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Contents

Abstract

This paper uses a model of import prices whereby exporters to the euro area set export prices partly as a mark-up on their production costs (i.e., the degree of exchange rate pass-through) and partly in line with euro area producer prices (i.e., pricing-to-market). Using both time series and panel estimation techniques, the econometric results suggest that the pass through of changes in the effective exchange rate of the euro to the price of extra-euro area imports of manufactures is around 50% - 70%, while pricing-to-market has an estimated weight of between 50% - 30%. We also find some evidence of differences across import suppliers, with EU member states who are not part of the euro area assigning a relatively larger weight to pricing-to-market, while euro area imports from the United States seem to be characterised by a relatively higher degree of exchange rate pass-through.

Keywords: extra-euro area import prices, exchange rate pass through, pricing-to-market.
JEL Classification: D40, E30, F10, F31.

Non-technical summary

The extent to which exchange rate changes are eventually reflected in import prices is commonly referred to as the degree of exchange rate 'pass-through' and can be empirically estimated. Imported goods are made up of a heterogeneous range of products and commodities and the 'pass-through' may vary considerably across these different types of imports, For example, one might expect a much higher degree of pass-through for more homogeneous and widely-traded goods and commodities where the so-called 'law-of-one-price' might hold, such as oil or raw materials, than for highly differentiated manufactured products.

This paper examines the impact and extent of exchange rate pass-through for extra-euro area import prices of *manufactures* (which account for three quarters of extra-euro area imports of goods). The econometric estimates of the extent to which exchange rate fluctuations are passed through to euro area manufacturing import prices are based on a model in which exporters to the euro area set prices partly as a mark-up on their production costs, and partly in line with the prices of euro-area producers. The mark-up strategy is undertaken in the pursuit of the traditional objective of profit maximisation, while pricing-to-market (PTM) is aimed at maintaining market share. In this model, the weight assigned by import suppliers to their production costs – proxied by an import-weighted average of foreign producer prices – represents the degree of exchange rate pass-through; the weight attached to pricing-to-market represents the degree to which these foreign suppliers seek to maintain market share by holding prices close to those of their euro-area competitors. Intuitively, foreign suppliers' export prices to the euro area – in other words the observed import prices of the euro zone - are set with a view to achieving the best compromise for the joint objectives of profit maximisation and maintaining market share. The relative weights of these two objectives will depend on both the structure of the product market as well as on the structure of production techniques and costs. In simple terms, one would expect the weight assigned to PTM to increase as the price elasticity of demand increases, but decrease as the price elasticity of supply increases.

In terms of relative importance, our estimates suggest that the 'average' import supplier to the euro area assigns a weight of around 50 to 70 per cent to maximising profits (ie, the degree of exchange rate pass-through), with a weight of approximately 50 to 30 per cent to shadowing euro area producers' prices through a pricing-to-market strategy. These estimates therefore imply that a 10 per cent decline in the effective exchange rate of the euro will, ceteris paribus, eventually result in a 5 to 7 per cent increase in manufacturing import prices. Of course, these estimates are subject to a margin of error and should be regarded as approximations, particularly as other factors may influence the magnitude of exchange rate changes to import prices. For example, the perception as to whether the change in the exchange rate is perceived to be transitory or permanent may also affect the degree of exchange rate pass-through.

The estimates also suggest that the average EU member who is not part of the euro area appears to assign a relatively larger weight to pricing-to-market compared to non-EU suppliers when exporting to the euro area (which implies a lower degree of exchange rate pass-through). Such behaviour may be connected to pressures for price convergence due to increased competition within an increasingly integrated EU market, as well as a greater tendency for these suppliers to be price-takers in comparison to larger non-EU countries. On the other hand, further results show that the lower pricing-to-market parameter for the non-EU countries may be driven by the much higher estimated exchange rate pass-through for imports from the United States (a result consistent with theoretical arguments that 'large-country' export suppliers have more monopoly power and tend to base their export prices primarily as a mark-up on costs with little pricing-to-market).

These results are obtained by using aggregate extra-euro area import price data – using unit value indices as a proxy - as well as individual country import supplier data by applying panel estimation techniques. Simple correlation coefficients between individual country import prices and bilateral exchange rates seem to confirm that the degree of exchange rate pass-through differs across import suppliers along the lines suggested above.

1 Introduction

This paper investigates the determination of *extra-euro area* manufacturing import prices with a particular focus on measuring the extent to which exchange rate changes are passed-through to import prices.[1] The theoretical framework uses a model whereby exporters to the euro area set export prices partly as a mark-up on their production costs (the degree of exchange rate pass-through) and partly in line with euro area producer prices (pricing-to-market).[2]

Imported goods are made up of a heterogeneous range of products and commodities and the degree of exchange rate pass-through and pricing-to-market may vary considerably across these different types of imports. For example, one might expect a much higher degree of pass-through for more homogeneous and widely traded goods and commodities where the so-called 'law-of-one-price' might hold, such as oil or raw materials, than for highly differentiated manufactured products. As there is little point in estimating the degree of exchange rate pass-through for products where the law-of-one price probably holds, we focus on imports of manufactures (which account for approximately three-quarters of euro area imports of goods).

Section 2 describes the theoretical framework behind the specification of our import price equation, starting with a simple framework where import prices are modelled purely as a mark-up on exporters production costs and then extending the model to explicitly take account of pricing-to-market behaviour. This is followed by section 3 which describes both the data and our econometric procedure. The paper reports econometric estimates of the exchange rate pass-through and pricing-to-market parameters for extra-euro area imports using both aggregate manufacturing import price time-series data along with panel estimation techniques which pool the data across seven major individual import suppliers. A variety of empirical tests and estimates of import price equations are carried out, such as testing whether the parameter for the exchange rate and foreign production costs can be constrained to be equal and imposing price homogeneity, etc. Impulse response functions are also reported in order to show how quickly exchange rate shocks are transmitted through to import prices. Section 3 also uses the panel dataset to investigate whether exchange rate pass-through parameters differ across different import suppliers and considers the various reasons for any differences. The paper concludes that the degree of exchange rate pass-through to manufacturing import prices for the euro area is in the region of between 50% to 70%, with at least half of the impact coming through in the current quarter and virtually all of the impact occurring in about fifteen months. Furthermore, there is some evidence that EU member countries (who are not members of the euro area) assign a much larger weight to pricing to the euro area market relative to non-EU countries. This may be partly due to pressures for price convergence within the EU arising from the integration of EU markets, or may simply be related to the lower degree of monopoly power of small EU countries relative to larger exporters such as the USA. Indeed, further results show that the lower pricing-to-market parameter for the non-EU countries may be driven by the much higher estimated exchange rate pass-through of around 90% for imports from the United States (a result consistent with theoretical arguments that the monopoly power of 'large-country' export suppliers allows them to base their export prices primarily as a mark-up on costs with little pricing-to-market). Finally, although the equations pass the diagnostic tests, and the estimated magnitudes of the key parameters are in line with those reported in the import price literature, some caveats regarding the robustness of

[1] Note that whenever this paper refers to euro area imports and import prices it is a reference to *extra-euro area* imports and import prices.

[2] Although the law-of-one price is a common assumption in much of the trade literature, many studies for a variety of countries find that the degree of pricing-to-market is **not** zero. For example: Deppler and Ripley, 1978 (various countries); Mastropasqua and Vona, 1989 (USA imports); Spencer, 1984 (various countries); Yang, 1991(USA imports); Anderton, 1999 (UK imports); Alexius and Vredin, 1999 (Swedish exports); and Yang, 1997 (USA imports). Goldberg and Knetter (1997) provide a very useful overview of the literature on exchange rate pass-through and pricing-to-market.

some of the econometric results are appropriate, particularly regarding the use of possibly non stationary data and the exclusion of cointegration techniques due to the short sample period.

