in the firm agree. In addition, in the case of a downturn, firms are now able to strike a "rapid, simplified" deal with the trade union or works council to

change wages or working hours to reflect the new market conditions better. Both Hollande and Macron further eased restrictions to fire workers.<sup>19</sup>

Spain even went a step further than France. The “Law 3/2012”, implemented in 2012, partially decentralized the wage-setting process, away from the sectoral to the firm level, by giving firms more opportunities to modify sectoral union agreements to reflect the economic situation of the firm better (Gobierno de España, 2012; Banco de España, 2013). The reform further introduced the possibility for firms to opt out of collective agreements, provided that workers’ representatives agree, moving a step closer to Germany’s system of industrial relations. In contrast, Italy’s reform efforts – in particular “Monti’s Legge Fornero” introduced in 2012 and “Renzi’s Jobs Act” of 2014 – have so far primarily concentrated on making it easier for firms to hire workers on fixed-term contracts – which may indirectly lead to a partial decentralization of the wage-setting process, as union agreements only apply to workers on permanent contracts. In addition, these reforms somewhat eased firing restrictions for workers on permanent contracts.

Despite some convergence, these recent developments underscore some crucial differences to Germany: Germany’s system of industrial relations proved to be much more flexible than that of France, Spain and Italy. The decentralization of the wage-setting process, from the sectoral level to the level of the firm and the individual worker, was possible without the intervention of the German government and without any legislative changes. In France, Spain and Italy, in contrast, governments have been required to step in and make legislative changes (possibly) to set a similar wage decentralization process into motion. At least as importantly, in Germany, the shift from sectoral to firm and individual wage negotiations was relatively consensus-based and was generally supported by trade unions and works councils. In France, Spain and Italy, by contrast, the reforms were controversial and have been met with some resistance by trade unions and the population at large. Whether the reforms will be successful in improving competitiveness and ultimately in reducing unemployment in these countries remains to be seen.

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<sup>19</sup> For example, this is reported in the French press by Sud Ouest, “[Les 10 lois que l'on retiendra du quinquennat de François Hollande](#)”, published online on May 12 2017; by France Culture, “[Réforme du code du travail: comprendre ce qui va changer](#)”, published online on September 21 2017; and by L'Express, “[Code du travail: pourquoi votre rémunération pourrait baisser](#)”, published online on September 2 2017.

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# Comment on “Productivity Growth, Wage Growth and Unions” by Alice Kügler, Uta Schönberg and Ragnhild Schreiner

By Michael C. Burda<sup>1</sup>

## Abstract

While cooperative unions and works councils were certainly a necessary element of Germany's successful labor market turnaround and its internal devaluation within the eurozone, they were not sufficient for achieving these objectives. First, labor adjustments at the extensive margin since 2003 expanded part-time and marginal employment and depressed average hours in a sustainable fashion. This is central to understanding wage flexibility, because dispersion of part-time wages increased even more than those of full-time workers, and are likely to have weakened union fall-back positions. Second, the Hartz IV reforms depressed reservation wages by reducing eligibility, incidence, and duration of unemployment benefit and increasing search intensity for workers in both covered and uncovered labor markets. From a simple Marshallian perspective, this corresponds to a rightward shift in the labor supply curve at given wages. Wage-employment and wage-participation correlations across cells of German data corroborate this interpretation.

## 1 General remarks

Kügler, Schönberg and Schreiner have written a timely paper on an issue that has particular relevance for the European Monetary Union: How have wages and unit labor costs in mature OECD economies reacted to the challenges of globalization and international competition, technical change and automation, and the global financial crisis, especially within a currency area? The work of Bruno and Sachs (1985), Calmfors and Driffill (1988), Hall and Soskice (2001), and Boeri et al. (2001) among many others lends support to the view that national labor market institutions in general and systems of industrial relations in particular matter for cross-country differences in short and long-run behaviour of wages, mark-ups and factor shares. Evidence shows that the demise of unions in the United States and the United Kingdom have coincided with deterioration of real wages across the wage distribution, especially at the lower end (e.g. Card, et al. 2003).

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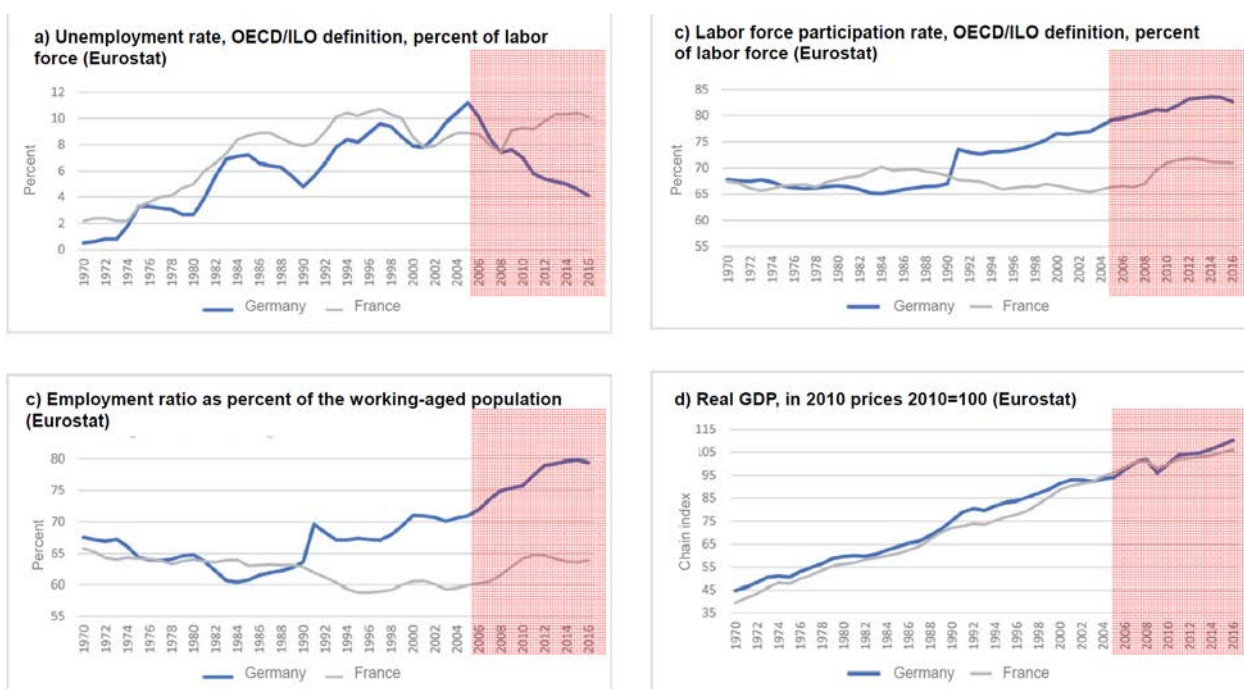
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Nominal price and especially wage adjustment are important for monetary unions to survive the consequences of asymmetric shocks, especially if migration and capital mobility are low. Because Germany's labor market has been extraordinary in the face of the Great Recession, Chinese trade expansion, and sovereign debt crisis, its system of wage determination has received increasing attention as a viable approach to macroeconomic adjustment. Uta Schönberg and her co-authors have presented a convincing case – drawing on their own and other evidence (Dustmann et al. 2014) that a distinguishing feature of Germany in the past two decades – especially when compared with France and southern Europe – is the flexibility of nominal wages not only at the mean, but at all quantiles of the wage distribution. The authors argue that this flexibility derives from collective bargaining arrangements that feature exit clauses and decentralized give-backs of unions when individual firms are threatened with job loss. It goes on to argue that growing individual wage inequality in Germany is a by-product of this flexibility, and that this flexibility was essential for the “German labor market miracle.”

The relevance of these issues cannot be overemphasized in light of ongoing labor reforms in France and other eurozone economies. Chart 1 compares Germany and France since 1970. Remarkably similar before reunification, the two countries diverged sharply in labor market performance afterward, despite very similar GDP paths. Initially, the burden of integrating a labor force of almost 9 million was a challenge for unified Germany, and was paid for by higher social security taxes and reduced international competitiveness. Yet after the mid-2000s, its labor market fortunes improved markedly relative to France.

**Chart 1**  
Labor market indicators, Germany and France

(1970-2016)



Sources: Macroeconomic database AMECO, European Commission.

After documenting divergent trends in both functional and individual pay inequality in several developed countries, the authors demonstrate a “Great Decoupling” of real wages and productivity in the United States and Germany since the mid-1990s, especially when wages are deflated by the CPI but also when the GDP deflator is used. They attribute German labor market recovery to the reduction of product wages, measured as hourly wages divided by GDP deflator, and see this as nominal wage moderation across the income distribution, not just at the mean or median. Most importantly, they see the decline of traditional collective bargaining institutions in Germany in the wake of reunification and European enlargement as a central factor for restoring conditions of full employment.

This is an important paper, and my comments mainly involve issues of emphasis. One central point is certainly not nuanced, however: flexible wage-setting in the form of decentralized or concession-driven wage bargaining was a necessary, but hardly a sufficient condition for the recovery of competitiveness and the elimination of unemployment in Germany. Given divergent labor productivity at different segments of the labor market, increased heterogeneity of wages at the lower deciles of the distribution is likely to increase the demand for those types of labor, but workers must also be willing to accept work at those lower rates of remuneration. I will thus argue – following previous research (Burda and Seele 2016, 2017, 2018) that shifts in labor supply behaviour are just as important for understanding the expansion of employment in Germany. Adjustment along the extensive margin – part-time work – was an essential element of the German adjustment process and its interaction with German labor legislation – raising the mandatory retirement age (Rentenreform) in 2001, reform of part-time work (Teilzeit- und Befristungsgesetz) in 2002, followed by the Hartz reforms in 2003-2005 – was a critical driver of labor supply, particularly in the years 2003-2010. Correlations of wages, relative employment and relative participation across labor market cells in the period 2003-2010 is consistent not only with firms moving down a negatively-sloped labor demand curve in that period, but also with a positive labor supply shock given wages and working age population, in the sense of Katz and Murphy (1992).<sup>2</sup>

The first part of my discussion addresses the macroeconomic meaning of the labor share and the source of its decline. Second, I discuss the role of wage flexibility and how to interpret the authors’ fascinating findings on the distribution of wage German growth since the mid-1990s. Finally I offer a few remarks on the portability of the German model to France and the European periphery.

## 2 The labor share and the macroeconomics of wage adjustment

The fraction of economy-wide value added accruing either directly or indirectly to workers has been the subject of increasing attention in recent years (e.g. Piketty 2013,

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<sup>2</sup> See Burda and Seele (2016, 2017, 2018). Katz and Murphy used a demand and supply framework to investigate the increase in US wage inequality in the years 1963-1987.

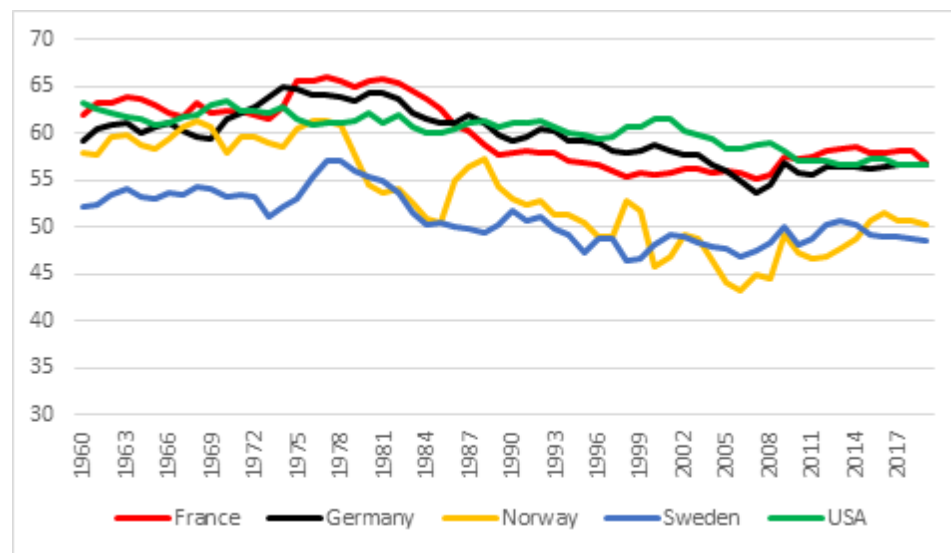
De Loecker and Eeckhout 2017). The labor share yields insights into cyclical and structural adjustment of labor markets as well as the functional distribution of income. It comprises many endogenous and exogenous influences. Conditional on the representative firm's production technology, it can be used to infer changes in product wages needed to move an economy towards high levels of employment (Sachs 1979, 1983, Bruno and Sachs 1985, Burda and Sachs 1988) and serve as an indicator of competitiveness (Thimann 2015). We should keep in mind that until the 1980s, most OECD countries had secularly rising wage shares, so a nuanced analysis is certainly necessary.

Tautologically, the wage share is the ratio of product wages to average labor productivity. If  $W$ ,  $L$ ,  $P$  and  $Y$  are hourly wage, employment in hours, value-added deflator and aggregate value added respectively, the wage share is  $WL/PY = (W/P)/(Y/L)$ . A declining wage share indicates a fall in the product wage relative to average productivity and a tilt in the functional distribution of income towards capital. Depending on the production technology, it could indicate either a decline or a rise in the marginal product of labor at given factor inputs. In a market clearing setting, a declining wage share may reflect a high elasticity of substitution between labor and capital in the face of accelerating capital deepening or a one-off episode of capital-augmenting technical change.

## Chart 2

### Gross adjusted labor share in GDP at market prices

(% of GDP)



Sources: Macroeconomic database AMECO, European Commission.

