

NBER WORKING PAPER SERIES

EXCHANGE-RATE PASS-THROUGH TO
IMPORT PRICES IN THE EURO AREA

José Manuel Campa
Linda S. Goldberg
José M. González-Mínguez

Working Paper 11632
<http://www.nber.org/papers/w11632>

NATIONAL BUREAU OF ECONOMIC RESEARCH
1050 Massachusetts Avenue
Cambridge, MA 02138
September 2005

The views expressed in this paper are those of the individual authors and do not necessarily reflect the position of the Federal Reserve Bank of New York or the Federal Reserve System. Address correspondences to José M. Campa, IESE Business School, Camino del Cerro de Aguila 3, 28023 E-Madrid; or Linda S. Goldberg, Federal Reserve Bank of NY, Research Department, 33 Liberty St, New York, N.Y. 10045. email: jcampa@iese.edu or Linda.Goldberg@ny.frb.org. The views expressed herein are those of the author(s) and do not necessarily reflect the views of the National Bureau of Economic Research.

©2005 by José Manuel Campa, Linda S. Goldberg and José M. González-Mínguez. All rights reserved. Short sections of text, not to exceed two paragraphs, may be quoted without explicit permission provided that full credit, including © notice, is given to the source.

Exchange-Rate Pass-Through to Import Prices in the Euro Area
José Manuel Campa, Linda S. Goldberg and José M. González-Mínguez
NBER Working Paper No. 11632
September 2005
JEL No. F3, F4

ABSTRACT

This paper presents an empirical analysis of transmission rates from exchange rate movements to import prices, across countries and product categories, in the euro area over the last fifteen years. Our results show that the transmission of exchange rate changes to import prices in the short run is high, although incomplete, and that it differs across industries and countries; in the long run, exchange rate pass-through is higher and close to one. We find no strong statistical evidence that the introduction of the euro caused a structural change in this transmission. Although estimated point elasticities seem to have declined since the introduction of the euro, we find little evidence of a structural break in the transmission of exchange rate movements except in the case of some manufacturing industries. And since the euro was introduced, industries producing differentiated goods have been more likely to experience reduced rates of exchange rate pass-through to import prices. Exchange rate changes continue to lead to large changes in import prices across euro-area countries.

José Manuel Campa
IESE Business School
Camino del Cerro de Aguila 3
28023 E-Madrid
SPAIN
jcampa@iese.edu

Linda S. Goldberg
Federal Reserve Bank of NY
Research Department
33 Liberty Street
New York, NY 10045
and NBER
linda.goldberg@ny.frb.org

I. Introduction

While exchange rate pass-through has long been of interest, the focus of this interest has evolved considerably over time. After a long period of debate over the law of one price and convergence across countries, beginning in the late 1980s exchange rate pass-through studies emphasized industrial organization and the role of segmentation and price discrimination across geographically distinct product markets. More recently, pass-through issues play a central role in debates over appropriate monetary policies, exchange rate regime optimality in general equilibrium models, and adjustment scenarios with respect to country external imbalances. These debates have broad implications for the conduct of monetary policy, for macroeconomic stability, international transmission of shocks and efforts to contain large imbalances in trade and international capital flows.

Another issue receiving attention in the recent macroeconomic debate is the stability of exchange rate pass-through rates over time. Taylor (2000), Goldfajn and Werlang (2000), Campa and Goldberg (forthcoming), and Chinn and Frankel (2005), have argued that pass-through rates may have been declining over time in some countries. The Brazilian experience of the late 1990s is often cited. In this experience, consumer prices responded very little to a large home currency depreciation, in sharp contrast with past depreciation episodes. Campa and Goldberg (forthcoming) caution against the assumption that pass-through has been declining over time across all OECD countries. While some countries have experienced reduced transmission of exchange rate changes into import prices, much of their measured declines are due to a change in the composition of their import bundle toward goods with lower pass-through elasticities. Other recent studies argue that declining pass-through has been more pervasive, at least for the United States (Marazzi et al. 2005). However, measurement and interpretation issues leave these findings under debate. The issue posed in these and related studies is whether this decline in pass-through rates is statistically significant, and if so whether it stems from improved macroeconomic conditions in the importing countries, changing competitive conditions facing exporters, changes in the composition of imports or from some other economic changes.