2 The import price model

Trade price models are usually based on the idea of an exporting firm operating in imperfectly competitive markets which has the potential to price discriminate between its export and domestic markets. Simple versions of this type of model are derived by Baldwin (1988), Kim (1990) and Yang (1991) where the long-run profit maximising foreign currency export price ($PX^{\max}$) is modelled as a simple mark-up on the exporters production costs expressed in foreign currency (all variables are in logarithms);

$$(1)\ PX_t^{\max} = A_t + E_t + C_t^*$$

Where: $PX^{\max}$ is the profit maximising export price; E_t is the exchange rate; C_t^* is the production cost in the exporters own currency; A_t reflects changes in profit margins and is usually a function of $1/(1-\eta)$ where η is the elasticity of demand.

This simple mark-up model approach can be extended by adding various other considerations. For example, actual export prices may differ from their profit maximising target due to factors such as uncertainty or adjustment costs, etc. Furthermore, exporters may try to maintain market share by keeping prices in line with their competitors. Accordingly, export prices are also frequently assumed to be set so as to achieve the best possible compromise between the objectives of maximising profits and the protection of market share. Such a pricing strategy is often specified within a quadratic loss function framework along the lines of (2) below;

$$(2)\ L = \lambda_1(PX - A - E - C^*)^2 + \lambda_2(PX - PX_{t-1})^2 + \lambda_3(PX - PC)^2$$
$$+\lambda_4[(PX - PX_{t-1}) - (PC - PC_{t-1})]^2$$

where:
$PC =$ competitor's prices.
$L =$ loss subjectively perceived by exporter.

The parameter λ_1 denotes the perceived loss attached to the export price deviating from it's profit maximising level, while λ_2 captures the perceived losses related to non-stable prices. The importance of perceived losses associated with deviations of the export price from competitor's prices in the long- and short-run are denoted by λ_3 and λ_4 respectively. Minimising the loss function (2) with respect to PX usually yields an equation similar to (3) below where the export price in the long-run is determined by a weighted average of (a) exporters costs ($PX^{\max}$), and (b) competitor's prices (PC).

$$(3) PX_t = \alpha_0 + \alpha_1 PX_{t-1} + \alpha_2 PX_{t-1}^{\max} + \alpha_3 PC_{t-1}$$

A related second strand of the trade price literature describes how the relative weights captured by α_2 and α_3 in equation (3) partly depend on the structure of both the product market and production (see, for example, Deppler and Ripley, 1978; Spencer, 1984; Mastropasqua and Vona, 1989; and Yang, 1997, etc).[3] For example, Deppler and Ripley (1978) show how the ratio of the weight on the cost variables (α_2) to the weight on competitors prices (α_3) is a function of $\beta\eta$, where β is the elasticity of domestic marginal cost with respect to output, while η is the absolute value of the price elasticity of foreign demand. In particular, α_3 becomes larger as the price elasticity of demand (η) increases and/or because there are strongly increasing marginal costs (i.e., β is large). Under certain assumptions the *long-run* values of α_2 and α_3 will sum to one.[4]

As in various earlier papers, such as Yang (1991), we use the above export price model as the basis for our euro area import price specification. Accordingly, there are some necessary departures from the theoretical model when moving to its empirical estimation: first, our import price specification proxies competitor's prices by the euro area's domestic price (i.e., euro area producer prices of manufactured goods); second, we proxy import suppliers costs by a weighted average of import suppliers producer prices; third, we add first difference terms of the equation variables (with the specific first difference terms in the final specification empirically determined by the testing down procedure carried out at a later stage). We begin by estimating the simple 'mark-up over production costs' model – i.e., excluding competitor's prices – as specified in equation (4) below. However, instead of constraining the parameters for the exchange rate and productions costs to be the same – as is frequently the case in the empirical literature - we first allow the two parameters to differ and then test whether the constraint of equal coefficients can be imposed. If the constraint of equal parameters for the exchange rate and costs is accepted, we then impose the parameters to be the same and add the proxy for competitor's prices (i.e., the pricing-to-market term) to an error correction framework as in equation (5) below.

$$(4) PM_t = \theta_0 + \theta_1 PM_{t-1} + \theta_2 E_{t-1} + \theta_2^{/} C^*_{t-1} + \theta_3 TIME + \sum_{i=0}^{n} \beta_{t-i} \Delta terms_{t-i}$$

Where:

PM = euro area manufacturing import price in euros.

E = euro exchange rate.

C^* = import supplier production costs in foreign currency (proxied by import weighted foreign producer prices).

TIME = time trend

$\sum_{i=0}^{n} \beta_{t-i} \Delta terms_{t-i}$ = first differences of equation variables from period t to t - n.

[3] For other related papers on trade pricing behaviour see Citrin (1989), Dixit (1989), Marston (1990) and Naug and Nymoen (1996).

[4] This price homogeneity restriction can be derived at the micro-level for the pricing setting behaviour of a firm which maximises profit subject to decreasing returns of scale, perfect competition in factor markets, and less than perfect competition in its product market (see Deppler and Ripley, 1978).

$$(5) PM_t = \theta_0 + \theta_1 PM_{t-1} + \theta_2 (E_{t-1} + C^*_{t-1}) + \theta_3 EAP_{t-1} + \theta_4 TIME + \sum_{i=0}^{n} \beta_{t-i} \Delta terms_{t-i}$$

Where:

EAP = euro area producer prices for manufactured goods.

Although θ_0 captures the mark-up, both of the above equations also include a time trend in order to pick up any trend change in the mark-up or other factors not captured by the other explanatory variables. In equation (5), the parameter θ_3 represents the weight foreign producers attach to maintaining competitiveness in relation to euro area producers in order to maintain market share and therefore captures the degree of pricing-to-market (ie, EAP represents euro area domestic prices). Meanwhile, the parameter θ_2 in equation (5) captures the weight representing the extent to which exporters to the euro area base their price on their production costs which are, in turn, proxied by foreign producer prices converted into euros ($E + C^*$). This parameter therefore also represents the degree of exchange rate pass-through. Equation (5) therefore imposes the same parameter for both E and C^* in a similar fashion to many studies in the exchange rate pass-through literature (see, for example: Baldwin, 1988; Mastropasqua and Vona, 1989; Yang, 1991).

3 Data and Econometric Procedure

3.1 Data

Here we provide a brief description of the major features of the dataset (a complete list of data sources are provided in a Data Appendix). The data are quarterly and cover the sample period 1989Q1-2001Q4 (the fairly short sample period is due to the lack of extra-euro area import price data before 1989).[5] We use both aggregate extra-euro area manufacturing import price data as well as bilateral import price data disaggregated according to seven major euro area external import suppliers, namely: USA, UK, Japan, non-Japan Asia, Sweden, Denmark and Switzerland. In line with the vast majority of studies which use trade data, we use import unit value indices (UVIs) as a proxy for import prices. A second reason for using *UVIs* is that they are available for extra-euro area trade, while euro area import *deflators* are only available for *total* euro area trade - i.e., total trade includes intra- as well as extra-euro area trade – which is obviously not a suitable category for estimating the impact of external exchange rate movements on import prices for goods imported from outside the euro area. However, UVIs have well-known limitations as proxies for prices (see Menon, 1996; Lipsey *et al*, 1991). For example, unit value indices are calculated as the value of products divided by their quantity, with the latter proxied by the product's weight in terms of tonnage. Accordingly, this distorts the UVI for products such as computers where a decline in weight has been substantial, but which does not represent a decline in quantity. A related criticism of UVIs is that they do not take account of changes in quality, which may result in an upward bias. In addition, UVIs may embody a considerable under representation of new commodities and may also omit many products.

Other key data consist of a proxy for the production costs of euro area import suppliers, constructed as a simple import-weighted average of the domestic wholesale prices of the major seven import suppliers named above. Meanwhile, competitor's prices are proxied by euro area producer prices for

[5] Accordingly, the usual caveats regarding short sample periods and econometric results apply to the empirical work.

manufactured goods, while the total effective exchange rate of the euro and the bilateral exchange rates vis-à-vis the euro are defined in terms of the number of euros per foreign currency (i.e., a depreciation of the euro causes a *rise* in our exchange rate variables).