Chart 2 shows that Germany and France exhibited only modest declines in the wage share after 1980, and over the longer haul they appear quite similar.<sup>3</sup> Kügler et al. show that cumulative real consumption wage growth was outstripped by productivity

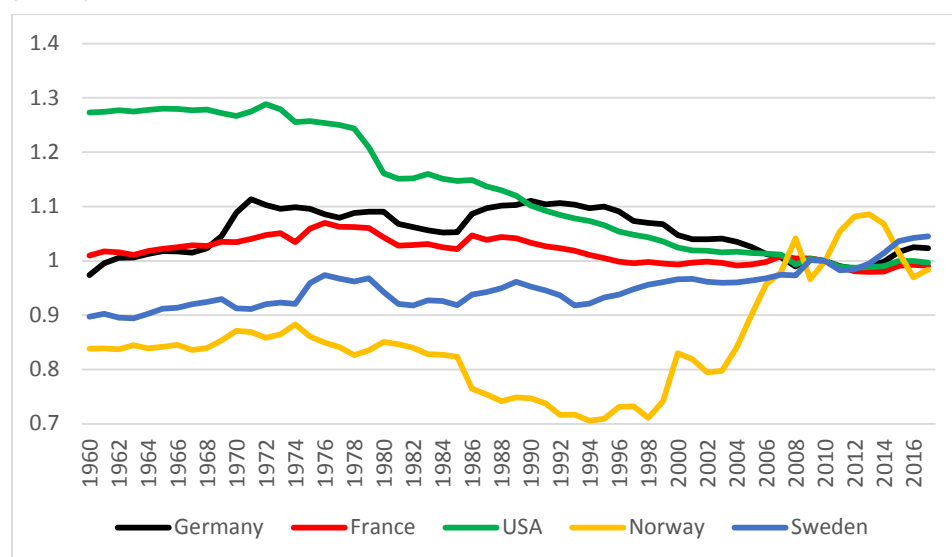
<sup>3</sup> Labor shares reported in Chart 2 are measured as a fraction of value-added at market prices; when measured at factor costs, the increases are even less spectacular, declining since 2000 only in the United States.

growth in the United States and Germany, while it remained strong in France. The fact that France and Germany's labor shares are so similar means that the culprit lies in differences of growth in either nominal wages or terms of trade. To see this, rewrite the wage share as  $WL/PY = (W/P)/(Y/L) = (W/Pc)(Pc/P)/(Y/L)$ , where  $Pc$  is the price index for consumer goods (HCPI). The wage share can decline only if the sum of real consumption wage and terms-of-trade growth is less than that of productivity. Lower real consumption wage growth in Germany is possible only if nominal wages rose more slowly there, or if France enjoyed an improvement in relative terms of trade over the period. Chart 3 shows that while Germany had a slight deterioration of terms of trade relative to France, this was dwarfed by other countries' experiences, especially the United States. This confirms the authors' findings that the most important difference between France and Germany since the 1990s is markedly slower nominal wage growth in the latter.

### Chart 3

Terms of trade (ratio of consumer price index to GDP deflator)

(2010=1.0)



Sources: Macroeconomic database AMECO, European Commission.

Explanations for the trends in the wage share abound. Increasing labor product market competition among firms increases efficiency and dissipates workers' access to rents, product wages fall and firms move to the efficient frontier. Falling wage shares could also reflect increasing monopoly power and mark-ups in product markets (DeLoecker and Eeckhout 2017), superstar firms (Autor et al. 2017), or ongoing gains in monopsony power in labor markets (Dube et al. 2018). It could also represent directed technical change leading to substitution of algorithms and robots for skilled labor; these developments are also consistent with the general overall trend. Yet France and Germany are so similar in the data until the mid-2000s that we need to look to labor market institutions to find an explanation for such different wage and employment outcomes.

### 3 Wage inequality, quantity adjustments and interpreting wage-employment correlations across the earnings distribution

Why were nominal wages so flexible in Germany relative to France? A central point in the Kügler et al. paper is the role of decentralization of collective bargaining arrangements that occurred in Germany starting in the mid-1990s as a reaction to declining membership and unfavourably heterogeneous conditions after reunification, moving from blanket regional industrial agreements to increasing plant-level negotiations. This was especially significant in Eastern Germany, where firms suffered from high unit labor costs at a 1:1 exchange rate in the aftermath of unification and were squeezed at high West German wage levels (Burda and Hunt 2001). Most recently this argument can be found in Dustmann et al (2014) but also in Dustmann et al. (2009), as well as in many analyses of wage inequality prior to this. It makes sense: unions are known to compress wages (Freeman and Medoff 1984) and German unions were no exception. Weaker unions compress wages less.

#### 3.1 The outside role of part-time work in the German “miracle”

Part-time work has already been seen as a mechanism of labor market adjustment in times of high underemployment or depression. In the mid-1980s, the Netherlands pursued a large-scale expansion of part-time employment to raise labor force participation of women and re-integrate long-term unemployed. Two decades later, Germany implemented that same approach. The 2000s – especially after 2003 and until 2010 – were characterized by a significant shift in employment from full-time to part-time work (see Chart 4). Unlike France’s heavy-handed Aubry Laws in the late 1990s, Germany achieved this shift to part-time work with little direct governmental intervention.<sup>4</sup> Total hours worked in Germany have hardly risen since reunification, from 49.5 billion hours in 1994 to 51 billion in 2016, or a 3% increase over 22 years; over the same period, employment in persons rose by 15.3%, and GDP rose by 35.2%! Employment can increase only if average hours worked decrease in tandem with increasing employment, and this was indeed the case (Burda and Seele 2017). From 1994 to 2016, part-time work rose from 22% to 39% of total employment (including marginal employment), or a third of total hours worked in 2016.<sup>5</sup>

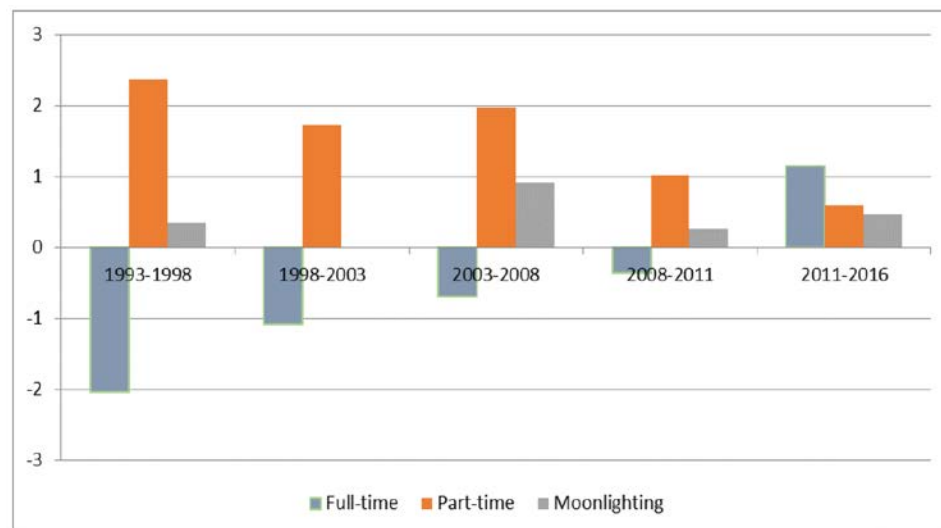
<sup>4</sup> For a description of “Les Lois Aubry”, see Askenazy (2008).

<sup>5</sup> Source: Institut für Arbeitsmarktforschung (IAB), Arbeitszeitrechnung, July 2017. Part-time work is defined as employment less than standard weekly working hours agreed in collective bargaining agreements, including forms of socially insured marginal employment.

## Chart 4

### Change in employment by type

(1993-2016; millions of persons)



Source: Institut für Arbeitsmarkt und Berufsforschung, Arbeitszeitrechnung.

The effect of the expansion of part-time work and extensive margin adjustment on aggregate wage developments cannot be ignored, as part-time and marginal employment represent substitutes for standard full-time workers. Our research, which uses the GSOEP to impute an hourly wage to IAB data, finds wage dispersion for part-time workers that is even more striking than evidence presented in this paper. Chart 5 presents those results.

## 3.2 Wage adjustment across the distribution

Chart 5, taken from Burda and Seele (2018) shows real wage growth at different points of the wage distribution in each year, just as in Figure 4 of the Kügler et al. paper, but considers both full-time and part-time workers in both eastern and western Germany.<sup>6</sup> Our results strongly resemble theirs, but also highlight key qualitative differences between eastern and western Germany (eastern German workers are gaining throughout) and most importantly between full-time and part-time workers. For the latter, the increase in dispersion and the wage losses at the bottom of the distribution are much larger.

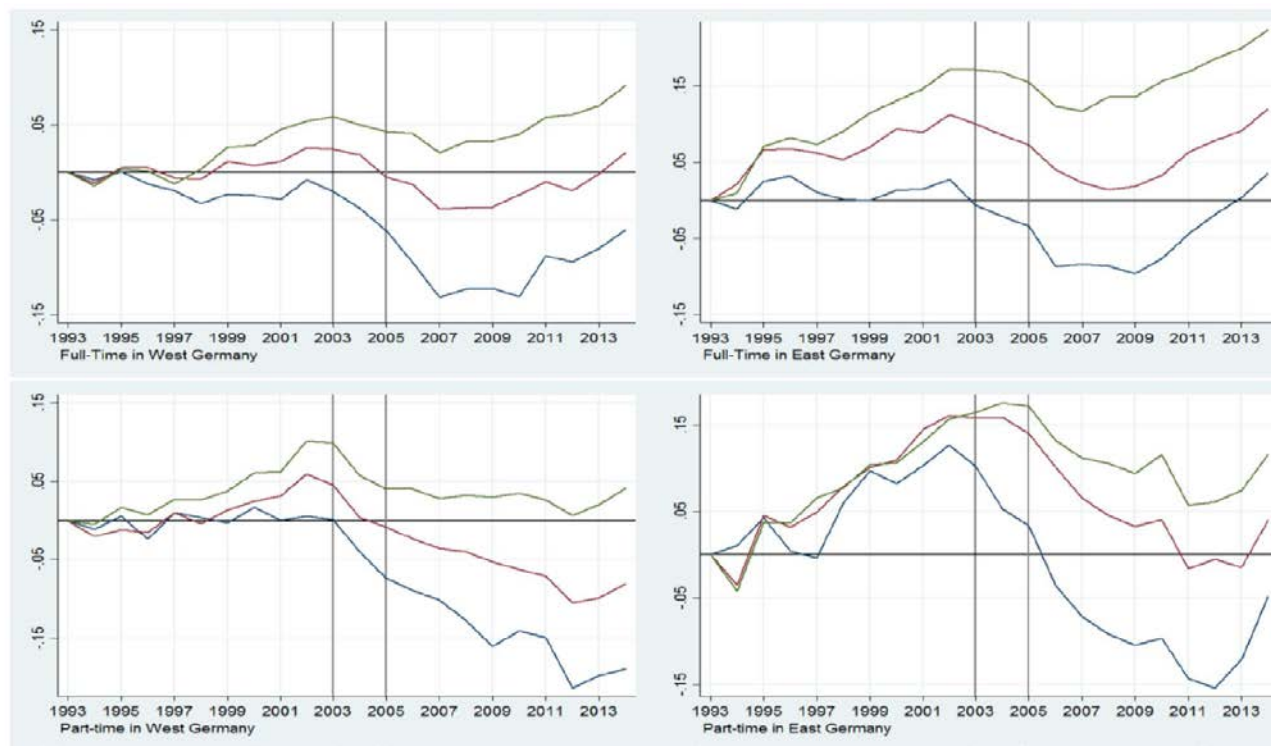
<sup>6</sup> Unlike Kügler, Schönberg and Schreiner, we do not impute wages that exceed the maximum social security earnings threshold capping contributions (Beitragsbemessungsgrenze) and choose a lower percentile (75<sup>th</sup>) to avoid censoring.



## Chart 5

Cumulative real wage growth for full- and part-time German workers at different percentiles of the wage distribution: 25th (blue) 50th (red) and 75th (green)

(1993-2014; cumulative change from 1993, natural logarithms)



Source: Reproduced from Burda and Seele (2018).

Note: Cumulative growth of real wages, deflated by the consumer price index, relative to base year 1993.

### 3.3 Wage-employment and wage-participation correlations

A key finding of the Kügler et al. paper is a systematic increase in pay dispersion for full-time workers in Germany that is absent in France – wages in the latter actually became more compressed in the period. But how should we interpret these findings? Rising variance of wages can be due to any number of factors. The standard assumption is that an increase in heterogeneity of workers' productivity increases the dispersion of market clearing wages. Inspection of their Chart 4 reveals that while wage dispersion at the top of the distribution began increasing already in the mid-1990s, the increase in wage dispersion at the bottom really only began after 2003-2005. My evidence for part- and full-time workers (see Chart 5) confirms that the rise in low wage dispersion does not emerge until after 2003, when the first Hartz laws took effect.<sup>7</sup> The Hartz reforms were mostly measures aimed at raising effective labor supply at current wages, so could they also have played a role? If so, should we think of changes in labor supply in a Marshallian supply and demand framework? Or are employment changes only movements along a negatively sloped demand curve?

<sup>7</sup> Although the authors make no mention of it, this is also evident in Figure 2 in Dustmann et al. (2014).



As a natural starting point, Katz and Murphy (1992) treat employment-wage data as an outcome of a cleared labor market; that is, the world according to Marshall.<sup>8</sup> Intuitively, if de-trended relative employment and wages co-move positively in a particular period across cells defined by labor types, then the dominant shift factors originated in labor demand. By contrast, a negative correlation signals predominance of labor supply shifts.<sup>9</sup> It is useful to distinguish between “stable demand hypothesis” in which only employment and wages are implicated, and a “market clearing hypothesis,” that additionally asserts that labor supply and labor demand are equated by the evolution of relative wages. While simple correlations of relative employment and relative wages cannot distinguish between these two visions of the labor market, extensions of the Katz-Murphy framework can. Intuitively, if labor supply on average is upwards sloping, an exogenous relaxation of wage rigidity should be associated with declining participation rates. In contrast, if the dominant force in the period is a positive shift to labor supply behaviour given demographic fundamentals (e.g. the Hartz reforms), participation rates should rise instead.

Table 1 displays correlations of relative wage changes with employment (measured as relative employment, in hours) across successive five period intervals starting in 1995 and proceeding in five year increments. Cells are based on gender, East versus West, and age. Initially positive, wage-employment change correlations with subsequent periods turn negative after 2000. Wage moderation is evidently strongly associated with relative employment growth in Germany between the early 2000s and the present. Table 2 shows, however that a “Marshallian” account of the labor market is better able to account for patterns of labor force participation, measured as the fraction of potential hours supplied by the working age population. If labor supply is positively sloped on average, wage reductions should be associated with reduction of labor supply at the margin. (A formal argument can be found in Burda and Seele (2018)). It follows that if the Hartz reforms were irrelevant, one would expect a positive correlation of relative wages and labor force participation – falling wages would induce workers to withhold labor supply, even if they are unemployed. As a matter of fact, the correlation is negative, as would be predicted by a market-clearing framework.

<sup>8</sup> This is the strategy pursued by Burda and Seele (2016, 2017, 2018) who extend the model to allow for non-cleared markets and endogenous labor supply.

