THE FORMATION OF EXPECTATIONS, INFLATION AND THE PHILLIPS CURVE

Olivier Coibion
UT Austin & NBER

Yuriy Gorodnichenko
UC Berkeley & NBER

Rupal Kamdar
UC Berkeley

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- Inflation expectations play a central role in almost all key economic decisions
  - Prices and wages (Phillips curve): $\pi_t = E_t\pi_{t+1} + \gamma * gap_t$
  - Consumption decisions (Euler eqtn): $c_t = E_t c_{t+1} - \sigma[i_t - E_t\pi_{t+1}]$
  - Investment decisions (Tobin's Q): $Q_t = MP_K/[i_t - E_t\pi_{t+1} + \delta]$
  - Asset prices: $P_t^{stock} = E_t D_{t+1}/(i_t - E_t\pi_{t+1}) + E_t P_{t+1}^{stock}$
  - Central bank decisions (Taylor rule): $i_t = \varphi_\pi E_t\pi_{t+h} + \varphi_x E_t x_{t+h}$

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  - Ben Bernanke (2007): "How should we measure inflation expectations, and how should we use that information for forecasting and controlling inflation? I certainly do not have complete answers to those questions, but I believe that they are of great practical importance. … Information on the price expectations of businesses--who are, after all, the price setters in the first instance--… is particularly scarce."

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  - Janet Yellen (2016): "Perhaps most importantly, we need to know more about the manner in which inflation expectations are formed and how monetary policy influences them."

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  - Full-information rational expectations (FIRE)
  - Sticky-information
  - Noisy information

  } Rational Expectations models subject to frictions/costs.

  - Bounded rationality
  - Learning

  } Rationality but no knowledge of the economy structure.

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  - New style: Fischer (1977), Taylor (1977), Calvo (1980)
  - New Keynesian Phillips Curve = dominant framework
    - Micro-founded
    - FIRE-based
    - Forward-looking

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- Pushback to Prescott (Zarnowitz, Lovell, Manski, etc.): one should not discount data even if it's inconsistent with a beautiful theory.

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- Learning
  - ➢ Least-squares regressions to find relationships in the data
  - ➢ Pick the model with the best fit from a menu of models

PHILLIPS CURVE WITH FIRE

NKPC: $\pi_t = \beta E_t \pi_{t+1} + \kappa X_t + shock_t$

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  - Missing disinflation

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Hall (2013): the Phillips curve is dead.

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- Missing disinflation
  - If we use household expectations, there is no puzzle

MISSING DISINFLATION

NKPC WITH AND WITHOUT FIRE

Information Structure	Phillips Curve
Full-information rational expectations with time-dependent pricing (Calvo 1983)	$\pi_t = \beta E_t[\pi_{t+1}] + b_1 X_t$
Sticky prices and backwards rule of thumb firms (Galí and Gertler 1999)	$\pi_t = (1 - b_4)\pi_{t-1} + b_4 E_t[\pi_{t+1}] + b_3 X_t$
Sticky information (Mankiw and Reis 2002)	$\pi_t = \bar{E}_{t-1}[\pi_t] + b_5 \bar{E}_{t-1}[\Delta y_t] + b_6 y_t$
Adaptive learning (Milani 2005)	$\pi_t = \hat{E}_t \pi_{t+1} + b_7 X_t$
Rational inattention (Afrouzi and Yang 2016)	$\pi_t = \bar{E}_{t-1}[\pi_t] + \bar{E}_{t-1}[\Delta y_t] + b_8 y_t + b_9(\bar{E}_t[\pi_{t+1}] + \bar{E}_t[\Delta y_{t+1}] - i_t)$

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No need to radically depart from the standard empirical specification of the Phillips curve

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How is this possible?

Adam and Padula (2011): Without full-information, inflation

$$\pi_t = (1-\theta)(1-\theta\beta)\sum_{j=0}^{\infty}(\theta\beta)^j F_t X_{t+j} + (1-\theta)\sum_{j=0}^{\infty}(\theta\beta)^j F_t \pi_{t+j}$$

where $F_t Y_{t+j}$ denotes date-t forecast for variable Y at time $t+j$.