Some of the key variables are shown in the charts at the end of the paper. Chart 1 shows extra-euro area manufacturing import prices alongside the effective exchange rate of the euro. The rapid rise in import prices associated with the depreciation of the euro after its launch in 1999 is particularly evident as is the clear positive correlation between import prices and the exchange rate (simple correlation coefficient of 0.73).[6] Charts 2 and 3 show the separate import prices of the seven individual import suppliers and highlights the disparate growth rates of import prices across the different exporting countries over the whole sample period and specific sub-periods. For example, prices of manufactures imported from the US grew the most rapidly during the period since the launch of the euro in line with the larger depreciation of the euro against the dollar compared to the other currencies. These charts also show the correlations between the growth rates of the individual import supplier's import price and their own bilateral exchange rate vis-à-vis the euro. These simple correlations show higher correlations between movements in import prices and exchange rates for the non-EU countries compared to the EU member states, with the USA showing the highest correlation of around 0.87 and Sweden showing the lowest correlation at 0.02. Accordingly, these correlations may suggest a higher exchange rate pass-through for the non-EU countries, particularly the USA, relative to the EU member states.

3.2 Econometric Procedure

We began the estimation process by investigating the stochastic properties of the data and conducted unit root tests on all of the variables. Two series of augmented Dickey-Fuller tests were carried out, one test including a constant only and another test including both a constant and a time trend. Bearing in mind the important caveat that unit root tests have low power in short samples such as ours, the results for the Dickey-Fuller tests suggest that virtually all of the variables are non-stationary processes of order 1 (or I(1)).[7] Given that the variables may be non-stationary, levels regressions may give rise to the familiar spurious regression problem and thereby embody an increased probability of falsely rejecting the null hypothesis that the equation parameters are equal to zero (see, for example, Hendry, 1999; or Banerjee *et al*, 1993). In the context of I(1) variables, modelling in levels is justified if the level variables are able to form a cointegrating vector. However, given the low power of cointegration tests in small samples it was deemed that the cointegration approach was inappropriate for our analysis given our short sample period.[8] Instead, and following the precedent of other papers in the pass-through literature characterised by short sample periods, we adopted the 'general to specific' methodology pioneered by Hendry in order to arrive at a parsimonious model.[9] Although adopting this approach in this paper involved *some* levels-based regression analysis, we

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[6] All correlations reported in the charts are between the change in the log of the import price and the change in the log of the exchange rate.

[7] Under some circumstances, the power of unit root tests can be less than 30% when the number of observations is as low as 100 (see Phillips and Xiao, 1999). As our sample period extends from 1989Q1-2001Q4, we only have a maximum of 52 quarterly observations.

[8] Doornik, Hendry and Nielson (1999) note the empirical lack of power of cointegration tests when the number of quarterly observations is equal to, or less than, 100 (they also point out that incorrect inferences regarding cointegration are possible if one uses the small sample corrections suggested by, for example, Reimers, 1992). This seems to be consistent with our preliminary tests for cointegration which gave mixed results across a variety of alternative specifications expressed in levels.

[9] For example, in the pass-through literature, Menon (1996) also argues that the cointegration approach is inappropriate due to small sample problems – and that "the long-run properties of the data may only be dimly reflected in short samples" - and therefore applies the same 'general to specific' methodology as ourselves.

argue that our parameter estimates are NOT prone to spurious regression problems for the following reasons:

- As we will see later, once we impose long-run price homogeneity - as shown later in equation (6) - the majority of the equations reported in the paper are estimated with the levels variables expressed in the form of ratios (or, equivalently, relative prices). As these ratios are generally stationary series, the parameter estimates obtained by imposing price homogeneity are not subject to spurious regression problems. Although we estimate a few other equations in a simple levels-form (i.e., not in ratios form), the results also do not seem to suffer from spurious regression problems as they give similar results to the ratio equations.
- Our parameters are obtained by estimating panel equations as well as aggregate time series specifications. However, spurious regression is not so likely to be an important problem in panel estimation (see Phillips and Moon, 1999).[10] Given that we obtain similar results for both time series and panel estimation techniques, it again therefore follows that – like our panel estimates - our time series results are NOT prone to spurious regression problems.

Our procedure is to estimate the extra-euro area manufacturing import price specifications outlined above, beginning with a general equation with up to four quarter lags for first difference terms for each equation variable along with a one quarter lag on the levels equilibrium terms. We then 'test down' from this general specification to a specific specification by eliminating the statistically insignificant variables one at a time. Our approach is to first obtain some broad preliminary estimates using an aggregate manufacturing import price equation for the euro area. We then re-estimate the specification by pooling the import price data across a selection of major individual extra-euro area import suppliers in order to obtain "panel-estimates".

3.3 Aggregate specification

For the aggregate equation, foreign costs are proxied by a weighted average of the producer prices of the major import suppliers to the euro area, namely: USA (with weight 25.3%); UK (31.5%); Japan (11.7%); non-Japan Asia (15.5%); Sweden (4.9%); Switzerland (7.0%); and Denmark (4.1%).[11] We begin by estimating the simple mark-up over production costs model described in equation (4) (i.e., excluding competitor's prices) and allow the long-run parameters for the exchange rate and exporter's production costs (in foreign currency) to be different. The estimated parameters for equation (4), after following the testing-down procedure are shown in column (a) in table 1.[12] All of the variables are of the expected sign and all of the parameters are statistically significant except for the constant. For example, the positive sign of both the level and the first difference of the effective exchange rate indicates that a depreciation of the euro leads to an increase in import prices, while a rise in the production costs (in foreign currency) of import suppliers also results in an increase in import prices. The adjusted R-squared, standard error of the equation and diagnostic tests confirm that the specification provides a reasonable description of the data generating process.[13] Next, we constrain the parameters for the exchange rate and production costs to be equal – a restriction which is accepted by the data - and the results are shown in column (b) of Table 1.[14] In both the unconstrained (a) and constrained (b) equations the long-run exchange rate pass-through (ERPT) is

[10] Put simply, this is because the covariance between the I(1) regressor and the I(1) error term, which produces the spurious regression in time series, is much weaker in panels because of the averaging across independent groups.

[11] These weights are based on the share of euro area manufacturing imports accounted for by the individual countries/regions. Non-Japan Asia is proxied by a weighted average of the production costs of South Korea, Thailand, Hong Kong, Singapore and Taiwan. The seven major import suppliers used to proxy foreign costs account for almost 70% of extra-euro area imports of manufactures.

[12] The testing-down procedure showed that the only first difference term to be statistically significant is the effective exchange rate.

[13] The diagnostic tests consist of tests for autocorrelation, normality and three tests for heteroscedasticity.

[14] An F-test shows that this restriction is accepted by the data [F(1,43)=1.23)].

very similar at around 62% and 66% respectively. Column (c) of Table 1 shows the results of adding the competitor's prices term (EAP) to the constrained equation (i.e., equation (5) above). Although the proxy for competitor's prices (i.e., euro area manufacturing producer prices) is not statistically significant, it does have the expected positive sign and also reduces the long-run ERPT elasticity to around 55%, while the parameter for EAP implies that pricing-to-market (PTM) is of the order of approximately 47% in the long-run, revealing that the sum of the elasticities is approximately unity thereby indicating that price homogeneity may hold in the long run.[15] As a result, we re-estimate the import price specification and impose long-run price homogeneity in the format of specification (6) below – which effectively means estimating the long-run variables in terms of ratios – while the resulting long-run parameters for the degree of ERPT and PTM are given in equation (7).[16]

$$(6) PM_t - EAP_t = \theta_0 + \theta_1 (PM - EAP)_{t-1} + \theta_2 [(E + C^*) - EAP]_t + \theta_4 TIME + \sum_{i=0}^{n} \beta_{t-i} \Delta terms_{t-i}$$

$$(7) PM_t = [1 - \theta_2 / (1 - \theta_1)]\, EAP_t + [\theta_2 / (1 - \theta_1)](E + C^*)_t$$

Where:

$\theta_2 / (1 - \theta_1 = \text{Long-run exchange rate pass-through (ERPT).}$

$[1 - \theta_2 / (1 - \theta_1)] = \text{Long-run pricing-to-market (PTM).}$

Column (d) in Table 1 shows the results of imposing price homogeneity as specified in equation (6) above, while column (e) also imposes price homogeneity but drops the (now) insignificant first difference term for the exchange rate.[17] Again, the equations pass all of the diagnostic tests and all the long-run equilibrium terms relating to the ERPT and PTM variables are now statistically significant. Accordingly, under the assumption of price homogeneity in equation (e), the parameters indicate that import suppliers assign a weight of approximately 51% to maintaining prices in line with increases in costs (ERPT) in the long run, with a similar weight of about 49% attached to maintaining competitive prices vis-à-vis euro area producers (PTM). Despite estimating a variety of specifications using the aggregate data – e.g., allowing the parameters for the exchange rate and foreign costs to differ as well as imposing them to be equal; relaxing and imposing the price homogeneity constraint, etc – the estimates of the long-run exchange rate pass-through elasticity fall within a narrow band, ranging from 51% to 66%.