<sup>9</sup> The simplest version of the Katz-Murphy (1992) model assumes a competitive representative firm that uses a constant returns, neoclassical production function of  $k$  types of labor  $Y = F(L_1, L_2, \dots, L_k)$ ; profit maximization gives rise to a  $(k \times 1)$  vector-valued labor demand function  $L^D(W, X)$  of a  $(k \times 1)$  vector of wages  $W = (w_1, w_2, \dots, w_k)$ , and  $X$ , an  $(m \times 1)$  vector of  $m$  exogenous labor demand shifters. Labor supply  $L^S$  to the  $k$  labor markets is assumed exogenous; Burda and Seele (2018) extend the model to the case of endogenous labor supply. Total differentiation of  $L^D$  gives  $dL^D = L^D_w dW + L^D_x dX$ , and market clearing implies  $dL^D = dL^S = dL$ . Premultiply  $dL$  by  $dW'$  to obtain  $dW' dL = dW' L^D_w dW + dW' L^D_x dX$ , or  $dW' L^D_w dW = dW' dL - dW' L^D_x dX$ . Because  $L^D_w$  is negative definite by virtue of profit maximization and concavity of the production function, the left-hand side is always negative. Thus, whenever demand shifts are inactive ( $dX=0$ ) and supply shifts do occur ( $dL^S \neq 0$ ) we have  $dW' L^D_w dW = dW' dL < 0$  and co-movement of employment and wages across the  $k$  labor types is negative.

**Table 1**

Relative wage change – employment change correlations across 37 cells

From five-year period centered around...	...to five-year period centered around		
	2000	2005	2010
1995	0.16	0.04	-0.14
2000		-0.46	-0.57
2005			-0.66

Source: Burda and Seele (2018).

Notes: Cells by age groups (10), gender (2) and region (2).

**Table 2**

Relative wage change – participation change correlations across 36 cells

From five-year period centered around...	...to five-year period centered around		
	2000	2005	2010
1995	0.15	-0.23	-0.60
2000		-0.16	-0.54
2005			-0.65

Source: Burda and Seele (2018).

Notes: Cells by age groups (10), gender (2) and region (2).

These results are robust to both stratification with respect to various subgroups as well as the addition of more characteristics for cell definitions.<sup>10</sup>

## 4

## Summary

Kügler, Schönberg and Schreiner have shown convincingly that rising wage dispersion, especially at the bottom of the wage distribution, was an important part of Germany's labor market adjustment regime. Some would call it an internal devaluation necessitated by the absence of an exchange rate. Just as striking is the fact that France experienced wage compression over the same period. Those German workers who were priced out of the market by technological change, eastern enlargement or trade integration with Asia found reemployment at lower, sometimes significantly lower wages. Germany has thus followed lead of the United States in accepting pay inequality, but appears to have dampened the impact on personal income inequality

<sup>10</sup> Similarly, Burda and Seele (2017) examine correlations of changes in employment rates and participation rates as defined by the ILO.

through in-work benefits and other family transfers (Sachverständigenrat 2017). Evidence from the European Social Survey indicates that happiness levels of Germans have risen relative to the French since the mid-2000s. Having a job at lower wages is evidently better than not having one at all.

Unions and works councils accepted wage flexibility described by Kügler et al. as part of a survival strategy. Greater differentiation of product wages was an important source of breathing room for struggling enterprises. Yet a low wage sector can emerge only if workers are willing to accept work at lower wages. Changes in the attractiveness of part-time and marginal employment in terms of pension rights, social security contributions, and overall social norms increased the participation of female and older workers with weak or no attachment to the labor force. More important, the Hartz IV law increased the willingness to work at given wages and demography. It did so by decreasing out of work benefits, especially for long-term unemployed and changing their status to that of social welfare recipients. Using the logic of Katz and Murphy (1992), we should expect a negative correlation of wage changes with both changes in employment and in labor force participation. This is indeed the case. Wage flexibility and work incentives were both key elements for labor market recovery.

To what extent is the German model exportable to other countries, especially in Europe? We should be wary of simple proposals that ignore the rich institutional, cultural and legal backdrops of EU labor markets. Works councils and co-determination enjoy a broad degree of consensus and trust built up over many decades between employees and employers. While even more abundant in the Nordic countries than in Germany, recent surveys show that trust is in short supply in southern Europe and especially in France. Simply slashing unemployment benefits and weakening unions is unlikely to be helpful in building trust, because employers profit immediately and workers benefit from more plentiful and stable employment only in the medium to long run.

It is also interesting to reflect on the implications of this paper's findings for future nominal wage inflation in Germany, with unemployment approaching historic lows in 2018. Absent explicit use of fiscal policy, an increase in domestic wage inflation and an associated real exchange rate appreciation represent a viable alternative for rebalancing current account and Target-2 imbalances within the monetary union. This may not be a popular suggestion among German employers, but would certainly involve less misery than a euro-exit of periphery economies as demanded by some, or more painful disinflation or even deflation in those countries, as demanded by others. While early signs of rising pay in Germany are encouraging, it remains to be seen if nominal wages are as flexible going up as they were going down.

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# Reflections on wage-setting

By Klaus F. Zimmermann<sup>1</sup>

## Abstract

Central banks need to be concerned about wages since they are a major driver of inflation. Rising wages are needed to signal directions for market adjustments to ensure growth. Wage growth is driven by relative scarcity, labor productivity and expectations about inflation and future growth. Migration plays a significant role to balance wages across regions and countries. Wage growth has been low in most developed economies because of underutilized labor if properly measured. Germany seems to be an exception, but the scarcity of workers has been tamed by internal flexibility resulting from more decentralized wage-setting and labor market reforms.

## 1 Introduction

Why do central banks need labor economists? When I wrote my diploma thesis forty years ago about “Rational expectations and the Phillips Curve”, there was none usable for policy – making and inflation was perfectly controlled by the size of available money. Inflation was an issue of too much money. Today, we are concerned about sluggish wage growth and measure inflation expectations by past inflation, if at all. The old Phillips Curve is rehabilitated. We do not care anymore about too much money. And central bankers like Jens Weidmann ask those bargaining for wages for a stronger wage growth. All puzzling, in particular in the face of discussions about scarce skilled labor in economies such as Germany. To what extent is this all still the consequence of the Great Recession or already the result of a new “digital economy”? Or is the lack of orientation driven by our fading ability to measure the key concepts of wages, prices, output (goods and services) and labor input effectively? In any case, since a tautology remains valid, using the definition of the labor share as wage costs divided by nominal output, we still see that inflation equals wage growth minus labor productivity growth minus growth of the labor share. All factors exposed by this decomposition are of interest for labor economists, and therefore are interesting topics for exchange between monetary economists and labor researchers.

## 2 What are wages and why should they rise?

Wages are not just simply cost factors for companies or the source of income for households. They carry important economic market signals about absolute and

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relative scarcity for the orientation of firm and household behavior. This helps to provide the best allocation of economic resources and to find the highest welfare levels. It is in particular important to deal with and properly respond to structural changes in the economy. This implies that relative wages across regions and between different occupations have to be flexible up and down.

With no wage growth, some types of wages would have to rise, others to fall. However, it is well known that wages fail to adjust downwards, even in recessions (Bewley, 1998; 1999) for current employees or new hires. Employers are afraid of damaging motivation, which wage cuts would cause. Hence, wages vary little with the business cycle. In a recent study, Hazell, Kazemi and Taska (2018) show that this also holds in the hiring process even for posted wages where employers are in a much stronger bargaining position. In a situation of posted wages, workers take the wage as given when they choose the job, while in the other situation there is wage bargaining.

In the face of this downward - inflexibility of wages, rising wages in general allow relative wages to be more flexible, since some wages can stay constant or rise only slowly, while others move up significantly in case of temporal relative scarcity or structural changes. Market signals can be conveyed more forcefully with rising wages.

However, the measurement of wages like the measurement of prices has become increasingly difficult with changes of production technology, the rise of the service sector, digitalization and the globalization of work and international collaborations. Dividing labor costs by the number of workers or hours spend at work is becoming questionable in the face of unpaid overtime work, labor hoarding strategies or “joint production” employing leisure on the job or working from home. Non-wage labor costs for the companies and non-wage labor benefits for the worker have to be considered.

### 3 What determinates low wage growth and should we worry?

Should we worry about the low wage growth observed? Missing clear signals of relative scarcity should eventually cause slower economic growth. The original Phillips curve connecting wage growth to unemployment as the measure of labor scarcity has been one way to measure this. Indeed, the instrument is not only back, but also this curve (as the modified replacing wage growth by inflation) has flattened strongly in most countries in recent years. (See for instance Bell and Blanchflower, 2018a; Kügler, Schönberg and Schreiner, 2018.) The natural rate of unemployment has fallen sharply since the Great Recession.

However, unemployment became fairly low in many countries and the question arises why wages would not move up. Bell and Blanchflower (2018a; 2018b) explain this by a substantially larger degree of underemployment on the job since the Great Recession. They claim that there is a lack of wage pressure in spite of comparatively low unemployment rates since those rates would understate the labor market slack. This moderates when they use a measure of underemployment replacing unemployment. In constructing such a measure they use survey data for various countries about the

degree people at work would like to provide more or less. They find that since the crisis, the underemployed like to work more than they did before, and the highly employed do not want to work as much less than they did before. Underemployment has not returned to their pre-crisis levels with the exception of Germany.

Hence, Bell and Blanchflower (2018a) argue that low wage growth and low unemployment can co-exist without harm for quite a while. They also point at a historical controversy between Beveridge and Keynes. Contrary to Beveridge, Keynes doubted in 1944 that persistent levels of unemployment around 3% were feasible without substantial wage increases. In 1960 Beveridge stated an average unemployment rate of 1.5% for 1948-1959 in the United Kingdom with no sign of wage explosion.

Next to scarcity there are other factors driving (nominal) wages including productivity, innovations, price and growth expectations as well as globalization through trade, migration and internet collaborations. Digitalization reduces scarcity. Relevant are also institutional changes like labor market reforms, the decline in the role of unions and a decentralization of wage bargaining.

## 4 Why is Germany different?

That Germany has seen for long a slow wage growth as has been noted by Deutsche Bundesbank (2018), Bell and Blanchflower (2018a) and Kügler, Schönberg and Schreiner (2018) among others. This is surprising since Bell and Blanchflower (2018a, 2018b) found it the only country where underemployment has also declined significantly recently and the labor market is close to full employment with scarcity of skilled labor. Kügler, Schönberg and Schreiner (2018) largely explain this by a long-term rise in internal labor market flexibility through a decline in union power and a rise in decentralized wage bargaining.

The question remains why this had happened contrary to the developments in other European countries like France, Spain and Italy with their inflexible and sticky labor markets. Cahuc, Carcillo, Rinne and Zimmermann (2013) had studied differences in the youth labor market between France and Germany to find that the fundamental differences between both countries result from structural differences in labor policy and in the vocational training system. To generalize, wage growth remained relatively high although with high unemployment because of the lack of structural reforms in France.

The issue of the rise of internal flexibility as a cause for the large labor market success of Germany had been promoted before in a series of articles by Rinne and Zimmermann (2012, 2013) and Brenke, Rinne and Zimmermann (2013). However, they argue that such development was significantly influenced by societal pressure and interacted closely with the German labor market reforms and policy design that enforced flexible adjustments responding to structural changes and the big shock during the Great Recession.



The reform measures brought a substantial amount of low-skilled workers into work. Their low wages and small pay dynamics by definition led to a smaller increase in general wage change measurement. The reform pressure and various “employment pacts” of the government with the social partners had enforced decentralization tendencies with wage bargaining including the rise in opt-out clauses in union wage contracts in reaction to critical situations in the companies. The available political instrument to declare union wages generally binding for all companies of a certain industry or region (“Allgemeinverbindlichkeitserklärung”) orchestrated by the responsible labor ministry was less used. Governmental policies like the elaborations and public support of the short-time work instrument brought also substantial flexibility at the time of the Great Recession.

Will Germany remain different? Recent German governments including the current one have re-reformed labor policies, increased non-wage labor costs and weakened flexibility again. The general minimum wage introduced in 2017 add to those factors affecting wage growth in the future. Indeed, also union wages were already rising stronger in 2018 and consumer prices were over 2% in Mai and June 2018.

## 5 Migration for monetary policy

However, also migration across Europe is reacting to relative scarcity and affects productivity. As Deutsche Bundesbank (2018) stated, Germany managed to attract the needed workers largely from other European countries. This has weakened wage-pressures and brought jobs particularly in low-wage sectors contributing to the slow wage-growth of Germany in recent years. Migration has also affected German labor productivity.

Migration remains an important source of flexibility in particular in the eurozone. With no flexible exchange rates, mobile workers can bring adjustments, in particular in response to asymmetric shocks. A recent paper by Jauer, Liebig, Martin and Puhani (2018) has studied whether migration can be such an equilibrating force by comparing pre- and post- Great Recession migration movements at the regional level in both Europe and the United States. They found Europe today as flexible with migration than the United States. In their analysis, up to a quarter of annual asymmetric shocks can be absorbed by migration in Europe. However, the flexible migrants largely come from new member countries from Eastern Europe and from third-country nationals.

The lesson is that labor migration should be studied carefully by central banks, in particular the European Central Bank. This is even more important in the face of the rising but unfounded mistrust in the various member states about the positive contributions of migration to the functioning of the European economies.

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# Views on advanced economy price and wage-setting from a reformed central bank researcher and national statistician

By Erica L. Groshen<sup>1</sup>

## Abstract

I address two topics concerning the recent unexpectedly low inflation and wage growth in advanced economies.

- First, could mismeasurement explain this? For US prices, I conclude that innovation and substitution biases are unlikely explanations, as they are small and stable over time. Wage growth receives much less attention, so it is harder to say whether recent surprises may be measurement artefacts. Thus, I conclude that there is uncertainty, but no compelling reason to doubt the reality of current low inflation.
- Second, does this imply that central banks need not support improvements in official statistics? No. A fuller understanding will require richer models and more data. In today's environment, as central bankers seek to maximize welfare, they must be vigilant to prevent degradation or elimination of the official statistics they rely on. Accordingly, I outline opportunities and challenges for official statistics and steps that central banks can take to support improvements.

## 1 Research, central banking and national statistics

My comments arise from things that I, a former central bank researcher, learned during my time as the Commissioner of the US Bureau of Labor Statistics. To frame my comments, it is helpful to consider the relationship between central bankers and their statistics agency counterparts.