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Test: $\pi_t = \beta \bar{F}_t[\pi_{t+1}] + b_1 X_t + a_2 \bar{F}_t[\pi_{t+2}] + a_3 \bar{F}_t[\pi_{t+3}] + \cdots + b_2 \bar{F}_t[X_{t+1}] + \cdots$

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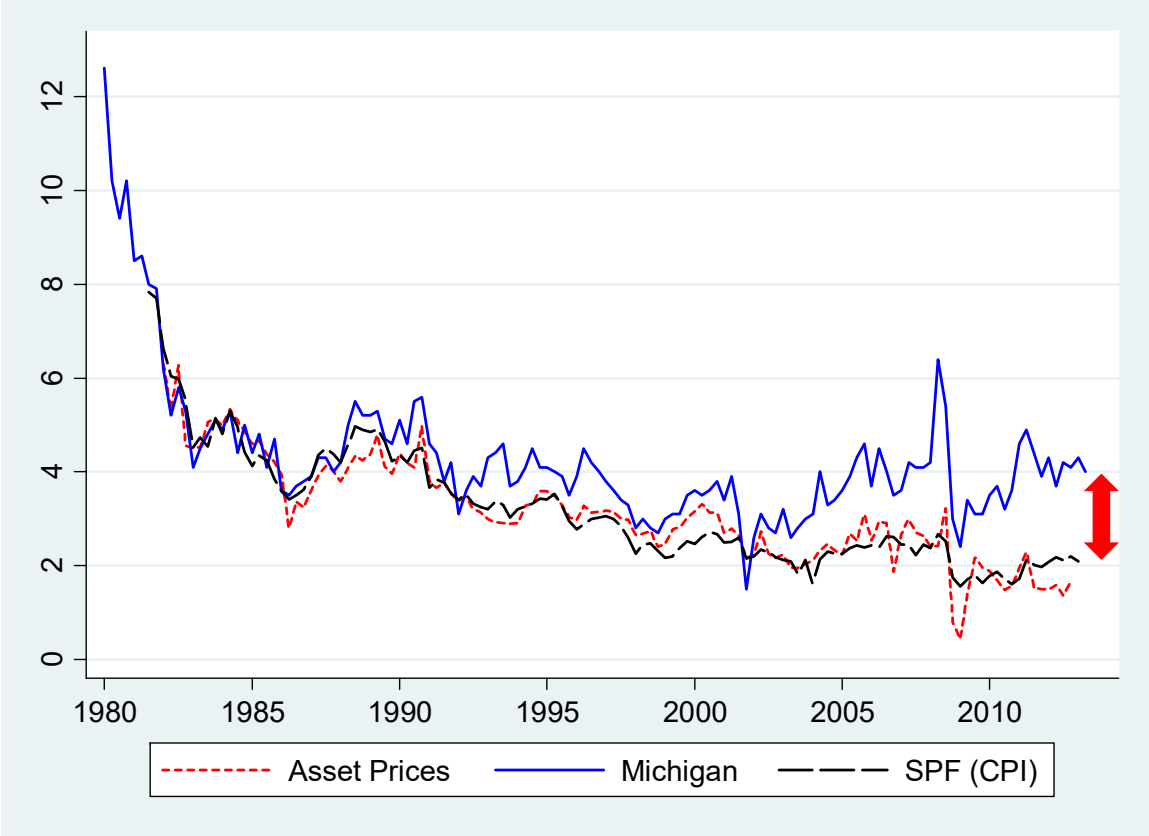
Outcome: we can't reject the null of $a_2 = a_3 = \cdots = b_1 = \cdots = 0$

CHALLENGES IN USING SURVEY EXPECTATIONS

- Do we have expectations of the right agents?
  - Professional forecasts / market expectations = expectations of firm managers?
  - Household expectations are likely a good proxy for expectations of managers



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- Truth telling?
  - Career concerns? Herding? Act upon expectations?