3.4 Panel estimates:

We now repeat the above estimation procedure, but obtain panel estimates by pooling the data across seven major euro area import suppliers (USA; Japan; the non-Japan Asia region; UK; Sweden; Denmark and Switzerland). We also include fixed effects by allowing each import supplier to have a different intercept. Although Nickell (1981) and Baltagi (1995) point out the potential bias of

[15] Given that the results up to now have been estimated in terms of levels using possibly non-stationary data, some caveats apply in the sense that the results may be subject to the criticism of spurious regression, thereby implying an increased probability of falsely rejecting the null hypothesis that the equation parameters are equal to zero. However, the results are similar to those obtained later which express the variables in ratios form and which are not subject to criticisms related to spurious regression.

[16] Imposing long-run price homogeneity requires that the sum of the long-run elasticities for production costs in euros (ERPT) and euro area producer prices (PTM) sum to unity, thereby ensuring that a proportionate increase in both of these variables results in the same proportionate increase in import prices. The fact that this results in the long-run variables being expressed in ratios form (or relative prices) - which, in turn, are generally stationary series – implies that the results obtained by imposing price homogeneity are not subject to criticisms of 'spurious regression'.

[17] An F-test using the sum of squared residuals from equations (c) and (d) of Table 1 shows that the restriction of price homogeneity is accepted by the data [F(1,42)=3.84].

dynamic panel models with fixed effects, we do not instrument the lagged dependent variable as the time dimension of our panel is sufficiently large to avoid serious bias of the estimated coefficients (see Judson and Owen, 1999).[18] Given that we have seven import suppliers, combined with a quarterly sample period of 1989Q1 to 2001Q4, we have a total of 364 observations for our 'panel'.[19]

In Table 2, we report the results for the panel estimates. After carrying-out the testing-down procedure we are left with two first difference terms (one for the bilateral exchange rate and one for the lagged dependent variable). Again, all of the variables are correctly signed and statistically significant. As before, column (a) in Table 2 shows the results of the simple mark-up model and reveals that the unconstrained estimated long-run parameters for (i) import suppliers costs in foreign currency, and (ii) the exchange rate, are virtually identical. Furthermore, column (b) constrains these long-run parameters to be equal – a restriction which is accepted by an F-test.[20] Accordingly, columns (a) and (b) show that both the restricted and unrestricted mark-up equations suggest that the ERPT is almost 70%, which is somewhat higher than the average of the previous aggregate equation estimates. Meanwhile, columns (c) and (d) repeat the first two equations, but add the competitors prices term (i.e., euro area producer prices). Again, column (c) shows that the foreign costs and exchange rates have very similar long-run parameters, while the acceptability of restricting these long-run parameters to be equal as in column (d) is confirmed by an F-test. These latter two equations have very similar long-run parameters, implying an ERPT of around 60% - 70% and PTM of approximately 50%-55%. Finally, in columns (e) and (f) we impose long-run price homogeneity in the same way as for the aggregate specification – experimenting with both lagged (e) and current period (f) terms for the levels exchange rate variables – which reveal similar results to the earlier panel estimates for the long-run ERPT and PTM elasticities. In a similar fashion to the previous estimates using aggregate data, despite the variety of specifications estimated, and the mixture of constrained and unconstrained parameter estimates, the long-run panel estimates for the exchange rate pass-through move within a narrow band, ranging from 59% to 69%.

3.5 Impulse responses for the exchange rate pass-through

When considering the above estimated parameters across both the aggregate and panel equations, we find that the estimated long-run pass-through of changes in the effective exchange rate of the euro to extra-euro area import prices of manufactures ranges between 50% to 70%.[21] However, the length of time it takes for changes in the exchange rate to affect import prices is also an important issue. Accordingly, Chart 4 plots the impulse response functions showing the quarterly time profile of the impact on the import price of manufactures of a 1% depreciation of the euro for a selection of both the aggregate and panel estimates (i.e., aggregate equation (e) of Table 1 and panel equations (c) and (e) of Table 2). In general, the exchange rate impact feeds through to import prices fairly rapidly,

[18] Judson and Owen (1999) compare the bias of six different estimators of dynamic panel data models: the OLS estimator, a 'standard' least squares dummy variable (LSDV) estimator, a corrected LSDV estimator as proposed by Kiviet (1995), two GMM estimators discussed by Arellano and Bond (1991), and the IV proposed by Anderson and Hsiao (1981). The results of their simulations are that the corrected LSDV estimator of Kiviet (1995) outperforms the other estimators in the case of a balanced panel, and the 'standard' LSDV estimator performs better than the other estimators in the case of an unbalanced panel. However, the LSDV estimator performs just as well, or better, than the majority of alternatives when the number of time periods is increased to at least 30 (hence, given our complete sample period of 52 quarters, our LSDV estimator should exhibit only a negligible bias).

[19] However, we lose 4 observations for each panel member when we use instrumental variable estimation as we require 4 lags of the other variables of the equation as instruments.

[20] The F-test of this restriction is [F(1,316)=3.51].

[21] The estimated weight for the degree of exchange rate pass is similar to other estimates reported in the import price literature. For example, Anderton (1996, 1999) estimates an exchange rate pass-through of between 60%-75% for UK manufacturing import prices; Mastropasqua and Vona (1989) estimate a pass-through of 54%-68% for US import prices; and Athukorala and Menon (1994) estimate a pass-through of 67% for Japanese exports. Other relevant papers in this area providing estimates of pass-through parameters are Kieler (2001) and Kenny and McGettigan (1998).

with at least half of the pass-through occurring in the same quarter as the exchange rate shock and virtually all of the long-run impact occurring after about fifteen months (with the panel results showing a small amount of overshooting). This is the case regardless of whether we impose price homogeneity and also constrain the parameters for the exchange rate and production costs to be equal – as in equations (1e) and (2e) – or relax the constraint of price homogeneity and allow the parameters for the exchange rate and production costs to be different (as in equation (2c)). However, it should be pointed out that the above impulse responses represent a partial equilibrium result in the sense that they do not include any second round effects arising from related changes to real output or wages, etc.

3.6 Differential degrees of exchange rate pass through for different import suppliers?

Experimenting with bilateral import price specifications for each of the individual import suppliers reveals a range of estimated elasticities, with the EU member states generally showing somewhat lower exchange rate pass-through parameters compared to the non-EU countries, particularly in comparison to a very high pass-through elasticity for euro area imports supplied by the USA. This general result also seems to be supported by the previously reported correlations between the growth rates of the individual import supplier's import prices and their own bilateral exchange rate vis-à-vis the euro (see Charts 1-3). Given that just over half of the sample countries within the 'panel' are EU countries (ie, EU countries exporting to the euro area who are not members of the single currency), combined with the above evidence that the exchange rate pass through may be smaller for EU members, and larger for the USA, the panel framework provides a good opportunity for testing whether different import suppliers exhibit differential degrees of exchange rate pass-through.