The recent unexpectedly low inflation and wage growth in many advanced economies provide a keen reminder that central bankers rely heavily on two imperfect tools. First, most macroeconomic models have very simple wage and price-setting mechanisms. Second, official inflation measures of wage and price inflation have a number of well-known limitations. Thus, as we see in the papers presented at this conference, when the behaviour of inflation surprises economists and central bankers, attention

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quickly turns to the usual suspects, that is, questioning measurement and then considering more realistic wage and price-setting models.

This intellectual pathway (from data surprise to questioning data quality or enriching models) is not unique. Indeed, its frequent recurrence makes a strong case for the importance of Central Bank support for national official statistics.

During 25 years in the US Federal Reserve System, I conducted research on wage and price-setting, particularly in relation to inflation and employment. After that, from 2013 to 2017, I headed the US Bureau of Labor Statistics (BLS), which is responsible for measuring prices, compensation, productivity and employment for the United States.

Just drawing on my own work, there are many examples of the close relationship between central banking and statistical agencies. As a central banker, I studied many topics related to wage and price-setting using data from statistical agencies. Very much related to the topics on this conference, Mark Schweitzer and I studied that we called the “grease and sand” effects of inflation on wage-setting. We argued that these offsetting effects on labor market efficiency could help central banks select an appropriate inflation target.<sup>2</sup> With support from the Federal Reserve and the ECB, I also co-led the International Wage Flexibility Project, which used international microdata and included ECB and BLS researchers, to examine the prevalence, causes and consequences of wage rigidity in advanced countries (Dickens et al., 2007).

## 1.1 Central bankers and national statisticians’ important relationship

Most obviously, national central banks and the ECB are avid important clients of the official indicators produced by national statistical agencies, including (but not limited to) national income and product accounts and inflation, productivity and employment measures, and often the underlying microdata). Monetary policy and regulatory decisions and public communications hinge critically on these data. Data needs from monetary and regulatory authorities often influence statistical agencies’ priorities and justify resource allocations.

In addition, central bankers and national statisticians are key professional peers. They have similar professional training – particularly in statistics and economics, very often at the graduate level from the same top institutions. They often publish and present research in the same venues – on work that tends toward empirical, rather than theoretical analysis. They have all chosen and trained to work for independent, nonpartisan public agencies. Not surprisingly, over the course of their careers, many move among academic, statistical agency and central banking positions. Thus, they frequently share professional jargon, education, and interests.

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<sup>2</sup> See Groshen and Schweitzer (1997a, 1997b and 1999) and Cecchetti and Groshen (2001).

While central banking and creating official statistics both aim to advance national welfare, they play distinct, complementary roles. To fulfil their particular missions, they must maintain mutual operational independence. For example, some part of the ECB's credibility rests on the fact that its key success measure (price stability) is not measured directly by the ECB itself. Similarly, Eurostat's inflation measures gain credibility from the ECB's reliance on the indicators it releases.

They also develop different specialties and perspectives as their institutions work independently work on dissimilar products. Producing monetary policy decisions and the input into them are quite different on a day-to-day basis from designing and producing monthly or quarterly economic statistics.

These differences and similarities mean that these colleagues often place high value on each other's expertise, mission, independence and perspectives. Crucially, though, the need to preserve operational and intellectual independence need not and should not result in monetary and statistical authorities failing to provide mutual support for each other.

## 1.2 National statistics in the trenches

Addressing an audience that is mostly central bankers, let me spend a little time reviewing the world in which national statistical agencies operate. As any economist would recognize, producing official statistics is a highly skilled exercise in constrained maximization.

To begin with, an agency like the US Bureau of Labor Statistics or Eurostat aims to produce the best possible official statistics to guide decisions. Good data has five characteristics.

1. Accurate: Minimized statistical bias and standard errors.
2. Objective: Not influenced by political or other non-statistical considerations.
3. Relevant: Useful to inform important decisions.
4. Timely: Available in time to be of use.
5. Accessible: Easily obtained and understood, in construction and meaning.

After a certain point, these virtuous characteristics can conflict with each other. Thus, the production choices made by statistical agencies must find the right balance among these five virtues.

For example, improved timeliness will often be at the cost of some accuracy and vice versa. That is, annual inflation measures are typically more accurate measures of trends than monthly readings. In adjusting for quality changes in price statistics, to meet the need for timeliness by producing a monthly inflation indicator, on average, no more than 20 days elapse between the collection of a price and the final publication of the index.

These trade-offs are not the only constraints. Budgets, methodological demands and respondent burden and confidentiality also impose very real and binding constraints on official statistics. More sample and data fields that could improve accuracy are often not possible within rigid budget constraints. Furthermore, the confidentiality of all collected data must be strictly protected at every stage of index construction.<sup>3</sup> Respondent participation is frequently voluntary (if de jure then de facto), so the agencies must minimize respondent burden in order to persuade respondents to participate.<sup>4</sup> These considerations mean that for a methodological improvement to be implemented, it must meet the following criteria:

- Feasible within the budget constraint and staff skill sets. That is, requires no increase in samples, staffing or surveys without a corresponding budget increase.
- Computable and reviewable within 20 working days for monthly series.
- Does not unduly burden respondents to the survey. Otherwise, response rates and data quality will suffer, reducing accuracy.
- Preserves respondents' confidentiality in accordance with the law and agency promises.
- Proven to improve quality in a statistically significant manner, otherwise it will waste resources.

Thus, statistical agencies are never under the illusion that their statistics are perfect. They know that their indicators represent constrained optimization: that is, the best possible statistics subject to current constraints. This is one more reason why the agencies aim for transparency, so that data users will understand the data's virtues and limitations.

Note that to say all this does not contradict the fact that national statistics in the United States and EU are still provide the gold standard. Official statistics are the most trustworthy, comprehensive, and transparent economic indicators available.

### 1.3 Economic phenomenon: real or data artefact?

It follows that whenever inflation or other economic indicators do not behave as expected it is important for central banker economists to consider whether the phenomena are real or reflect data limitations. This is certainly true of the current question (that is, what is the cause of recent unexpectedly low inflation). Indeed, two of the four papers at this conference (Stock and Watson, 2018 and Nevo and Wong, 2018) consider data issues explicitly.

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<sup>3</sup> See an example of [US confidentiality protections](#).

<sup>4</sup> Countries vary on whether participation in price surveys is voluntary. For example, participation in [Norway's](#) and [Canada's](#) price index programs is mandatory. Even when participation is mandatory, statistical agencies generally do not prosecute companies who fail to participate.

In the context of pressing policy concerns, researchers and central bankers often approach data limitations as urgent new questions that demand immediate attention and resources. In this they differ from the staff in statistical agencies, which have long acknowledged, studied and worked to reduce those limitations.

At this point, joining forces can be very productive. Statistical agencies can provide data access and institutional memory while external researchers add new energy, resources and understanding of the consequences of particular data limitations.

## 2 Price index measurement challenges

One area where central bankers and statistical agencies have a history of working together is on estimating and reducing biases in the price indexes that measure inflation. Two major challenges in constructing price indexes are minimizing biases from innovation and substitutions. In this section, I consider whether these two biases are behind the recent behaviour of inflation.

Wage growth measurement issues are addressed in the section on opportunities for improvement because there has been much less work on their biases.

### 2.1 Innovation and new goods measurement challenges

An often-stated concern in recent years is that national economic accounts miss some of the value of some goods and services arising from the growing digital economy. That is, quality improvements and innovations in new goods that are unaccounted for in price statistics can lead to overestimating inflation and underestimating real GDP.

Groshen et al. (2017) examines the severity of these thorny issues for the United States. I briefly summarize those findings below and encourage readers to consult the full article for more detail.

#### 2.1.1 Matched model as the cornerstone of price measurement

The matched model is the cornerstone of constructing BLS price indexes. When products match over time, the characteristics of each product are held constant. Thus, any price change can only be attributed to inflation, and not to changes in characteristics. For example, from December 2013 through November 2014, BLS found matches for CPI items 73 percent of the time. Of the remaining 27 percent of items that were not matched, 22 percent reflected temporarily missing items, such as a bathing suit in Milwaukee in December. The other 5 percent represented a permanent disappearance.

So, what does BLS do for non-matches, the 5 percent? This is where the innovation or new goods bias could creep in. As items disappear (5 percent of items), a “replacement” is identified whenever possible. Most of the time – 3 percent of items



over the year – BLS finds a “replacement good” that is very similar and proceeds accordingly. For remaining 2 percent of items, BLS needs to adjust for a quality change: it has a new price for a slightly different product.

## 2.1.2 How to account for innovation in price indexes

So, how do statistical agencies like the BLS treat new and evolving goods and services? To begin with, this problem is hardly a recent development. For example, consider the 1920s. That decade saw a rapid introduction of new goods such as indoor plumbing, electricity, and radios, as well as dramatic quality improvements of existing products such as automobiles and airplanes. Over the past century, technical innovation has continued to improve existing goods and has led to the introduction of myriad new products.

Academics' and statistical agency staff's decades-long search for the best ways to adjust price indexes for innovations has generated a vast literature.<sup>5</sup> The methods in present use fall into three groups:

- Quality adjustment from producers: In some cases, an item's producer can provide a value (generally cost-based) for the change in its characteristics. The BLS uses this value to adjust the transaction price before it is entered into the index. This method is referred to as explicit quality adjustment and is most prevalent in the PPI and Import and Export Price Indexes (MXP) for autos, machinery, computers, and other goods with model changes. This approach is appropriate for adjusting output (not welfare) prices.
- Outside surveys to measure quality changes: For example, the US Department of Health and Human Services has created a Hospital Compare and a Nursing Home Compare database, which looks at inputs that experts believe can serve as proxies for quality of health care.<sup>6</sup>
- Hedonic approaches: This “demand for characteristics,” model relies on estimates of how much each product characteristic contributes to the value of a good. In the CPI, about 33 percent of the total expenditures in the underlying basket of goods are eligible for quality adjustment with hedonics when price-determining characteristics change. Housing-related expenditures account for most of this share. In addition, the PPI and MXP use hedonic adjustment procedures for computers.

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<sup>5</sup> See Groshen et al. (2017) for a partial list of references for studies done by BLS staff.

<sup>6</sup> BLS uses [these data](#) to adjust the hospital and nursing home components of the PPI. In addition, the Insurance Services Office (a private firm) creates a database on the risk characteristics of cars, which BLS uses for quality adjustments in auto insurance prices.

### 2.1.3 Some quality adjustment and new goods bias remains

Using innovation and new goods bias estimates from experts external to BLS and the US Bureau of Economic Analysis – BEA – (produced by Federal Reserve and academic researchers), Groshen et al. (2017) finds that these influences on existing price indexes may overstate inflation in Personal Consumption Expenditures and Private Fixed Investment. This bias leads to a corresponding understatement of real economic growth of about -0.4 percentage point per year. The bias appears fairly stable over time and arises mostly from innovation in health care, rather than from digital products and services.

These measurement issues are far from new and, based on the magnitude and timing of recent changes, Groshen et al. (2017) concludes that it is unlikely that they can account for slow growth in recent years. Nevertheless, this bias looms larger when overall growth is slow.

The statistical agencies involved (BLS and BEA) are neither alarmed nor satisfied with this persistent bias. In their ongoing efforts to improve statistics, this research helps to focus attention where it is most needed. The bias estimates also help inform data users, including central banks, so that they can factor the information into their decisions.

For the current discussion, it is important to note that fears of increased bias from innovation and new goods run counter to the immediate fear that price inflation is understated. Thus, this explanation requires a recent reduction – not an increase – in innovation bias. Such a reduction could stem from a slowing of innovation or from recent success on the part of statistical agencies in reducing bias. The results in Groshen et al. (2017) do not suggest that the bias has changed much lately, at least up until 2015.

## 2.2 Substitution bias

### 2.2.1 Substitution bias concept

Nevo and Wong (2018) raise the question of whether recent subdued inflation reflects the presence of substitution bias in the inflation measures. Substitution bias arises if consumers change their purchasing behaviour in response to relative price changes. Economic theory predicts that an increase in a good's price will cause consumers to reduce their purchases of that good and instead purchase a substitute with a relatively lower price. The Boskin Report (Boskin et al., 1996) asserted that this was another important source of bias in the CPI, which at the time assumed no substitution.

In 1999, BLS changed the way it calculated the CPI for many of the basic indexes, moving to a geometric means formula. (A basic index is an index for a particular item category and location; these basic indexes are the building blocks that are aggregated into the broader CPI measures, such as the all items index.) This new formula

effectively assumes modest consumer substitution *within item categories*, correcting for what the Boskin Report termed “lower-level substitution bias.” That is, it assumes that consumers will substitute away from one brand or type of item, such as a steak or a car, as that brand or type becomes relatively more expensive compared with other brands or types of that product. It does not assume, however, substitution between steak and chicken or between cars and bus fare.

The geometric means formula does not correct for “upper-level substitution bias” or substitution across item categories. Some argue that this omission is a reason that the CPI is still biased upward; others argue that the CPI should not assume any substitution at all. In any case, the use of geometric means for most categories has had the effect of lowering the CPI by 0.2 or 0.3 percentage points per year. (Some categories, for which substitution is unlikely, such as shelter, utilities, and most medical care, are excluded.)

## 2.2.2 Substitution bias modest and not increasing

The Chained Consumer Price Index (Chained CPI), a supplemental index introduced by BLS in 2002, uses updated expenditure weights. Rather than make any assumptions about substitution, it derives its weights from expenditure measures both before and after a price change. It is thus free of upper-level substitution bias.<sup>7</sup> As would be expected, it tends to run slightly lower than the regular CPI-U. Therefore, those who believe that upper-level substitution bias is important can focus on this measure and those who want to check for a change in bias can compare it to the CPI.

Chart 1 compares the recent behaviour of the Chained CPI to the CPI over the past 17 years. The overall mean for the series is +0.27 percentage points. The mean for the second half of the period is +0.22 percentage points, less than the 0.32 mean for the first half. This chart suggests that substitution bias is small and positive and may be declining modestly. This reduced bias could contribute to the recent moderation in measured inflation, but the impact is likely to be small.