The analysis of aggregate pass-through rates can be divided into two parts. The first part is a border phenomenon and addresses the extent to which there are changes in pass-through rates at the level of import prices. The second issue addresses the extent to which these border price changes are transmitted to consumers or even offset by anticipated current or future monetary policy changes. Our analysis specifically deals with the former question. This component of the question motivates an analysis that explicitly focuses on the pricing and invoicing decisions of the foreign exporter.

In this paper, we begin with a review of the conceptual underpinnings of exchange rate pass through. While debates over pass through elasticities seem to focus on estimates, theoretical analyses appropriately emphasize that there are clear structural forces at work in determining the sensitivities of prices to exchange rates (as well as the more general equilibrium determination of exchange rates). In Section III we apply these lessons to import prices for the euro area countries. We estimate short- and long-run pass-through elasticities and allow them to differ by country of destination and by industry. Short-run pass-through is incomplete and country- and industry-specific. In the long-run, elasticities are larger, although it can generally be rejected that they are equal to unity. Moreover, long-run pass-through rates are not statistically different for most industries in each country and for most countries given an industry. Finally, we perform tests of structural stability in the pass-through rates around the introduction of the euro. Although several arguments point towards a possible reduction in the rates of transmission of exchange rate movements to import prices after the start of EMU, there is only very weak statistical evidence in that direction.

II. Conceptual underpinnings

Pass-through of exchange rate movements into a country's import prices has been at the center of macroeconomic debate over the past two decades. The increased openness of most developed economies and the incidence of large fluctuations in nominal exchange rates have led to a need for a better understanding of the determinants of the transmission of exchange rate changes into import prices.

In the purely statistical sense the relationship between import prices and exchange rates is the correlation between those two variables. We will call this relationship the “statistical beta” $\beta = \text{cov}(p_m, e) / \text{var}(e)$, where p_m are the (log) import prices denominated in the currency of the importer, and e is the (log) nominal exchange rate expressed in terms of units of the importer currency per unit of the exporter currency. This purely statistical relationship between exchange rates and prices does not have a meaningful economic interpretation. First, exchange rates are by definition the relative prices of currencies. They are endogenous variables and their value gets determined within a general equilibrium context, alongside other asset prices. The effect of any movements in exchange rates on prices will therefore depend on three issues: 1) the underlying shock within the economy that induced the exchange rate to move; 2) the mechanisms within the model that lead to a relationship between the underlying shock, the exchange rate and import prices; and 3) the time frame of interest for understanding the relationship between exchange rates and import prices. The answer to the question of the effect that exchange rate changes has on import prices in any theoretical framework crucially depends on the approach taken on modelling these circumstances. These alternative approaches motivate the empirical specifications to be used in estimating exchange rate pass through elasticities across countries and over time, and shed light on the implicit assumptions behind the resulting estimates.

The initial research on this topic focused on the modelling of partial-equilibrium setups arising from the problem of a single exporter/importer or from the industrial organization of one industry (Dornbusch, 1987). The approach ignores the view that exchange rates are endogenous economic variables and looks at the impact that an exogenous exchange rate movement has on the resulting equilibrium price in the industry. In this context, nominal exchange rates change the import price of the good according to the interaction of industry participants in oligopolistic markets. The micro-foundations of pricing behavior by exporters are presented as a useful starting point for understanding the dynamics of exchange rate pass-through into import prices.¹ By definition, the import prices for any country, $P_t^{m,j}$, are a transformation of the export prices of that country’s trading

¹ Some of the theoretical work in this literature is Froot and Klemperer (1989), Giovannini (1988), Marston (1990). Goldberg and Knetter (1997) provide a review of this literature.

partners, $P_t^{x,j}$, using the exchange rate E_t defined in units of the home (importing country) currency relative to the foreign (exporting country) currency:

$$P_t^{m,j} = E_t P_t^{x,j} \quad [1]$$

The export prices, in turn, are a markup ($mkup_t^x$) over exporter marginal costs (mc_t^x). We rewrite equation [1] in logarithms as²