Accordingly, we re-estimated the above panel regressions using dummy variables to allow the long-run exchange rate pass-through parameters to be different across different import suppliers. In order to better distinguish between EU and non-EU countries, we first dropped Switzerland from the panel and re-estimated the panel equations by pooling the data across the remaining import suppliers.[22] The panel results excluding Switzerland are shown in column (g) of table 2 and reveal that the long-run results are broadly the same as for the whole sample including Switzerland. Our next step is to add a dummy variable to this equation to see if the long-run exchange rate pass-through for EU import suppliers is different (i.e., we add an extra term where the long-run ERPT parameter is multiplied by a dummy variable with a value of 1 when the import supplier is an EU member state and zero otherwise). Column (h) shows that the dummy variable is statistically significant and negatively signed, suggesting that the exchange rate pass-through of the non-EU countries is around 80% (with a weight of approximately 20% given to pricing-to-market), while EU member countries may pass-through only around 50% of exchange rate changes and assign a much larger weight to maintaining prices in line with euro area domestic prices (i.e., around 50%) than their non-EU counterparts. However, as suggested by the bilateral specifications and correlations mentioned earlier, this result may be partly driven by a very high ERPT for US import suppliers. Therefore, column (i) estimates a similar equation to (h) but instead replaces the EU dummy with a US dummy designed to capture any differential between the long-run exchange rate pass-through of US import suppliers and the other import suppliers (i.e., the long-run ERPT parameter is multiplied by a dummy variable with a value of 1 when the import supplier is from the USA and zero otherwise). The results show that the US dummy is statistically significant and positively signed (in line with our other evidence that the exchange rate pass-through is relatively larger for US import suppliers). Indeed, the results in column (i) suggest that the exchange rate pass-through for euro area imports originating from the USA is around 93%, compared to approximately 58% for the other import suppliers.

[22] For example, Switzerland has several trade agreements with EU member states along the lines of some intra-EU agreements.

There could be several possible reasons as to why the degree of exchange rate pass-through might be relatively lower for EU member countries and relatively higher for US import suppliers:

- First, the price elasticity of demand (η) may be greater for EU member countries relative to non-EU countries when exporting to the euro area. For example, the creation of the Single Market and the process of harmonisation of product standards, etc, should encourage price convergence among EU members, implying that deviations away from some hypothetical ‘common’ Single Market price may result in a larger loss of market share than previously. Obviously, non-EU members face the same degree of price competition, but it is likely that these countries are exporting somewhat different types of products to the euro area in comparison to the EU members (the latter are more likely to specialise in products where tariff and non-tariff barriers have been reduced for EU members). Accordingly, η is likely to be larger for the EU member countries who are not EMU members vis-à-vis the products of the euro area due to the greater degree of market integration, thereby consistent with our larger estimated degree of PTM for EU import suppliers to the euro area.
- Second, large countries such as the USA have a greater degree of monopoly power, while smaller countries – such as the EU members – have very little monopoly power. Again, this implies a larger degree of PTM for the EU import suppliers and a higher ERPT for US import suppliers.
- Given the possible future EMU membership of the EU member countries, large swings in exchange rates might be perceived to be of a more transitory nature for these countries in comparison to the non-EU countries. Again, this is would be consistent with a smaller degree of exchange rate pass-through for exports to the euro area from EU member states.

4 Conclusions

This paper estimates the extent to which exchange rate changes are passed through to euro area manufacturing import prices using a model where exporters set export prices to the euro area partly as a mark-up on their production costs (the degree of exchange rate pass-through) and partly in line with euro area producer prices (pricing-to-market). A variety of empirical tests and specifications of import price equations are reported, for example: testing whether the parameter for the exchange rate and foreign production costs can be constrained to be equal; imposing price homogeneity; estimating both time series and panel equations, etc. However, despite the variety of specifications estimated, and the mixture of constrained and unconstrained parameter estimates, the long-run estimates for the exchange rate pass-through move within a fairly narrow band. The econometric results across both the aggregate specification and 'panel' results suggest that the pass through of changes in the effective exchange rate of the euro to extra-euro area imports of manufactures is around 50% - 70% in the long-run, while pricing-to-market has an estimated weight of between 50% - 30%. Impulse response functions indicate that most of the exchange rate impact is passed through to import prices in about fifteen months, with at least half of the impact occurring in the same quarter in which an exchange rate shock occurs. We also find some evidence that the degree of exchange rate pass-through may differ across import suppliers. It seems to be the case that EU member states who are not currently part of the euro area assign a larger weight to pricing-to-market – i.e., a lower exchange rate pass-through - when exporting to the euro area in comparison to non-EU members. This may be due to pressures for price convergence within the EU arising from increased competition due to the integration of EU markets, but is also consistent with smaller countries having relatively little monopoly power. Meanwhile, further results show that the lower pricing-to-market parameter for the non-EU countries may be driven by the much higher estimated exchange rate pass-through for imports from the United States (a result consistent with theoretical arguments that 'large-country' export suppliers have more monopoly power and tend to base their export prices primarily as a mark-up on costs with little pricing-to-market). Finally, although the estimated equations pass the diagnostic tests, and the estimated magnitudes of the key parameters are in line with those reported in the import price literature, some caveats regarding the robustness of *some* of the econometric results are appropriate, particularly regarding the use of possibly non stationary data and the exclusion of cointegration techniques due to the short sample period.

Table 1: Manfacturing import prices: aggregate specification

	(a)	(b)	(c)	(d)	(e)
Constant	-0.965 (1.4)	1.466 (4.2)	0.9132 (1.2)	-0.092 (2.3)	-0.139 (5.0)
PM_{t-1}	0.622 (8.4)	0.658 (8.3)	0.595 (4.5)	-	-
C^*_{t-1}	0.337 (2.0)	-	-	-	-
E_{t-1}	0.235 (3.8)	-	-	-	-
$(E+C^*)_{t-1}$	-	0.226 (3.5)	0.222 (3.1)	-	-
EAP_t	-	-	0.185 (1.0)	-	-
ΔE_t	0.508 (7.1)	0.507 (6.9)	0.464 (2.6)	0.308 (1.5)	-
TIME	0.025 (2.1)	0.031 (3.4)	0.028 (1.8)	0.026 (2.1)	0.039 (4.7)
$(PM-EAP)_{t-1}$	-	-	-	0.643 (5.0)	0.491 (5.7)
$[(E+C^*)-EAP]_t$	-	-	-	0.199 (3.0)	0.259 (4.4)
Adj. R^2	0.988	0.987	0.987	0.969	0.965
SEE	0.0141	0.0142	0.0143	0.0134	0.0143
AR (1-4); F(4,37)	1.386	1.048	1.335	0.641	0.594
ARCH (1-4); F(4,33)	0.931	0.790	1.136	0.969	1.617
NORM ($Chi^2(2)$)	5.158	4.476	3.968	0.761	0.306
HET [F(10,30)]	0.403	0.583	0.443	0.276	0.985
HETX [F(20,20)]	0.301	0.448	0.433	0.774	1.109
Long Run parameters					
ERPT	0.62	0.66	0.55	0.56	0.51
PTM	-	-	0.47	0.44	0.49

Notes: *All variables in logarithms; 't' statistics in parentheses (based on White's heteroscedastic consistent standard errors). SEE=standard error of equation; Full details of the diagnostic tests are given in an appendix, but briefly: AR(1-4) is a test for autocorrelation; ARCH (1-4), HET and HETX are tests for heteroscedasticity and NORM is a normality test; Total sample period=1989Q1-2001Q4; Where current 'period t' terms are included in the equation, the current period terms are instrumented to avoid simultaneity problems and the equation is estimated by instrumental variables techniques. PM = import price;* C^* *=import suppliers production costs in foreign currency; E=effective exchange rate;* $(E+C^*)$*= import suppliers production costs in euros; EAP=euro area manufacturing producer prices in euros; TIME=time trend; Dependent variable=PM; ERPT=Exchange Rate Pass-Through; PTM=Pricing-to-Market.*