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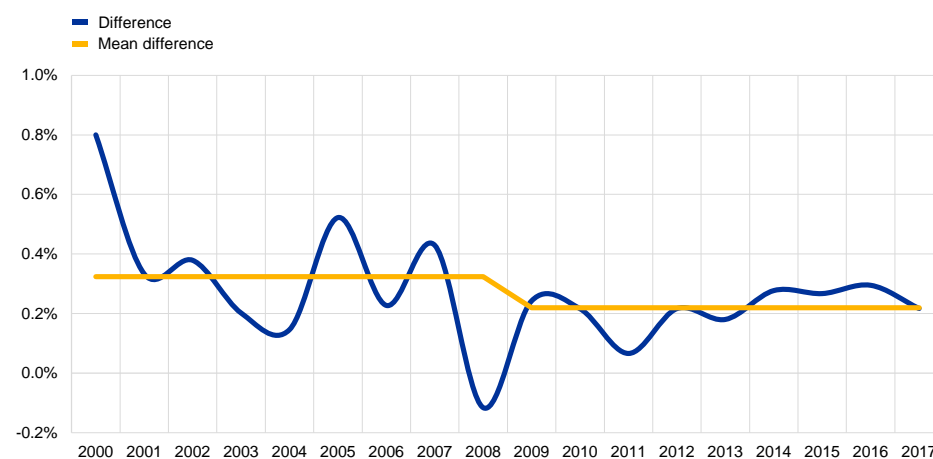
<sup>7</sup> See information about the [C-CPI-U](#).

## Chart 1

### Substitution bias modest and not increasing in the United States

#### 12-month change in CPI minus 12-month change in Chained CPI

(percentage points)



Source: US Bureau of Labor Statistics.

## 3 Improvements: progress, opportunities and challenges

Statistics are always estimates. While they will never be perfect, they can get better or worse. Indeed, methods and coverage must continually adapt, improve and modernize or official measures will certainly slide into irrelevance. Statistical agencies work continually to improve their products by reducing standard errors and bias, speeding up delivery of releases, providing more granularity (by industry, geography, etc.), and addressing new relevant questions.

### 3.1 Price index progress

How are statistical agencies improving their inflation measures? Here are some examples of what BLS and BEA are doing. While these examples are limited to the United States, statistical agencies in all the developed economies learn from each other and are engaged in similar sorts of improvements.

- BLS is expanding use of hedonic methods. Hedonic methods are feasible when adequate sample sizes and information on relevant characteristics are available. Hedonics must be implemented on a case-by-case basis, to ensure that key conditions are met: 1) adequate sample size for estimation; 2) observable product characteristics, ruling out features such as enhancing the user's social status; 3) unchanging set of relevant characteristics, ruling out this approach for goods where stark new attributes are introduced frequently, such as the smartphone; and 4) a competitive product market, with mark-ups playing only a very limited role (to ensure that a characteristic's coefficient is an unbiased estimate of its shadow price).

- BLS Producer Price Index (PPI) introduced new quality adjustment methods for microprocessors this winter in response to research and changes in pricing practices within the market.<sup>8</sup>
- BLS PPI has developed its first hedonic regression model for broadband services.<sup>9</sup>
- BLS introduced a new hedonic regression model for quality adjustment for cell phones in the Consumer Price Index (CPI) that features directed substitutions twice a year when major new smartphone models are released.<sup>10</sup>
- BLS CPI refined its quality adjustment practices for wireless telephone services last spring:<sup>11</sup>
- For a very recent example of BLS efforts to validate and improve quality improvements for electronic switches, see Adams and Klayman (2018).
- BLS and BEA have created experimental disease-based price indexes for medical care that correct for the portion of the new goods bias that arises when less expensive goods and services substitute for more expensive treatments.<sup>12</sup>
- Working with a small number of major retailers, CPI has begun using scanner data to price certain well-defined products.

## 3.2 Opportunities for more improvement

Groshen (2018) presents important opportunities to further expand and improve BLS official statistics on wage and price-setting. These needed improvements include expansion of services coverage in price programs, development of the capacity for one-off surveys and supplements to obtain gold-standard answers to pressing policy questions, and a wide variety of possible changes to improve timeliness, detail, and response rates. Below I call attention to three areas of particular relevance to this conference.

### 3.2.1 Trade services margins

Past data improvements now offer an important research opportunity to expand understanding of how trade margins interact with inflation. In 2014, BLS introduced a

<sup>8</sup> The [new hedonic regression model](#) uses statistical learning methods for specification and provides a potential template for hedonic quality adjustment for other industries with rapid technological change.

<sup>9</sup> See <https://www.bls.gov/ppi/broadbandhedonicmodel.htm>.

<sup>10</sup> See <https://www.bls.gov/cpi/factsheets/telephone-hardware.htm>.

<sup>11</sup> See <https://www.bls.gov/cpi/factsheets/telephone-services.htm>.

<sup>12</sup> See for more information on [BLS experimental disease-based price indexes](#). See for more information on [BEA's treatment of disease-based measures](#) as reflected in Health Satellite Accounts. Disease-based price indexes report medical inflation by the treatment of disease, rather than by the good or service that treats this disease. However, they do not at this point account for improved outcomes, such as increases in life expectancy coming from an innovation such as coronary bypass surgery.

new comprehensive final demand-intermediate demand aggregation system for PPI.<sup>13</sup> This system incorporates price indexes for services and margins. The behaviour of PPI Trade Services margins, which had never been comprehensively observed before proves to be very complex.<sup>14</sup> Just as the availability of data and development of theory has helped explain the previously perplexing behaviour of inventories, I expect that economists will soon use these new PPI data to illuminate the role of margins in the transmission of inflation and other shocks. Such research is also likely to help improve measurement.

### 3.2.2 Wage growth indexes

As my discussion until now shows, price measurement issues have attracted a lot of attention from central banks, researchers and statistical agencies. Wage growth indexes have not attracted nearly as much attention, despite the very interesting policy issues advanced in the conference paper by Kugler et al. (2018). Thus, it is hard to say much about possible biases and needed improvements in wage growth estimates, simply because they have not been studied extensively.

Further study of wage-setting and the virtues and limitations of wage growth measures have strong potential to inform understanding of inequality, pass-through, productivity, and macroeconomic vulnerabilities. The topics worthy of study include the following:

- Work hours: Particularly for white-collar and non-traditional workers, hours are notably difficult to measure. Are there better ways of tracking work time? What are the consequences of the assumptions that statistical agencies make with regard to hours?
- Non-wage compensation: Are we capturing and accurately pricing all the meaningful forms of non-wage compensation? Who receives these benefits? When do they substitute for or complement higher wages?
- Non-traditional work: How should we measure compensation growth in nonstandard employment, such as for the self-employed, contractors, contracted-out workers, gig workers, etc.? How do employers choose among the various ways they can hire labor, including as employees, contractors, outsourced, etc.?
- Composition of workforce: How has composition of the workforce influence wage growth measures? How does wage growth vary by demographics, geography, skill level, wage-setting regime, etc.?
- New data sources: How can administrative and corporate data be tapped to improve wage growth measures without raising reporting burdens on employers? How can the barriers that prevent statistical agencies' access to government administrative data be lowered?

<sup>13</sup> See <https://www.bls.gov/ppi/fdidaggregation.htm>.

<sup>14</sup> See US Bureau of Labor Statistics (2012).

Without answers to these questions and related ones, our understanding of the links between wage growth and other macroeconomic variables will continue to be very limited.

### 3.2.3 Alternative (non-survey, organic) data sources

For statistical agencies, tapping alternative data sources (that is, from administrative, corporate, transactional, web-scraped, satellite images or other non-survey sources) provides one of the most promising opportunities for advancing official statistics. While these data will never replace surveys entirely, they have enormous potential to redesign, improve and expand statistical programs without increasing respondent burden. Additional possibilities emerge when separate data sets are merged to uncover new relationships and used for modelling to produce more granular estimates by geography, demographic group, industry or other characteristics.

It should be noted, however, that only a subset of alternative data sources will be useful for official statistics. In particular, for an agency to use any source for ongoing production of gold-standard economic indicators, it must be affordable within agencies' budgets, timely, of acceptable and verifiable quality, relevant, have guaranteed continuity, secure from manipulation or front-running, and collected in a manner consistent with any applicable informed consent rules. See further discussion of the challenges posed by alternative data sources in the following section.

## 3.3 Challenges

### 3.3.1 Institutional barriers and adverse trends

These efforts to improve statistics face some growing challenges, including the following:

- Rising difficulty of preserving privacy, confidentiality and data security. More malicious attacks and publicly available data on respondents is raising costs and limits the detail of what can be published without compromising confidentiality.
- Household survey response rates are falling everywhere, reducing accuracy and raising costs. The pattern is less clear for establishment surveys, but participation is certainly not universal or rising.
- Many developed economies have imposed real budget cuts on their national statistical agencies. For example, BLS has had a flat nominal budget for the past decade.
- While increased use of administrative data promises a way to improve statistics that does not impose new respondent burden, many countries have persistent legal and bureaucratic constraints that prevent data sharing among government agencies.

### 3.3.2 Preserving integrity, independence and reputation

While hardly a new problem, statistical agencies today face a new rash of challenges to their integrity, independence and reputation for trustworthiness. Such interference hurts everyone, because we all rely on the data and the decisions they inform.

A few recent high-profile examples of interference with independence include: (1) the prosecution of Andreas Georgiou, former chief Statistician of Greece, for publishing accurate GDP statistics against the wishes of the government; (2) the government of Puerto Rico effort to undermine the independence of the Puerto Rico Institute for Statistics; and (3) the US Secretary of Commerce's decision to introduce a citizenship question into the 2020 decennial census over objections from the Census Bureau professional staff.

More generally, ongoing social media attacks on official statistics as "fake news" undermine public confidence in the integrity and independence official statistics. In so doing they undermine confidence in the institutions that rely on the statistics and can lower the quality of the data by lowering respondent participation and effort.

### 3.3.3 Official stats versus private big data

Interestingly, a modern challenge to official statistics comes from misunderstanding the implications of successful use of corporate, transactional and social media "big data." In this case, I have confidence that the challenge can be met largely with adequate communication.

The issue is that some observers assert that private big data products imply declining future needs for official statistics, by pointing to efforts such as the Billion Prices Project's web-scraped daily inflation rates or Indeed's and Burning Glass's job vacancy rates obtained from online posts. Yet, nothing could be further from the truth. Far from being a threat to official statistics, the advent of more analysis of non-survey, unstructured data actually increases the value of official statistics and the need for them.

To see this, consider Table 1, which contrasts the merits of official statistics with those of private big data products. In general, official statistics have the advantages of transparency, history, access to universal sensitive data, and collection methods that are designed to answer questions of high relevance. By contrast, big data products rely on high-volume sources that are by-products of some activity and feature innovative methodologies and adaption. However, coverage is not universal or representative, the variables have not been designed for statistical purposes, and the producers have a vested interest in keeping at least some of their methodology proprietary.



**Table 1**

How private big data products contrast with official statistics

	Official statistics	Private big data products
<b>Features and merits</b>	Transparent sourcing, methodology and production Access to universal, sensitive administrative and survey data High survey response rates Long documented history Follow OMB directives and audited to ensure objectivity Designed for broad relevance to private and public decision-makers	Proprietary sourcing, methodology and production Access to private, high-volume transactional data Speedy production Quick innovation and adaptation Can be tailored to special needs and to raise visibility of issuer
<b>Value to the other</b>	Validation, weights, benchmarks, methodology innovations, historical patterns, missing variables or part of universe	Validation, methodology innovations, novel variables

Source: Author.

The bottom row of the table summarizes the value that statistical agencies provide to private big data products and vice versa – showing their growing mutual dependence. To begin with, virtually all private sector big data products rely on official statistics to weight their samples, validate findings, benchmark indexes, understand historical relationships and provide supplementary information. Without this information, they would be unable to make sense of their data. The Billion Prices Project relies on BLS for many inputs, including coverage of products whose prices do not appear on line, to continually benchmark and validate its results, and for the weights in the consumer market basket. Burning Glass and Indeed rely on BLS for estimating wages, sample coverage and number of overall positions by occupation and geography.

By the same token, the statistical agencies increasingly find value in private big data analysis for out-of-scope imputation, validation, and new methodologies.

Thus, while the advent of private big data is undoubtedly beneficial to the statistical agencies, it is hardly a replacement. Indeed, the value of official statistics is likely to continue to grow in the big data world because official statistics will improve and uses will expand.

## 4 Conclusions and policy implications

I see no evidence that the current unexpectedly low inflation rates in the United States (and by extension, in other developed economies) reflect mismeasurement in official statistics. An increased bias from innovation, new goods and substitution would run counter to the immediate fear that price inflation is understated. Thus, this explanation requires a recent reduction – not an increase – in biases. While such a reduction could stem from slower innovation or less substitution or from recent success on the part of statistical agencies in reducing bias, the results in Groshen et al. (2017) and the comparison between CPI and Chained CPI do not suggest that these biases have changed markedly in the United States of late.

By contrast, wage growth measurement issues have received much less attention, so it is much harder to say whether recent surprises may be measurement artefacts.

If the phenomenon of subdued inflation and wage growth is real, then models will need to be made more realistic to explain this behaviour. Developing and testing these enriched models will require richer data. If not, then more analysis is needed to help improve current measures.

So, the main policy implications of my remarks are two-fold:(1) there is no compelling reason to doubt the reality of current low inflation; and (2) there is a very strong case for central bankers to actively support improvements in official statistics.

Statistics are always estimates. While they will never be perfect, they can get better or worse. Indeed, methods and coverage must continually adapt, improve and modernize or official measures will certainly slide into irrelevance. Even with their imperfections, official economic statistics possess a unique combination of accuracy, objectivity, relevance, timeliness and accessibility that serve as infrastructure in support of efficient markets as they help policymakers and citizens form opinions and make decisions.

Thus, central bankers, as they seek to make decisions that maximize welfare must be vigilant to prevent degradation or elimination of the official statistics they rely on. Their active support is of growing importance in today's environment. Steps to help preserve the data and its integrity include:

- Providing feedback to statistical agencies on data trends and methodology and participating in research on issues of mutual concern.
- Standing ready to decry political interference with the integrity of official statistics, as recently seen in Greece, Puerto Rico, and the United States.
- Speaking up for the trustworthiness of official statistics. The fight for trust in the data is not one the statistical agencies can win alone. They need the active help of leaders and institutions who are trusted voices. Researchers should remember to cite the sources when using official statistical data so that audiences will understand how much they are relied upon. And, it is important to not allow uninformed criticism (or cheap shots, nihilism, or sloppy work) to stand. Such comments undermine all work and decisions that rely on official data.
- Educating citizens, elected officials and businesses about how much they rely good data for making good decisions – and that this is even more important in the era of the digital economy and corporate big data. Thus, central banks should
  - Actively encourage participation in statistical surveys.<sup>15</sup>
  - Inform appropriators that funding is essential for the quality statistics.
  - Encourage elimination of bureaucratic and legal barriers that prevent access to administrative data for statistical purposes.

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<sup>15</sup> For example, Federal Reserve chairs Bernanke, Yellen and Powell and recent Reserve Bank Presidents have all written letters of endorsement that BLS field staff use to obtain participation.