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- Truth telling?
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- Do respondents understand what inflation is?
  - People use different notions of general prices
  - Percent change is hard for some respondents

PHILLIPS CURVE WITH SURVEY INFLATION EXPECTATIONS

$$\pi_t = a_0 + a_1 E_t \pi_{t+1} + b_1 (UE_t - UE_t^N) + error$$

where

π_t = the actual q-o-q inflation rate (CPI, annualized),

$E_t \pi_{t+1}$ = one-year ahead inflation forecast (CPI),

UE_t = the unemployment rate,

UE_t^N = the natural rate of unemployment (CBO's NAIRU).

TEST #1: STABILITY

Dep. var.: π_t	1978-2014	1978-1989	1990-1999	2000-2014
	(1)	(2)	(3)	(4)
Michigan Survey of Consumers, 78Q1:14Q3				
$UEGap_t$	-0.230**	-0.240	-0.261	-0.234**
	(0.098)	(0.149)	(0.287)	(0.118)
$E_t\pi_{t+1}$	1.440***	1.515***	1.469***	0.898***
	(0.075)	(0.094)	(0.400)	(0.224)
R-squared	0.697	0.787	0.463	0.159

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Survey of Professional Forecasters, 81Q3:14Q3				
$UEGap_t$	-0.175	-0.374**	-0.538**	-0.167
	(0.110)	(0.146)	(0.239)	(0.208)
$E_t\pi_{t+1}$	0.714***	1.179***	1.863***	0.603
	(0.134)	(0.269)	(0.364)	(1.227)
R-squared	0.192	0.269	0.482	0.042

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Financial markets (Cleveland Fed), 82Q1:14Q3				
$UEGap_t$	-0.140	-0.449***	-0.105	-0.078
	(0.104)	(0.150)	(0.227)	(0.206)
$E_t\pi_{t+1}$	0.562***	0.976***	1.719***	0.630
	(0.122)	(0.315)	(0.365)	(0.500)
R-squared	0.131	0.138	0.411	0.054

TEST #2: WHICH EXPECTATIONS?

Dep. var.: π_t	(1)
$UEGap_t$	-0.230**
	(0.098)
Expected inflation, $E_t\pi_{t+1}$	
MSC	1.440***
	(0.075)
SPF	
Financial markets	
Observations	146
R-squared	0.697
Sample period	78Q1:14Q3

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Expected inflation, $E_t\pi_{t+1}$		
MSC	1.440***	1.072***
	(0.075)	(0.208)
SPF		0.178
		(0.164)
Financial markets		
Observations	146	132
R-squared	0.697	0.296
Sample period	78Q1:14Q3	81Q3:14Q3

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MSC	1.440***	1.072***	1.057***
	(0.075)	(0.208)	(0.214)
SPF		0.178	
		(0.164)	
Financial markets			0.103
			(0.163)
Observations	146	132	130
R-squared	0.697	0.296	0.254
Sample period	78Q1:14Q3	81Q3:14Q3	82Q1:14Q3

TEST #3: PREDICTIVE POWER

- Step #1: fit a model on the data before the Great Recession
- Step #2: compute forecast errors during the Great Recession

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Source of inflation expectations	Mean (1)	Std. Dev. (2)
Michigan Survey of Consumers	-0.17	1.63
Survey of Professional Forecasters	1.02	1.61
Financial markets (Cleveland Fed)	0.94	1.60

CONCLUDING REMARKS

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  - Current state: "theory ahead of business cycle measurement"

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- Pronounced deviations from FIRE in the data
- There are alternatives to FIRE such that one does not have to abandon rationality
- The behavior of survey expectations is consistent with at least some of these alternatives
- Using survey expectations seems to yield a better-behaved Phillips curve
- Challenges for future work for non-FIRE models:
  - Current state: "theory ahead of business cycle measurement"
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  - How to rule out many alternative deviations from FIRE
    - Impose discipline on non-FIRE models
    - Derive testable implications and test them