$$p_t^m = e_t + mkup_t^x + mc_t^x \quad [2]$$

The industrial organization based literature has a partial-equilibrium approach and takes the process of the exchange rate (e_t) as exogenous in the economy. Its focus is on the modelling of how the markup and the marginal cost of production, $mkup_t^x$ and mc_t^x , move with exchange rates. The markup response is often interpreted as an indicator of changes in the competitive conditions confronting foreign exporters in the destination market. In this case, the correlation between import prices and nominal exchange rates is different from one, $\beta \neq 1$. Estimated pass through elasticities represent the summed effects of the unity translation effect on imports from the exchange rate movement, the response of markup to offset some of this translation effect, and any changes in marginal costs that are specifically attributable to exchange rate movements such as effects of imported inputs in production or wage sensitivity to exchange rates. Markup responsiveness will depend mainly on the market share of domestic producers relative to foreign producers, the form that competition takes place in the industry, and the extent of price discrimination possible in the industry. A general result in this literature is that a larger share of imports in total industry supply, a higher degree of price discrimination or a larger share of imported inputs in production in the destination country leads to higher predicted pass-through rates of exchange rates into import prices. Exchange rate pass-through may be higher if the exporters are large in number relative to the presence of local competitors.³ Exchange rate variability and local monetary volatility could also matter as exporters compete for market share, as discussed in

² In addition, the country superscript j has been dropped for simplicity.

Froot and Klemperer (1989): exchange rate pass-through may be lower when exporters try to maintain local market share, even if nominal exchange rate variability is high.

The second strand of literature embeds a more general-equilibrium approach, whereby prices are sticky in one currency, i.e. set in advance of the realization of the exchange rate by exporters. When prices are determined in the exporter's currency (producer currency pricing or PCP) exchange rate pass-through tends to be much larger than when prices are set in the importer's currency (local currency pricing or LCP). In the extreme case of a purely exogenous exchange rate shock, exchange rate pass-through would be one under producer currency pricing and zero under local currency pricing. As exemplified by the dialogue between Devereux and Engel (2001) and Corsetti and Pesenti (2005), the assumptions made on the currency of export pricing generate radically different conclusions on optimal monetary, fiscal and exchange rate policies. New models of international macroeconomics have imperfect competition and/or some form of price stickiness built in, as in Obstfeld and Rogoff (1995), Corsetti and Pesenti (2005), and Corsetti, Dedola, and Leduc (2004). These new micro-based open-economy general equilibrium models yield clear predictions for exchange rate behavior, and for pass-through into import prices as a function of the underlying shocks in the economy and given the assumed specific competitive structures of the industries involved.

Recent research in this area experiments with integrated production activities and the interplay between producers and distributors in the supply chain. Imperfect competition in the intermediate goods sector and the local component value added of the final price both dampen the pass-through of exchange rates into consumer prices. Corsetti and Dedola (2002) provide a model of optimal international price discrimination in a world with nominal wage rigidities and monopolistic competition in production, in which upstream firms differentially price goods to retailers in different locations. Bacchetta and van Wincoop (2003) expand upon the Dornbusch (1987) insights that a pass-through disconnect may be linked to the optimal pricing strategies of foreign exporting firms who sell intermediate inputs to domestic firms producing final goods. Empirical research attempts to

³ Dornbusch (1987). One approximation to this point is that pass-through elasticities might be inversely related to real GDP in the destination country. An alternative approach would be to also consider measures of sector-

quantify the importance of distribution margins for pass through and whether such margins are viewed as parameters, as in Burstein, Eichenbaum, and Rebelo (2002), or whether distributors also adjust such margins in response to exchange rate fluctuations, as in Campa and Goldberg (2005).

Most recently this literature has evolved into endogenously determining the choice for currency of denomination of exports.⁴ In much of this research, price stickiness remains an essential part of the model, but the decision by exporters to set prices in domestic or foreign currency is endogenous in the model. In so doing, exchange rate risk is considered ex ante and potentially optimally hedged. Engel (2005) and Goldberg and Tille (2005) show that optimal invoicing currency choice has a close analogue to optimally chosen rates of exchange rate pass through. Devereux and Engel (2001) and Devereux, Engel and Storgaard (2004) argue that in equilibrium, countries with low relative exchange rate variability and relatively stable monetary policies would have their currencies chosen for transaction invoicing. All else equal, exchange rate pass-through would be higher for importing countries with more volatile monetary policy.⁵

An alternative argument, emphasized by Bacchetta and van Wincoop (2002) and Goldberg and Tille (2005), is that – even in the context of these models – the role of macroeconomic variability in currency invoicing choices may be limited. The industry composition of trade, and in particular the dominance of trade in differentiated products, is needed for macroeconomic variability to drive invoice currency choices. If trade is largely in homogeneous or reference-priced goods, the role of macroeconomic variability in invoice currency choice is substantially damped. For these producers, the most important driver of invoice currency selection will be the need to have their goods priced in the same way as

specific openness for countries.