None of these steps is contrary to the mission of central banks. Indeed, failure of central banks to take strong policy positions in support of gold-standard official statistics could mean that the data that we all need could easily disappear, leaving themselves and all of us flying blind.

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# Wage dynamics and labour market institutions

By Philippe Marcadent<sup>1</sup>

## Abstract

In this ten-minute intervention, the relationship between real wage growth and labour productivity growth in developed economies, as well as wage inequality between and within enterprises in Europe are reviewed. This contributes to a better understanding of wage dynamics. The observed decoupling of real wage growth from labour productivity growth has multiple causes. One of the possible causes is the diminishing bargaining power of workers in relation to the evolution of some labour market institutions. In that context, the evolution of trade union density, collective bargaining coverage and employment arrangements are examined. They effectively converge toward a diminishing bargaining power of workers.

## 1 The decoupling between real wages and labour productivity growth

The first Chart will allow to compare labour productivity and wage growth. This helps to clarify how far the economies are experiencing wage moderation or if there is simply no possibility for higher wages considering productivity growth.

The Chart 1 shows the relationship between wages and productivity from 1999 to 2017 in the group of 36 developed economies. Here, instead of hourly figures, as in the paper presented this morning, we use the more widely available monthly wages and – consistently – our measure of labour productivity is GDP per worker (not per hour). We also deflate wages by both the CPI and the GDP deflator. Using the GDP deflator somewhat reduces the gap between the two variables, but we nevertheless reach the same conclusion: in both cases, we observe that there was a “decoupling” between productivity and wage growth. We see that the phenomenon is not recent and we are confronted with a long term trend.

This has implications on the labour income share, with a reduction of the labour income share in a majority of countries in the world as documented in our ILO Global Wage Reports and also in academic publications.<sup>2</sup>

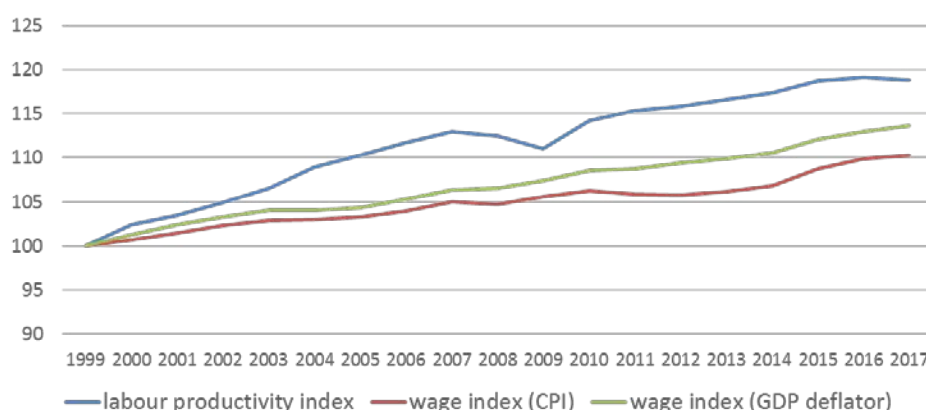
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<sup>1</sup> Chief of the Inclusive Labour Markets, Labour Relations and Working Conditions Branch of the International Labour Office in Geneva (Switzerland).

<sup>2</sup> e.g. Karabarbounis and Neiman, the Global Decline in the Labour Share, The Quarterly Journal of Economics, 2014.

In Chart 1 both the real wages index and the labour productivity index are calculated as weighted averages. This means that large countries influence the figure more than small countries and results are to a large extent driven by the trends in the United States, Germany – and also Japan. In reality, of course, there is much diversity across countries and this pattern is not universal. For example, the decoupling between real wage and labour productivity growth is not observed in France, where labour productivity has been growing, or in Italy, where it has been stagnating.

**Chart 1**  
Index of real wages and labour productivity in advanced economies



Sources: ILO, Global Wage Report 2018/19 (forthcoming).  
Note: The wage and productivity indices are calculated as a weighted average of year-on-year growth in average monthly real wage and GDP per worker in 36 economies.

## 2 Wage inequality in Europe

After this first clarification, we should emphasise that wage dynamics should be approached by considering both average and distribution. The centiles/deciles in the wage distribution experienced different evolutions over time. This translated in an increase in wage inequality since the 80s in a majority of developed economies (about two-thirds of OECD countries). This has important implications. First, we know that high wage earners have higher propensity to save than middle or low-wage workers. So if average wages increase mainly as a result of wage increases at the top of the distribution, the effect on aggregate demand may be weaker than a more broad-based wage increase which benefits the middle-class and low paid workers. Secondly, another important consideration is that wages in different parts of the distribution are not responsive, or not in a similar way, to same policies and labour market institutions.

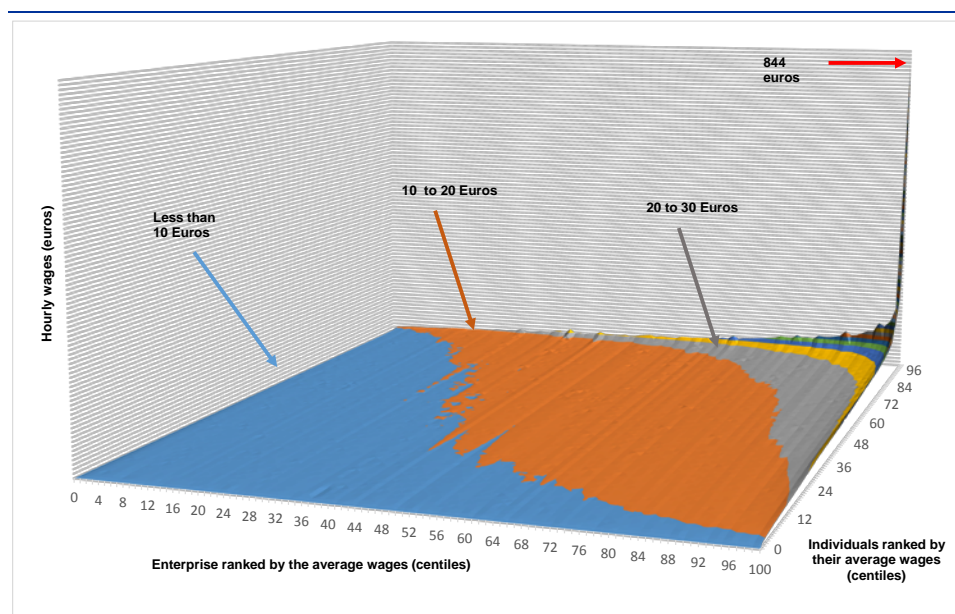
To illustrate the extent of wage inequality in Europe, we have produced a 3D Chart. On the horizontal axis of Chart 2, we rank enterprises according to the average wages they pay, from lowest to highest; on the depth axis we rank workers in these enterprises according to their wages, from the lowest paid to the highest-paid; on the vertical axis, we see these workers' hourly wage levels (on average, within cells, in Euros). We can observe that a majority of workers have wages of less than 20 euro per hour – and these are mostly the workers whose wages have in many countries



stagnated. For those with higher wages in the upper right-hand corner of the Chart 2, wages have tended to increase more rapidly with different patterns across countries.

Some recent studies have emphasized the importance of reducing inequality between enterprises but our chart shows that not everyone is well paid in enterprises with high average wages and that inequality within enterprises is significant. According to our calculations, close to 80 per cent of workers are paid less than the enterprise average wage, and the total variation of wage inequality due to differences within enterprises accounts for 42 per cent of total wage inequality in Europe. So finding ways to reduce inequality within enterprises should also be part of the package of responses.

**Chart 2**  
Wage inequality in Europe



Source: ILO estimates based on EUROSTAT Structure of Earnings Survey (SES, 2010); See ILO Global Wage Report 2016/17.  
Note: These estimates are based on weighted averages of 22 European countries.

### 3 Incidence of employment arrangements on wages: penalties for temporary work

It is important to consider the evolution of labour market institutions that influence wages dynamics. Beginning with contractual arrangements, we see in Europe, increases in part-time work and fixed-term contracts. This phenomenon is in part cyclical, but it is also structural, as non-standard employment has proliferated in sectors and occupations where it did not previously exist, and its overall importance in the labour market of most countries of the world has increased over the past decades. Technological changes are expected to further diversify employment patterns in the future.

There is a range of legal instruments that embed the principles of equal treatment and equal pay for workers in all forms of contractual arrangements, including ILO



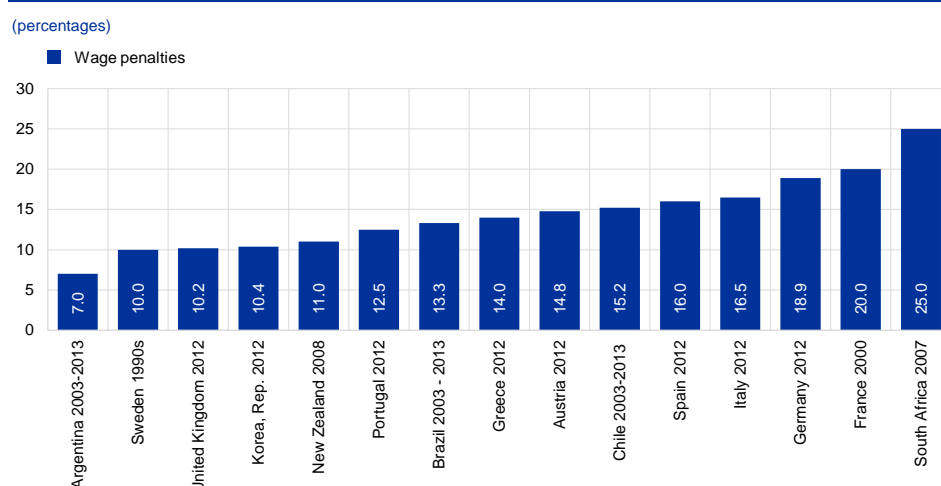
standards and EU Directives. Nevertheless, as the data in Chart 3 shows, in practice, temporary work usually results in wage penalties (controlling for worker and job characteristics). Sometimes, part-time employment can feature premiums but this is the exception. In Europe, part-time employment is in most cases also associated with wage penalties. Wage penalties for temporary employment also vary along the wage distribution, being in general larger for workers with low salaries.

Workers in temporary employment, multi-party employment relationship and on-call arrangements have a level of participation in trade unions and collective bargaining, and more broadly a bargaining power, that tends to be lower than workers in standard employment for several reasons including, (1) fear of retaliation, (2) limited attachment to the same enterprise (higher turnover), (3) diverging interests with standard workers, and (4) lack of awareness of rights. There is also some evidence that the prevalence of these forms of employment can weaken under certain conditions the bargaining power of standard workers.

In addition, workers in non-standard forms of employment may have difficulty to transit to permanent jobs and have fewer opportunities for promotion. Their ability to establish a career path and to command higher earnings over a working life may be further compromised.

Non-standard employment can help enterprises to respond and adapt to market demands, contributing to enterprise sustainability and growth and it can facilitate access to employment. The objective isn't to get rid of non-standard work, but rather to ensure that these jobs are good jobs, including that they provide workers with earnings that are predictable and in accordance with the principle of equal pay for work of equal value.

**Chart 3**  
Wage penalties for temporary contracts – selected countries



Source: ILO, 2016b.  
Note: Partial coefficients from regression analysis, controlling at least for age, education, occupation and sector of activity (other controls vary across studies). Years refer to the years of data on which the analysis was based.

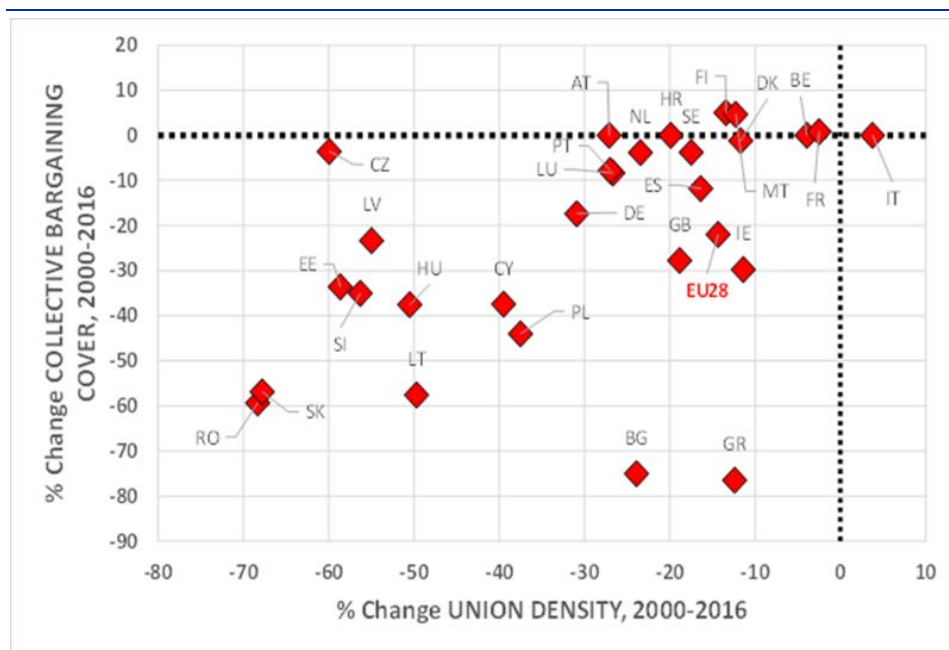
## 4 Decline in trade union density and collective bargaining coverage in Europe

We will now look at the evolution of other labour market institutions. I am referring to trade unions and collective bargaining that also influence wage dynamics.

Chart 4 shows the evolution of trade union density and collective bargaining coverage from 2000 until 2016. We see that only two countries (Finland and Malta) experienced an increase in collective bargaining coverage during the period. For the EU28, the decline of the coverage is more than 20%. And all countries with few exceptions (Belgium, France and Italy) experienced a 10 per cent or more decline in trade union density, with extreme cases such as Estonia, Latvia and Slovakia, where the decline was above 50 per cent.

Despite a general discourse in favor of social dialogue and industrial relations in Europe, we observe an erosion of trade union density and collective bargaining coverage in most countries that affect the bargaining power or manifest the declining bargaining power of the workforce. Often the reduction in collective bargaining coverage in the last decade has been induced by public policies such as imposed and uncoordinated decentralization and limits on the use of extension mechanisms.

**Chart 4**  
Decline in trade union density and collective bargaining coverage in Europe



Sources: ILO Estimates Database on Institutional Characteristics of Trade Unions, Wage Setting, State Intervention and Social Pacts (ICTWSS Release 5.1, September 2016, Amsterdam Institute of Advanced Labour Studies, University of Amsterdam).