Table 2: Manufacturing import prices: panel estimates

	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)
PM_{t-1}	0.794 (27.1)	0.804 (27.1)	0.779 (24.8)	0.797 (26.3)	-	-	-	-	-
C^*_{t-1}	0.112 (4.1)	-	0.100 (3.7)	-	-	-	-	-	-
E_{t-1}	0.138 (6.5)	-	0.138 (6.6)	-	-	-	-	-	-
$(E+C^*)_{t-1}$	-	0.133 (6.1)	-	0.141 (5.4)	-	-	-	-	-
EAP_t	-	-	0.114 (1.9)	0.111 (7.3)	-	-	-	-	-
ΔE_t	0.383 (11.4)	0.375 (11.0)	0.386 (11.4)	0.632 (7.3)	0.352 (10.2)	0.451 (5.6)	0.449 (5.5)	0.448 (5.81)	0.352 (4.69)
ΔPM_{t-4}	0.223 (4.4)	0.215 (4.2)	0.229 (4.5)	0.267 (4.8)	0.231 (4.9)	0.277 (5.5)	0.282 (5.3)	0.278 (5.27)	0.269 (5.66)
TIME	0.025 (5.6)	0.024 (5.8)	0.019 (3.7)	0.014 (2.3)	0.018 (6.2)	0.018 (5.7)	0.017 (5.3)	0.0187 (5.66)	0.024 (6.2)
$(PM-EAP)_{t-1}$	-	-	-	-	0.818 (28.2)	0.814 (27.8)	0.798 (24.5)	0.778 (21.7)	0.724 (16.4)
$[(E+C^*)-EAP)]_{t-1}$	-	-	-	-	0.108 (5.1)	-	-	-	-
$[(E+C^*)-EAP)]_t$	-	-	-	-	-	0.125 (4.9)	0.144 (4.9)	0.181 (4.62)	0.158 (5.63)
DEU* $[(E+C^*)-EAP)]_t$	-	-	-	-	-	-	-	-0.069 (2.1)	-
DUSA* $[(E+C^*)-EAP)]_t$	-	-	-	-	-	-	-	-	0.099 (2.5)
ADJ. R^2	0.986	0.985	0.986	0.981	0.973	0.967	0.968	0.968	0.973
SEE	0.0177	0.0177	0.0177	0.0177	0.0176	0.0192	0.0200	0.0200	0.0183
LM(4)	7.481	6.739	9.311	1.51	2.447	4.085	5.59	26.2	7.23
OBS	329	329	329	329	329	329	282	282	282
Long-run parameters									
ERPT	0.67	0.68	0.62	0.69	0.59	0.67	0.71	0.81	0.58
PTM	-	-	0.52	0.55	0.41	0.33	0.29	0.19	0.42
ERPT EU	-	-	-	-	-	-	-	0.50	-
PTM EU	-	-	-	-	-	-	-	0.50	-
ERPT USA	-	-	-	-	-	-	-	-	0.93
PTM USA	-	-	-	-	-	-	-	-	0.07

Notes: *Same notes as for Table 1 except: E=bilateral exchange rate of individual import supplier vis-a-vis the euro; LM4=Breusch-Godfrey Lagrange multiplier test for fourth-order serial correlation[23]; DEU=dummy variable with a value of 1when the import supplier is an EU member and zero otherwise; DUSA=dummy variable with a value of 1when the import supplier is the USA and zero otherwise; Fixed effects included in equations, but parameters not shown. Data pooled across all seven import supplier countries in equations (a) to (f) (non-EU countries : USA, Japan, non-Japan Asia and Switzerland; EU member states; Sweden, Denmark, UK), while Switzerland is excluded from equations (g) to (i). Differences between reported long run parameters and calculations from the individual parameters in the table are due to rounding.*

[23] The Breusch-Godfrey test for fourth-order autocorrelation is based on regressing the current period residuals on the residuals in period t-1 to t-4 plus all of the other exogenous regressors. The resulting R^2 is then multiplied by the number of observations to give the test statistic. The test statistic follows a CHISQ distribution with 4 degrees of freedom.

Chart 1:
Euro area total manufacturing import prices and the effective exchange rate of the euro

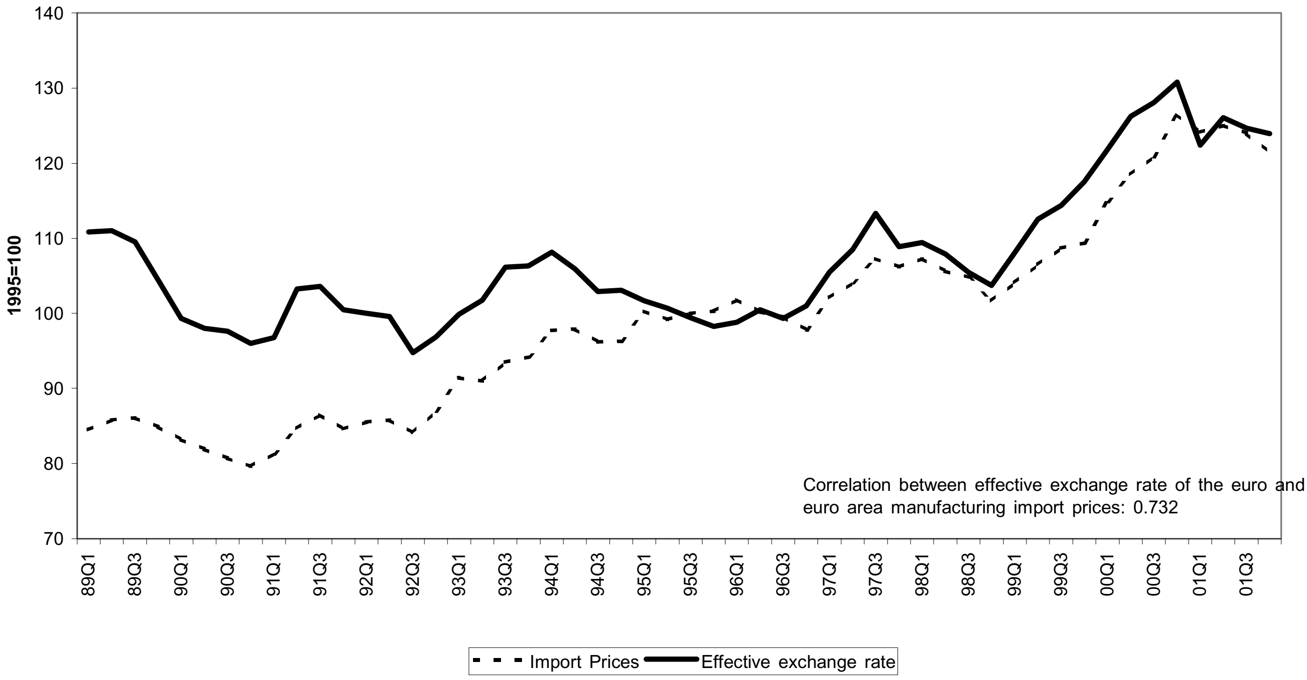


Chart 2:
Euro area manufacturing import prices for imports from the USA, Japan and Non-Japan Asia

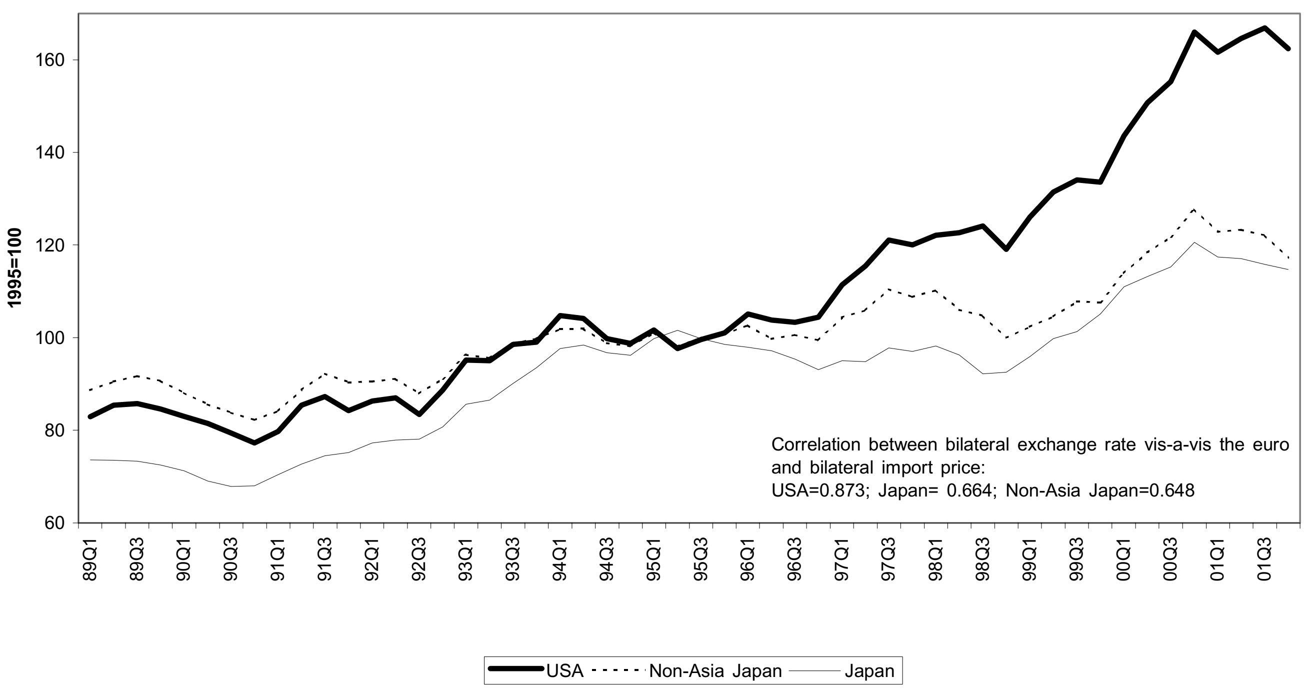


Chart 3:
Euro area manufuring import prices for imports from the UK, Denmark, Sweden, and Switzerland