⁴ See for instance Bacchetta and van Wincoop (2002, 2003), Corsetti and Pesenti (2002) and Devereux, Engel, and Storgaard (2004) for examples in this literature of different ways to endogenize the pricing decision.

⁵ Engel (2005) shows that, with flexible prices, an industry structure that leads to the variability of prices in the exporter's currency being larger than the variability of prices in the importer's currency will also result in an equilibrium exchange rate pass-through greater than $\frac{1}{2}$. This same condition will imply in a sticky-price model that the producer will prefer producer currency pricing to local currency pricing in invoicing exports. Therefore, an economic setting with pass-through being less than $\frac{1}{2}$ arising from an imperfect competition setup with flexible prices could be observationally equivalent to a setting with local-currency-pricing, regardless of whether prices are sticky or not.

other competing producers price their products. This herding into a common invoicing currency will be more important than the volatility hedging motives emphasized elsewhere in the literature.

This discussion has focused mainly on the relationship between movements in exchange rates and import prices into an economy. Yet another important observation is that the degree of pass-through into aggregate price indexes is substantially smaller than into import prices [Campa and Goldberg (2005), Bachetta and van Wincoop (2003)]. Various explanations have been offered for these differences in the elasticity of prices to exchange rate changes. The most obvious, but still an incomplete explanation, is that tradable goods account for only a portion of consumption in the overall price indices. Burstein, Neves and Rebelo (2003), in considering the effects of large contractionary devaluations in developing countries, emphasize both the importance of distribution costs (transportation, wholesaling and retailing services) and the ability of consumers to substitute away from high quality imports toward lower quality domestically-produced goods. The distribution costs reduce the weight of the border price of imports in the aggregate CPI, since the imported goods ultimately consumed will contain value added from domestic distribution services.⁶ The substitutability implies that the weight of foreign products, and the overall quality mix of consumption, is responsive to exchange rate fluctuations. Moreover, distributors also can adjust the profit margin that they receive, thereby further dampening the real effects of exchange rates (Hellerstein, 2004). One only partially countervailing force arises through the use of imported inputs into production, which can introduce price sensitivity to exchange rates even among nontraded goods, as in Campa and Goldberg (2005).

Another explanation for the lack of CPI responsiveness hinges on a policy-reaction function by monetary authorities, as argued by Gagnon and Ihrig (2001) and Baily (2002). This line of research generates observed price insensitivity to exchange rates because an inflation shock arising through import prices due to domestic currency depreciation may trigger contractionary monetary policy. Thus, the prices of domestic non-traded goods will have to decline to offset the inflationary stimulus through traded goods prices. This research

makes the point that CPI unresponsiveness is not because of a lack of pass through of exchange rates into import or tradables prices. Rather, it is because central banks are so good at containing price pressures that they pursue policies that immediately insulate aggregate prices from these exchange rate induced pressures.

Overall, the degree of insensitivity of consumer prices to exchange rates still is unexplained, given the estimated sensitivity of import prices to exchange rates. This issue continues to receive attention from the research community. In our exploration of euro area issues below, however, we focus exclusively on import price sensitivity to exchange rates, leaving the aggregate CPI insensitivity issue to ongoing research.

III. Import Price Pass-through for the Euro Area

III.1 Introduction⁷

There have been large movements in exchange rates across euro area countries, with the euro strongly depreciating against the U.S. dollar in 1998 through 2001, and then appreciating between 2002 and 2004. As shown in Figure 1 which tracks both real and nominal exchange rates for the period through the end of 2004, these realignments were not just a nominal phenomenon. Indeed, such swings in currency values are not unique to this period, as they were a regular feature of legacy currency valuations relative to the U.S. dollar and baskets of currencies. Figure 2 shows the real effective exchange rates for sample legacy currencies – the German mark, the French franc, and the Italian lira – for the period 1985 through 1998. Cycles and sharp quarterly movements in exchange rates have occurred many times in recent histories.

⁶ Dornbusch (1987) argued that such distribution costs can help explain why comparable goods are more expensive in rich countries than in poor countries.

⁷ This section is based on the methodology used in Campa and Goldberg (forthcoming) and Campa and González-Mínguez (2005) and provides more updated estimates for the euro area.