## 5 Conclusion

There are different reasons for real wage stagnation. In some of the countries low wage growth is a reflection of slow growth in labour productivity. But for others, wage growth has been “decoupled” from labour productivity growth. Here again causes are multiple but ILO research in this area has mainly focused on the evolution of labour market institutions that translate in a diminishing bargaining power of workers. This diminishing power is partly linked to external factors, such as the globalization of trade and finance, but it is also linked to the erosion of trade-union, collective bargaining and the growth of some employment arrangements.

I am convinced that the decline in collective bargaining coverage is not an inevitable consequence of the changing world of work. History has demonstrated that this institution has the flexibility and adaptability required to face changes. Adaptation has to continue and it's up to the social partners to determine in which direction this must happen. I personally believe that it will be of a growing importance to establish or develop collective bargaining processes that include workers in a diversity of forms of employment, including new forms of employment related to the digital economy. But the stability of or increase in bargaining coverage depends also to a large extent on government policies. To inform or influence the design of such policies as well as the strategies of the social partners, more research is required to deepen the understanding of the role that a diversity of collective bargaining arrangements play in promoting greater equity and improved performance in the labour market. This is a task to which we will devote ourselves in the future. In particular, I will propose that our next Global Wage Report will be dedicated to this important issue.

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# Concentration in markets: trends and implications for price-setting

By Tommaso Valletti<sup>1</sup>

## Abstract

I describe recent trends in various market parameters, such as concentration, margins, and labour markets. Most available data refer to the United States but there are also some preliminary findings for Europe. Recent times seem to have witnessed an increase in market concentration and, in parallel, a lack of inflation despite expansionary monetary policies. I offer some tentative explanations to solve this apparent tension.

## 1 Introduction

Competition is one of the foundations of a market economy. Firms innovate to stay ahead of their rivals, keep prices low to attract customers, and pay wages high enough to avoid losing workers to competitors. Recently, a debate has started arguing that there are indicators of decreasing dynamism and competition in the United States economy over the past few decades. An important trigger of this discussion was a paper published by the Council of Economic Advisers to the Obama administration (CEA, 2016). Empirical academic research followed suit, characterizing secular trends in various market parameters, such as concentration, margins, and labour markets. The findings are briefly summarized in this note. This debate is also particularly useful in that it brought together scholars typically belonging to different fields in economics, most notably Industrial Organization (IO) and Macro Finance. In itself this is a very welcome development in the economics profession.

When analysing markets, it is common practice to use metrics of concentration based on the market shares of the firms competing in those markets. Using the standard Herfindhal-Hirschman Index (HHI) of market concentration, that is, the sum of the squares of market shares, Grullon et al. (2018) indicate that almost 80% of US industries have registered an increase in concentration levels over the past two decades. See Chart 1.

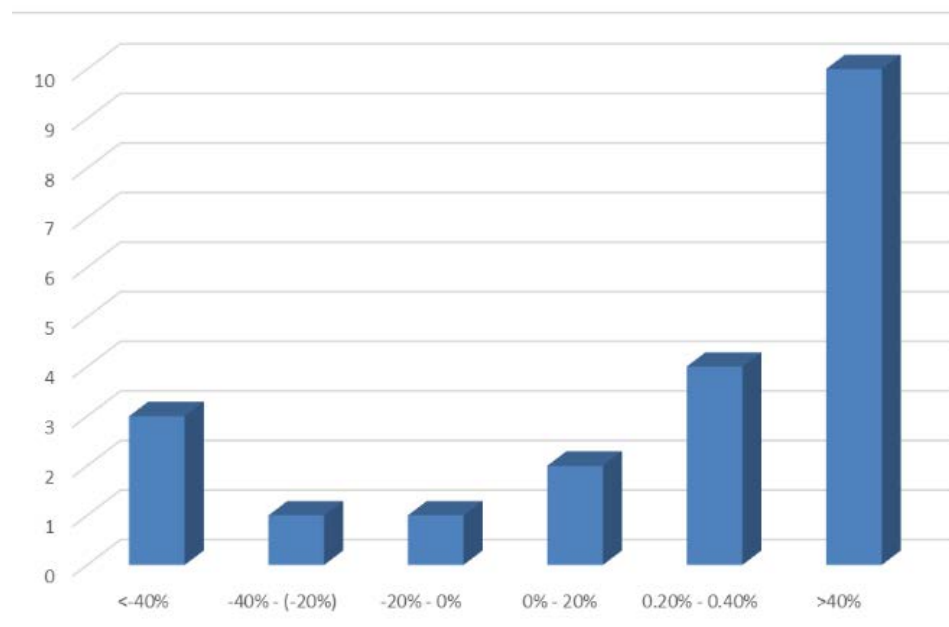
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<sup>1</sup> European Commission and Imperial College London. I thank Szabolcs Lorincz, Gabor Koltay and Hans Zenger for numerous comments. I also thank the participants to the 2018 ECB Sintra Forum for a very stimulating discussion. The opinions in this note are mine alone and cannot be attributed to any institution I am affiliated to.

## Chart 1

### Market concentration in the United States

(change in HHI (1997-2014))



Source: Grullon et al. (2018)

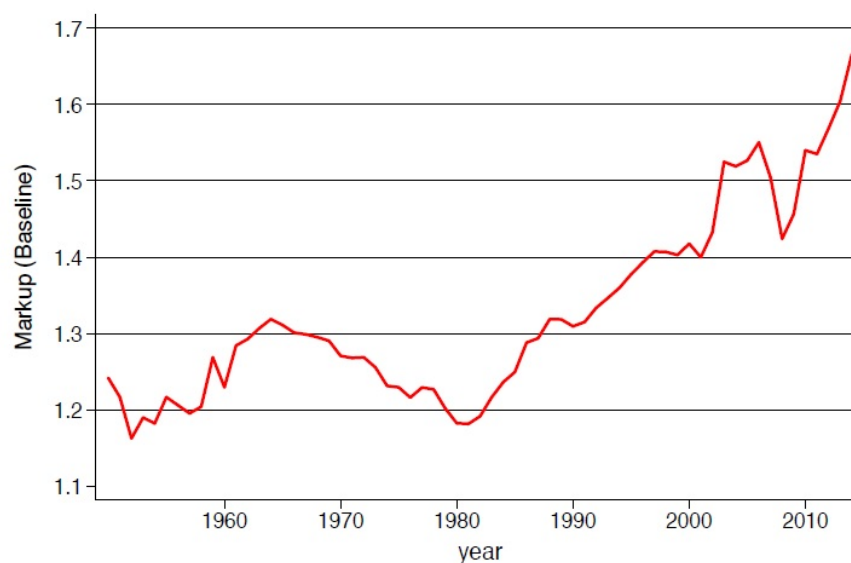
Similar trends are reported by Autor et al. (2017), who show that concentration seems to be particularly high in the United States and on the rise in the past three decades in retail, finance, manufacturing, and utilities. A key issue here for researchers and statistical authorities alike is that these studies typically do not identify 'antitrust' markets where competition occurs, but are likely to be more aggregated. For instance, the study mentioned above by Grullon et al. (2018) reports the HHI at the NAICS 3-digit industrial classification level. This would pool together, for example, industries such as Electric Power Generation (Industry Group 2211) and Sewage (Industry Group 2213), as they both belong to the subsector 221 Utilities, despite the fact they are not likely to be in direct competition with each other. Also, globalisation tends to lead to larger geographic markets, so measurement of concentration over time with unchanged boundaries may not pick up this possible enlargement of markets. While it is clear that these measures should be discussed and possibly improved, it is also true that large datasets covering the economy at large and still based on 'antitrust' markets simply do not exist. Hence I think that even imperfect levels of aggregation deliver the best one can currently hope to get and they contain informative signals about concentration trends economy-wide.

The second type of evidence that is becoming available is on firms' margins and mark-ups. This evidence comes from employing different methods and using different sources of data. Some works start from aggregate data (national accounts). For instance, Barkai (2017) using data from NIPA (National Income and Productivity

Accounts) and BEA (Bureau of Economic Analysis) documents that the profit share of GDP in the United States has increased from around 5% in 1990 to 15% in 2015.<sup>2</sup>

De Loecker and Eeckout (2018a) follow instead a disaggregate approach, notably the production approach whereby, assuming cost minimization, they estimate a production function using individual firm output and input data from Compustat. Compustat reports financial statements of all publicly traded firms covering all sectors of the US economy over the period 1955-2016. A measure of mark-up is then obtained for each firm at a given point in time. Notice that, with this method, one does not need to make any assumptions on the competitive behaviour of firms, nor does one need to be able to define a market. Chart 2 shows their empirical estimation of mark-ups over cost of US companies. While the average firm charged prices of around 20-25% above incremental cost in the 1980s, by 2014 the average mark-up had increased to well over 60%. This implies that the average economic margin approximately doubled during this time period (from around 20% to around 40%).<sup>3</sup> As the chart indicates, this upward trend was only briefly interrupted by the global financial crisis and soon after began to follow its previous path again.

**Chart 2**  
Economic mark-ups in the United States



Source: De Loecker and Eeckout (2018a)

Digging deeper, these increases were concentrated amongst the most profitable firms: the average margin for the most successful firms (those in the 90% percentile of the sales-weighted distribution of mark-ups) rose substantially while that for less

<sup>2</sup> Gutiérrez (2017), replicating Barkai's methodology, reports a longer historical perspective. The results show that the profit share was highest in 1960 and through a trend decrease reached a trough in the early 1980s. Since then a trend increase has been observed.

<sup>3</sup> Denoting price by  $p$  and cost by  $c$ , profit margins are defined as  $m = (p - c)/p$ , whereas mark-ups are defined as  $\mu = (p - c)/c$ . Simple algebra implies  $m = \mu/(1 + \mu)$ . Setting for instance  $\mu_1 = 0.25$  and  $\mu_2 = 0.67$  thus yields  $m_1 = 0.2$  and  $m_2 = 0.4$ .

successful firms (firms at or below the median) was flat or in some cases declining. Overall, the evidence on increasing margins is quite robust and compelling, while there is still some examination on the scale of these effects. Chart 2, for instance, becomes flatter (but the upward trend would still be unmistakable) if the definition of costs includes not only COGS (Cost of Goods Sold, that is, expenses directly attributable to the production of the goods sold by the firm and includes materials and intermediate inputs, labour cost, energy, and so forth) but also a measure of overheads such as SG&A (Selling, General and Administrative Expenses). See also Hall (2018).

Other interesting developments that are currently being discussed include the extent to which ownership of competitors overlap. According to Anton et al. (2018), common ownership further adds to the HHI, boosting effective concentration, and this has again increased over the past two decades. Much of this common ownership can be ascribed to the rise of passive investors, such as BlackRock and Vanguard, and empirical studies exist showing an impact this has on prices in the US airline and US banking industry (see, e.g. Azar et al., 2018).

Concentration in product markets can be mirrored by its labour market counterpart: monopsony, that is, a situation that arises when employers face limited competition for workers. Firms might have a degree of power to set wages rather than to take them as given. The potential link between employer concentration and wages is also the subject of an active ongoing research. Some results indicate associations between local concentration and wages. Azar et al. (2017) examine online job-posting data in the United States. They calculate the HHI index of concentration for over 8,000 geographic-occupational labour markets. They find suggestive evidence that concentration increases labour market power: an increase from the 25th to the 75th percentile in HHI is associated with a 17% decline in posted wages. See also Benmelech et al. (2018).

## 2 What about Europe?

Data availability is typically better for the United States than for Europe. Still I note that, due to globalization, US firms are much present in Europe too. Therefore, at least in some global industries, whatever finding comes from the United States is directly relevant for Europe, too.

There are however some initial studies of European concentration and margin trends. Weche and Wambach (2018) report that, in Germany, a slightly downward trend can be noted when looking at the share of the 100 largest companies. In contrast to this, the average price mark-up in Europe has risen in very recent times, after a slump associated to the financial crisis. This work can use a fairly short time series (2007-2015) based on Orbis data.

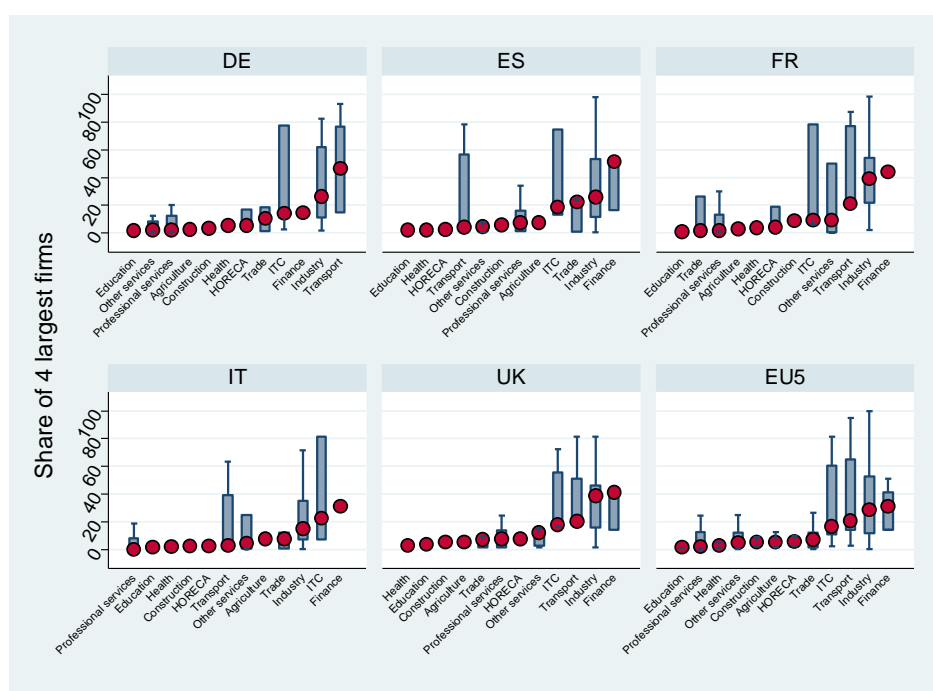
Work currently done at the European Commission, DG COMP, looks at 177 industries in the 5 largest economies in the EU (France, Germany, Italy, Spain and the United Kingdom). At least in a fairly short time period of 6 years (2010-2015) there was no



indication of changes in concentration levels. See Chart 3. The most concentrated sectors are ITC, Transport, Industry, and Finance. This is not too dissimilar from the United States in terms of industries. Work is being extended to include a longer time period and updated results should be soon available. I remark that many European markets are still well within national boundaries, and aggregating them at the EU level is likely to give rise to concentration results biased downwards.