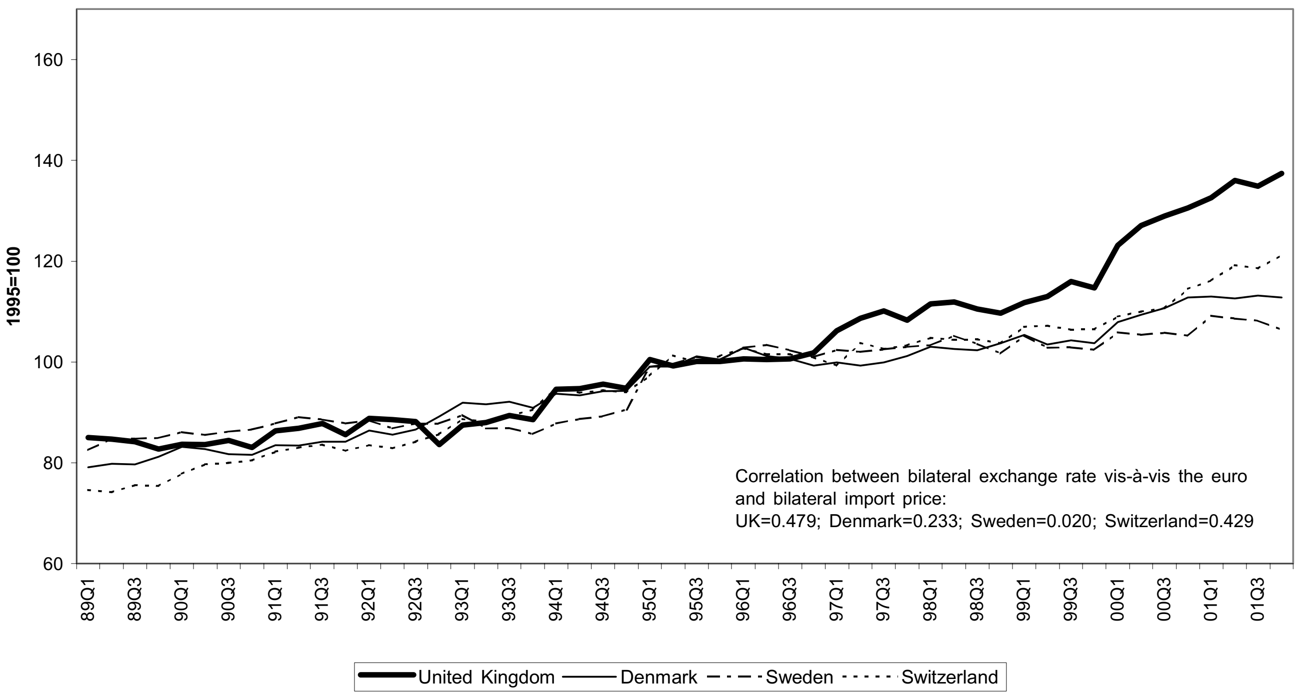
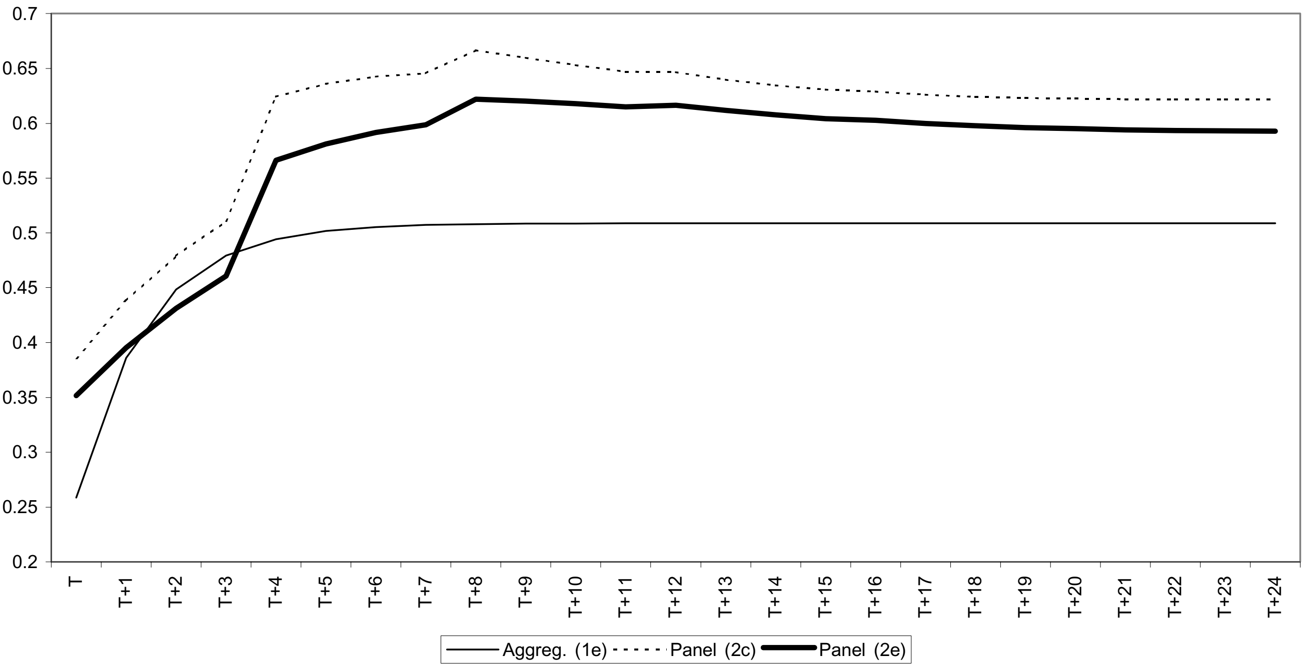


Chart 4:
Impulse responses showing quarterly time profile of percentage increase in import prices due to 1% depreciation of the euro



Data Appendix

Import prices

Data for aggregate and bilateral extra-euro area import prices expressed in ECU's/euros are from Eurostat, originating from the COMEXT database (in index form 1995=100). Import prices are proxied by import unit value indices (i.e., import values divided by import quantities).

Import suppliers production costs

For the aggregate specification, the production costs of import suppliers are proxied by an import weighted average of the producer prices of seven major euro area import suppliers, namely: USA (with weight 25.3%); UK (31.5%); Japan (11.7%); non-Japan Asia (15.5%); Sweden (4.9%); Switzerland (7.0%); and Denmark (4.1%). The weights are based on the share of euro area manufacturing imports accounted for by the individual countries/regions, with Non-Japan Asia costs proxied by a weighted average of producer prices for South Korea, Thailand, Hong Kong, Singapore and Taiwan. Import suppliers producer prices are taken from various sources: International Monetary Fund (IMF) International Financial Statistics; Organisation for Economic Cooperation and Development (OECD), Main Economic Indicators; ECB; and Eurostat.

Euro area manufacturing producer prices

Euro area manufacturing producer prices are a GDP weighted average of the producer prices of the individual euro area countries (in index form 1995=100). Recent movements in this series are published in Table 4.2 of the "Euro area statistics" section of the ECB's Monthly Bulletin.