Figure 1: Euros per dollar, 1998 through 2004

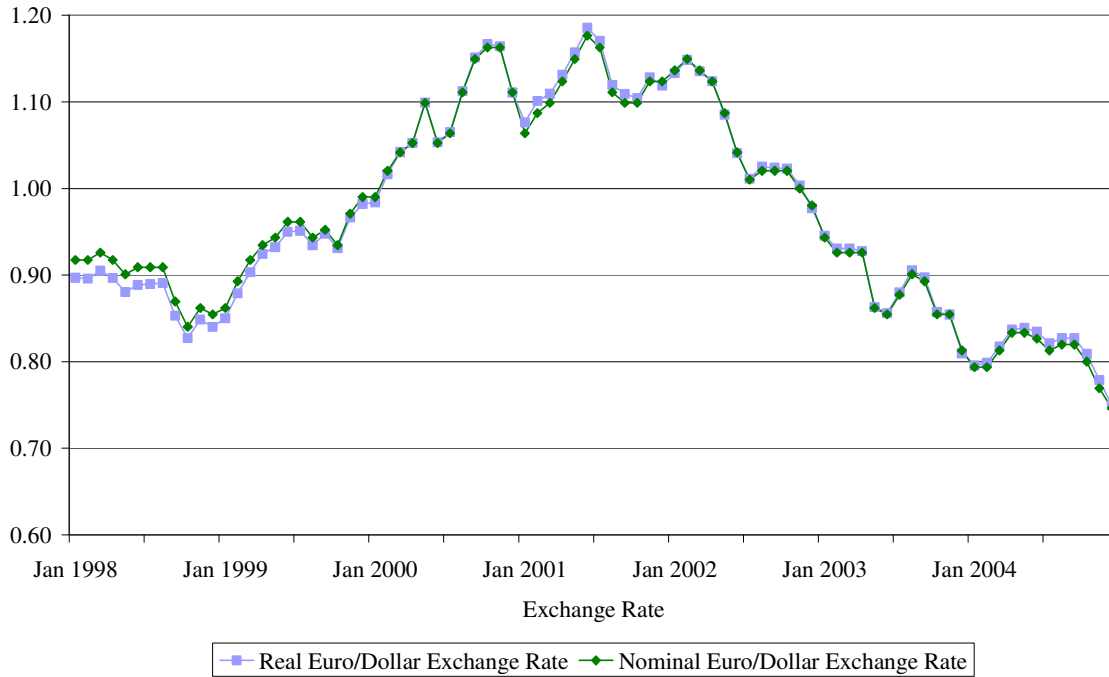
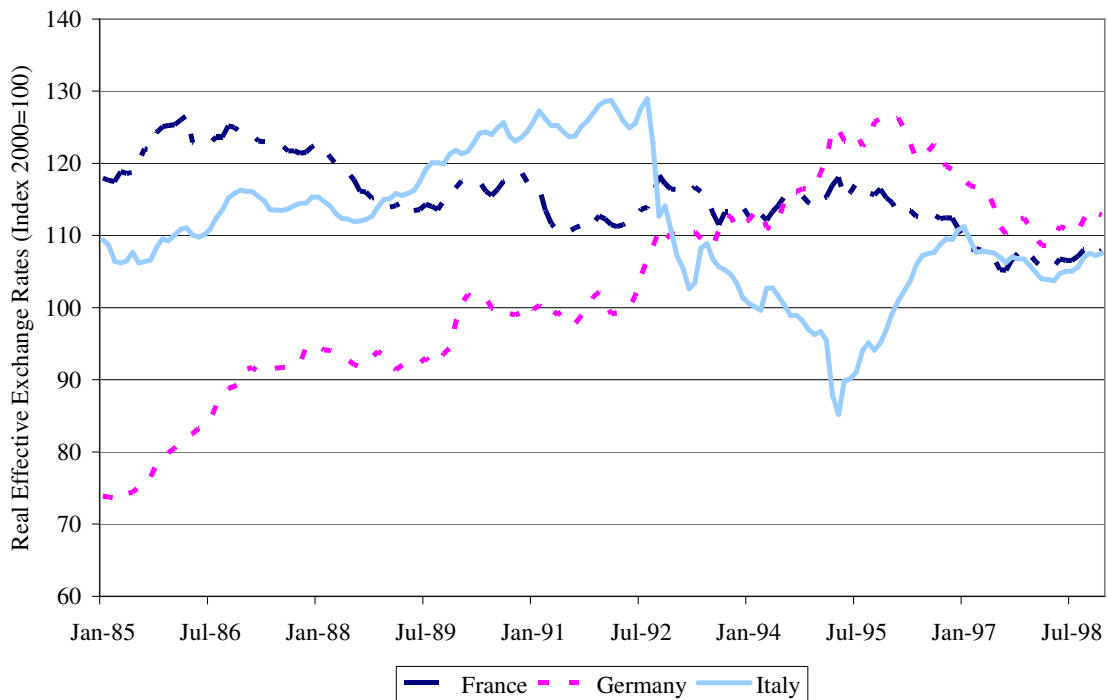