**Chart 3**  
Market concentration in EU5

(C4, 2015)



Source: European Commission calculations based on Euromonitor data  
Notes: C4 denotes the share of the four largest firms' production value of the respective country/industry.

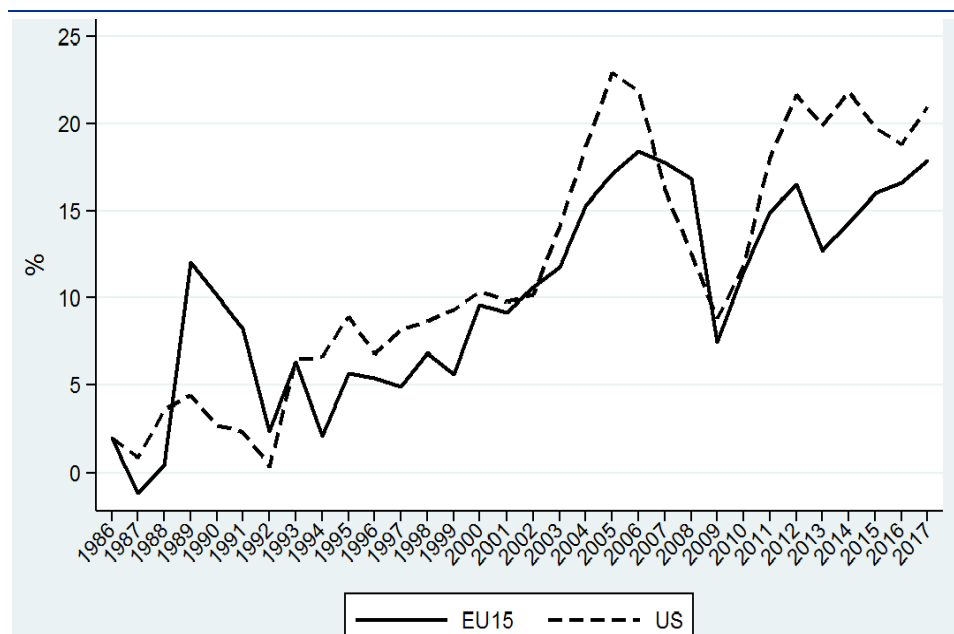
There are also some preliminary indications that long-term profitability trends in Europe might be broadly consistent with the US experience. See Chart 4, which uses aggregate data based on National Accounts from Eurostat, and employing a version of the methodology of Barkai (2017).<sup>4</sup> There seems to be a trend increase in profitability both in the United States and Europe since the 1980s. However, Europe's increase has been more sluggish, and since the 2008 financial crisis a gap emerged between

<sup>4</sup> The idea is to calculate net profit = net operating surplus – capital cost. Based on National Accounts data, net operating surplus = gross output – intermediate consumption – consumption of fixed capital – compensation of employees – indirect taxes less subsidies. Capital cost is lagged real net capital stock times capital return, where the latter is approximated as Moody's AAA corporate bond yield minus capital good inflation (based on gross fixed capital formation's deflator). The NA and capital stock data are from the EC's AMECO database that is based on Eurostat's and National Statistical Offices' data. The net profit is then expressed as a percent of GDP. The calculations are carried out on a year/country level to be aggregated to EU15. Barkai (2017) for the United States, uses instead industry level data with capital further broken down into asset types. For the EU, the capital asset break-down with industry disaggregation is only available from 1995 until 2015 (e.g. from the EU KLEMS database). Using this shorter, alternative dataset, the EU profit variable shows a somewhat less steep trend than the aggregated approach discussed above, but overall the results are not inconsistent with each other.

the United States and EU that has only started closing in 2016-17. I also observe that the overall trend for EU15 hides some country heterogeneity.<sup>5</sup>

**Chart 4**

Profit share of GDP: EU vs. United States



Source: European Commission calculations based on AMECO and FRED

Notes: Net profit as a share of GDP. Net profit = net operating surplus - capital costs. Capital cost = lagged net real capital stock times Moody's AAA bond yield minus expected capital good inflation plus depreciation.

EU15: AT, BE, DE, DK, ES, FI, FR, GR, IE, IT, LU, NL, PT, SE, UK.

It is clear that researchers have only recently started exploring longer time series on European margin developments. This is an area where progress is needed. In the Appendix I also discuss important data issues.

### 3 What caused increased concentration?

The purpose of this note is not to delve into the causes for the trends reported above, though this is also in itself a first-order question that has to be asked (and also a very tough one to answer). I just mention briefly here potential (and not mutually-exclusive) candidates. One is that of a lack of antitrust enforcement has led to the observed patterns in concentration and profitability. Another one is that both globalization and technological change (such as digitization and automatization) have tended to benefit so-called “superstar firms” by permitting them to efficiently scale up their operations and earn meaningfully higher margins than used to be possible in the past.

This discussion about the causes of increased profitability is important. Exciting academic efforts are being produced to improve our understanding of these issues

<sup>5</sup> Weche and Wambach (2018) also calculate profitability measures for European countries. They implement the methodology of De Loecker and Eeckout (2018a) for the period 2007-2015. Their results confirm that (i) profitability dropped during the financial crisis which was followed by a strong recovery; and (ii) there is significant heterogeneity across EU countries.

(see, e.g. Autor et al., 2017 and Gutiérrez and Philippon, 2017). Currently the jury is still out on the relative significance of different candidate explanations. Personally, I am tentatively inclined to believe that the most likely cause for the increase in margins (which is the more robust empirical finding) should lie with technological causes. A recent paper of De Loecker and Eeckout (2018b) has extended their work to global firms, not only from the United States. They extract data from the financial statements of over 70,000 firms in 134 countries, and show that the average global mark-up has gone up from close to 1.1 in 1980 to around 1.6 in 2016. With the exclusion of some developing markets, the increasing trends are confirmed worldwide. In my opinion it is unlikely that antitrust enforcement can have such an effect worldwide. Ultimately, antitrust enforcement is confined to a few very concentrated markets. This is not to say that antitrust enforcement is already at an optimal level – it may well be and have been suboptimal – but simply that it is difficult to believe that competition policy could have such a global impact. Instead, it is more likely that we are witnessing the impact of technological changes and globalisation processes.

## 4 Implications for price-setting

IO economists are interested in partial equilibrium analysis of narrowly defined markets. Macroeconomists look at aggregate inflation in the economy at large. Recent times seem to have witnessed an increase in market concentration and, in parallel, a lack of inflation despite expansionary monetary policies.<sup>6</sup>

At first sight there seems to be a tension between the two. Firms' market power is, first and foremost, the ability to set prices above costs. Hence, if concentration increases, one would expect an upward pressure on prices. Why don't we see this picked up by inflation then? I will oversimplify but will try to offer some ideas that are perhaps testable by colleagues.

First, the two facts (increasing margins and low inflation) may not be in contrast after all. IO economists look at price margins and mark-ups. Macroeconomists look at price levels. Imagine that technological process has shifted down variable costs and increased fixed costs. This, as argued above in Section 3, is compatible with increases both in concentration and margins: only a few firms can enter an industry to cover their fixed costs, and they manage to do that by charging well in excess of variable costs. So concentration goes up, as well as margins do. However, this is saying nothing about price levels. They could well stay constant (and inflation would not pick any change), simply because the variable costs have declined due to technological progress or globalisation generated downward price pressure (see, for example, Bernard et al., 2018), despite the increase in market power of the firms.<sup>7</sup> Slow long term wage growth or even decline of the wage of the median worker could

<sup>6</sup> There is one area where we have observed increases in inflation: asset prices, e.g. equity prices, real estate prices and bond prices. Here, monetary expansion has probably increased these prices – there was just not so much pass-through from the financial into the real economy.

<sup>7</sup> In a typical industrial supply chain, the part of final good prices going to profits is substantially smaller than the part going to labour cost. Hence, one could expect the observed increase of net profit margins to be overcompensated by the decrease of the labour share.

also have contributed to price moderation. In this sense rising income inequality could be an explanatory factor of price stagnation or moderate inflation. Similarly, if the ability of firms to collude over the cycle is increased during slumps of the economy, price levels might not vary much despite a corresponding increase in margins.

A second possible answer is that price and margin changes are temporary phenomena that affect relative prices. In the medium and longer run, it is unlikely to see effects on the aggregate price level beyond some temporary period that should not matter much for monetary policy. While this is true, it is still difficult to reconcile with the trends that I described in Section 1 that, as an order of magnitude, have seen an increase in margins of roughly 1% per year over the last 30 years.<sup>8</sup> The distribution of the mark-ups is also very heterogeneous, pointing to a changing of TPF too. Therefore, to the extent that market power is a feature of our economy, it may make sense to incorporate market power in our macromodels. Since this evidence points to mark-ups that differ by industry and over time, I would expect monopolistic competition models with constant mark-ups not to be flexible enough in this respect. I am not an expert in this area, and I would imagine this to be a very difficult exercise whose payoff is uncertain.

A third and more specific observation relates to pass-through (PT), which is a very important element of the transmission of monetary policies. The degree of PT typically depends on the curvature of the demand function (Weyl and Fabinger, 2013). Going from monopoly to competition, the PT converges to 1 from below if demand is linear or concave, while the PT converges to 1 from above if demand is very convex. For normal goods, one would expect that, increasing concentration, margins should increase and less competition will lead to less PT. Hence here there is a link between increases in concentration and reduced monetary transmission. However, industries where demand could be very convex (perhaps a good approximation could be “essential” goods such as transport, energy, or communications) might even become more sensitive to monetary policy shocks. A takeaway is that, *de minimis*, the composition of industries should play a central role when thinking of transmission of monetary policy (on top, of course, of the impact that monetary policy might have also on the demand side).

I further note that expansionary monetary policies are likely to have helped the increase in margins directly. Lower interest rates have decreased the capital costs of corporations and thus expanded net margins (though not variable cost margins). Moreover, cheap money has incentivised financial engineering (e.g. share buybacks) and thereby increased both corporate leverage and profits per share.

I would also find it fruitful to discuss more about the sources of possible misallocations. From an IO perspective, it is quite clear that positive margins imply that relative prices are not aligned with costs, which generates inefficiencies in a partial equilibrium analysis. But what about the source of misallocation from the perspective of capital? In Europe we have witnessed, with the banking and monetary union, a large flow of capital that flew from the core to the periphery, and this coincided with a stagnation of

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<sup>8</sup> Margins here refer to variable cost margins, not net margins which have increased by much less.

productivity. Clearly, the misallocation of credit can have effects on the real economy. Here there are several avenues that one could take: were financial systems not mature enough to allocate capital flows? Or were banks not sufficiently regulated or benefited from too low interest rates resulting from too lax monetary policy? Or was it instead government that has overprotected some sectors or some firms? Studying markets should help provide an answer to these fundamental questions that link macro capital flows to misallocations in the real economy.

## 5 Appendix: Data issues

To generate results on profitability and concentration reviewed in Section 1 and Section 2, various datasets have been used. Each type of dataset presents different issues and renders one or another method to calculate a given profitability or concentration measure more or less difficult.

Profitability measures can be categorized as directly measured or econometrically estimated. Directly measured profit variables can use two types of datasets. First, aggregate data from the National Accounts systems of various countries or blocks can be used to calculate net profit. In the United States, examples of these data include the National Income and Productivity Accounts (NIPA) and further data of the Bureau of Economic Analysis (BEA). In the EU, various National Statistical Offices, aggregators like Eurostat and compiler datasets (such as the European Commission's AMECO, or the KLEMS database) offer aggregate, country or industry level data. As discussed, Barkai (2017), Gutiérrez (2017) or Chart 4 above are based on such data. The advantage of the methodology is that the underlying data are relatively consistent, available and historically long enough. However, the resulting profitability measure is overall and includes all cost categories and all firms.

Second, firm-level datasets can be the basis of calculating accounting type profit measures, such as EBIT(DA) margins. In the United States, Compustat and Orbis, while in the EU Orbis/Amadeus, or CompNET are examples. The advantage of these datasets is their availability and the possibility to select firms and sectors more precisely. However, for these margin variables the allocation of costs and revenues is based on accounting rules, which are potentially unrelated to economic principles.

Econometrically estimated mark-ups are approximating the economically relevant mark-ups of pricing models. First, the demand-side approach uses first-order conditions of price equilibria of well-defined antitrust markets to calculate marginal costs and mark-ups. To achieve this goal, sophisticated systems of product level demand have to be estimated, see, e.g. Berry, Levinsohn and Pakes (1995). However, the estimation complexity can in some cases be prohibitive, the underlying competition assumption might be invalid, and the method could be difficult to implement for several different product markets. Moreover, detailed, market and product level data is needed. A typical example is retail market level supermarket scanner data.

Second, in the production side method individual firm output and input data is used, coupled with an assumption of cost minimization to estimate a production function frontier and each firm's productivity shock and mark-up (De Loecker and Eeckhout, 2018a, building on the references therein). The data can be disaggregated company level data as above (CompNET, Orbis/Amadeus, etc.). The advantages include theoretical consistency, better scalability than in the case of the demand approach, no need to specify a demand function, and public availability of data. Estimation might still be somewhat complex, though probably less than that of the demand approach.

Calculating market/industry concentration presents its own issues, too. These issues might differ across data sources; hence, I focus on some of the European, firm-level datasets. First, the *ownership* issue means that different affiliates of the same parent company should be treated as the same entity for the purposes of share calculations in order not to underestimate concentration. In the raw Orbis data, with some further, quite tedious, data management, the problem can be tackled. In the CompNet dataset, which is anonymised, however, ownership is not resolved, some subsidiaries are potentially treated as separate entities. In the (proprietary) Euromonitor dataset the ownership structure is sorted out within country. Second, as a given firm can be active in different industries/markets, the *industry allocation* of the total revenues into different industries is an issue. In the Orbis dataset, further, very significant data steps would be needed to resolve the issue. In the CompNET dataset each entity is assigned to its "main" industry, and no further change is possible because of anonymization, resulting in potentially serious bias of unknown direction. In the Euromonitor dataset the allocation is solved by combining consolidated and unconsolidated company accounts with external expert information. Third, the *market size* should be estimated using additional external sources (Eurostat). This is applied in Euromonitor, while the raw Orbis and CompNET datasets are to be appended. Finally, unresolved in all three of the above datasets: (i) the data contain production, as opposed to sales, values, leaving the export/import activities un-tackled; (ii) industry definitions are typically more aggregated than antitrust market definitions.

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