Effective exchange rate of the euro and bilateral exchange rates vis-à-vis the euro

The nominal narrow effective exchange rate of the euro and the bilateral exchange rates vis-à-vis the euro are defined in terms of the number of euros per foreign currency (i.e., a depreciation of the euro is captured by a *rise* in our exchange rate variables). The narrow effective exchange rate of the euro is calculated by applying an average of the double export weights and simple import weights of bilateral exchange rates of the euro against the currencies of ten major trading partners. Full details of the methodology behind the construction of the nominal narrow effective exchange rate of the euro and the bilateral exchange rates vis-à-vis the euro are provided in Buldorini, Makrydakis and Thimann (2002). Recent movements in these series are published in Table 10 of the "Euro area statistics" section of the ECB's Monthly Bulletin.

The sample period of the database used in this paper is from 1989Q1 to 2001Q4. The fairly short sample period is due to the lack of extra-euro area import price data before 1989.

Diagnostic tests

Many of the diagnostic tests are computed by estimating an auxiliary regression. The tests usually take the form of TR^2 for the auxiliary regression asymptotically distributed as CHI^2 under their nulls. In addition, following Harvey (1990), F approximations are calculated as they perform better in small samples.[24] The AR (1-4) test is a Lagrange Multiplier test for serial correlation of order 1 to 4 calculated by regressing the residuals on all the regressors of the original model and the lagged residuals (missing residuals are set to zero). The ARCH (1-4) heteroscedasticity test is the TR^2 of the squared residuals regressed on their own lagged values from 1 to 4 lags. The HET heteroscedasticity test is based on White (1980) and consists of the TR^2 of an auxiliary regression of the squared residuals on the original regressors and all their squares, while the HETX heteroscedasticity test is based an auxiliary regression of the squared residuals on all squares and cross products of the original regressors. NORM is a normality test based on Doornik and Hansen (1994).

[24] All tests for the aggregate time series equations computed using PcGive (see Hendry and Doornik, 2001: "Empirical Econometric Modelling Using PcGive").

Bibliography

Alexius, A. and Vredin, A. (1999), "Pricing-to-market in Swedish exports", Scandinavian Journal of Economics, Vol. 101(2), pp.223-239.

Arellano, M. and S. Bond (1991), Some Tests of Specification for Panel Data: Monte Carlo Evidence and an Application to Employment Equations, *Review of Economic Studies*, 58:277-297.

Anderson, T. W. and C. Hsiao (1981), Estimation of Dynamic Models with Error Components, *Journal of the American Statistical Association*, 76: 589-606.

Anderton, R. (1996), "UK trade performance and the role of product quality, innovation and hysteresis: some preliminary results', *National Institute of Economic and social Research Discussion* Paper No. 102.

Anderton, R. (1999), "UK trade performance and the role of product quality, innovation and hysteresis: some preliminary results', *Scottish Journal of Political Economy*, Volume 46, November, No. 5, pp. 570-595.

Athukorala, P. and Menon, J (1994), "Pricing to market behaviour and exchange rate pass-through in Japanese exports", *The Economic Journal*, Vol. 104, March, pp. 271-281.

Baldwin, R., 1988, "Hysteresis in Import Prices: The Beachhead Effect," *American Economic Review*, 78, 4, pp 773-785.

Baltagi, B.H. (1995), *Economic Analysis of Panel Data*, Wiley, Chichester.

Banerjee, A., Dolado, J.J., Galbraith J.W. and Hendry, D.F. (1993), *Co-integration, Error-Correction and the Econometric Analysis of Non-Stationary Data*, Oxford: Oxford University Press.

Buldorini, L., Makrydakis and Thimann, C. (2002), "The effective exchange rates of the euro", *ECB Occasional Paper* No. 2.

Citrin, D (1989), "The recent behaviour of US trade prices", *IMF Staff Papers*, Vol. 36, No.4, December, pp. 934-949.

Deppler, M. and Ripley, D. (1978), "World Trade Model: Merchandise Trade", *IMF Staff Papers*, March, pp. 147-206.

Dixit, A. (1989), "Hysteresis, import penetration and exchange rate pass-through", *Quarterly Journal of Economics*, Vol. 104, pp.205-228.

Doornik, J.A. and Hansen, H. (1994), "A practical test for univariate and multivariate normality", Discussion Paper, Nuffield college.

Doornik, J.A., Hendry, D.F. and Nielson, B. (1999), "Inference in cointegrating models: UK M1 revisited", in M. McAleer and L. Oxley (editors) *Practical Issues in Cointegration Analysis*.

Doornik, J.A. and Hendry, D.F. (2001), *Empirical Econometric Modelling Using PcGive*, Timberlake Consultants Ltd.

Goldberg, P. and Knetter, M. (1997), "Goods prices and exchange rates: what have we learned?", *Journal of Economic Literature*, Vol. XXXV (September), pp. 1243-1272.

Harvey, A. (1990), The Econometric Analysis of Time Series, 2nd Edition. Hemel Hempstead: Philip Allan.

Hendry, D.F (1999), *Dynamic Econometrics*, Oxford: Oxford University Press.

Judson, R. and Owen, A. (1999), "Estimating dynamic panel data models: a guide for macroeconomists", *Economics Letters*, No. 65, pp. 9-15.

Kenny, G. and McGettigan, D. (1998), "Exchange rates and import prices for a small open economy: the case of Ireland", *Applied Economics*, No. 30, pp. 1147-1155.

Kieler, M. (2001), "Exchange rate pass-through for the euro area", International Monetary Fund mimeo.

Kim, Y. (1990), "Exchange rates and import prices in the United States: a varying parameter estimation of exchange rate pass through", *Journal of Business and Economic Statistics*, Vol. 8, 1990, pp. 305-315.

Kiviet, Jan F. (1995), On Bias, Inconsistency, and Efficiency of Various Estimators in Dynamic Panel Data Models, *Journal of Econometrics,* 68(1):53-78.

Lipsey, R.E., Molineri, L. and Kravis, I.B. (1961), "Measurement of prices and price competitiveness in international trade in manufactured goods." in *International Economics Transactions: Issues in Measurement and Empirical Research* (edited by P. Hooper and J. David Richardson), pp. 217-236. Chicago: Chicago University Press.
Marston, R. (1990), "Pricing to market in Japanese manufacturing*", Journal of International Economics*, Vol. 29, pp. 217-236.
Mastropasqua, C. and Vona, S. (1989), "The US current account imbalance and the dollar: the issue of the exchange rate pass-through", *Banca D'Italia* Discussion Paper No. 120.
Menon, J (1996), "The degree and determinants of exchange rate pass-through: market structure, non-tariff barriers and multinational corporations", The Economic Journal, Vol. 106, March, pp. 434-444.
Naug, B. and Nymoen, R. (1996), "Pricing to market in a small open economy", *Scandinavian Journal of Economics*, Vol. 98, pp. 329-350.
Nickell, S. (1981), "Biases in dynamic models with fixed effects", *Econometrica*, No. 47, pp. 1249-66.
Phillips, P.C.B. and Moon, H. (1999), Linear regression theory for non-stationary panel data, *Econometrica*, Vol. 67, pp. 1057-1111.
Phillips, P.C.B and Xiao, Z. (1999), "A primer on unit root testing", in M. McAleer and L. Oxley (editors) *Practical Issues in Cointegration Analysis*.
Reimers, H.E. (1992), "Comparisons of tests for multivariate cointegration", Statistical Papers, 33, pp. 335-359.
Spencer, G.H. (1984), "The World Trade Model: Revised Estimates", *IMF Staff Papers*, September.
White, H. (1980), "A heteroscedasticity-consistent covariance matrix and a direct test for heteroscedasticity", *Econometrica*, Vol. 48, pp.721-46.
Yang, Y. (1991), "Structural change in the US import prices of manufactures", *Weltwirtschaftliches Archiv*, Band 127, Heft 2, pp. 323-342.
Yang, J. (1997), "Exchange rate pass-through in US manufacturing industries", *Review of Economics and Statistics*, No.1, February, Vol. LXXIX.

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