Figure 2: Real Effective Exchange Rates, 1985-1998



Such movements can put substantial pressures on producers and subsequently be reflected in pricing. In this section we explore these pricing consequences, estimating exchange rate pass-through into import prices for euro area countries (Austria, Belgium-Luxembourg, Finland, France, Germany, Greece, Ireland, Italy, Netherlands, Portugal and Spain). We use both aggregated and disaggregated data for this purpose. The aggregate import price data used for the analysis are monthly unit value indices for the period 1989:1 to 2004:5⁸. The disaggregated import price data for each country corresponds to the 1-digit level of disaggregation in the SITC classification for nine different industry categories⁹.

The aim in this exercise is twofold. First, we provide evidence on the degree of exchange rate pass-through observed and contrast these experiences across countries and product categories. Second, we explore the stability of the exchange rate pass-through (ERPT) relationships. Structural shifts in pass-through rates during the sample period could stem from the establishment of the euro or other environmental changes as motivated by the theoretical work surveyed in section II. We conclude the section by comparing our results with existing evidence on pass-through rates to import prices from other studies [Campa and González-Mínguez (2005) and Anderton (2003)], including from a wider sample of 23 OECD countries (Campa and Goldberg, forthcoming).

The methodology for estimation draws heavily on Campa and González-Mínguez (2005), whose results are updated here. That analysis obtains estimates of pass-through of exchange rate changes into the prices of imports made by countries from outside of the euro area for disaggregated product categories in each country of EMU. In the short run, pass-through rates are smaller than one and differ across industries and countries. In the long-run neither full pass-through nor equality of pass-through rates across industries and countries can be rejected. These findings corroborate ones for the broader group of OECD countries.

⁸ The source for this data is the database COMEXT produced by Eurostat. For Austria and Finland the import price series start only in 1995:1.

⁹ There are no data for category 9 (goods considered as “n.e.s.” or not elsewhere specified), which has a residual nature. The product disaggregation is as follows: 0. Food and live animals, 1. Beverages and tobacco, 2. Crude materials, inedible, 3. Mineral fuels, 4. Oils, fats and waxes, 5. Chemical products, 6. Basic manufactures, 7. Machines and transport equipment, 8. Miscellaneous manufactured goods.

The rest of this section is organised as follows. Section III.2 summarizes the estimation strategy and presents the results, comparing them with those in the existing literature. Section III.3 provides arguments for a structural shift in exchange rate pass through among euro area countries due to the creation of the monetary union. The section also reports statistical evidence on the existence of such a structural shift for euro area imports.

III.2. Empirical Estimation of Exchange Rate Pass Through into Import Prices.

Equation (2) expressed import prices as a function of exchange rates, exporter markups, and exporter marginal costs, forming the basis of our empirical implementation.

We start the implementation of the empirical set-up from equation [2] above:

$$p_t^m = \alpha_0 e_t + \alpha_1 mkup_t^x + \alpha_2 mc_t^x + \varepsilon_t \quad [3]$$

where ε_t is a regression residual, all variables are in logarithms. Pure currency translation effects generate the expectation of $\alpha_0 = 1$. The specification for markups and marginal costs determines if there are additional influences that would lead to exchange rate pass through at levels below one. As in the empirical work of Campa and Goldberg (forthcoming) or the theoretical analysis of Corsetti, Dedola and Leduc (2004), exporters operating in a given industry decide to what extent they pass-through exchange rate variations into their prices expressed in the importing country currency. These firms may decide that this pass-through is complete, in which case their mark-ups are insensitive to the exchange rate and producer currency pricing occurs. Alternatively, exporters may decide not to vary prices in terms of the destination currency, in which mark-ups fully absorb the exchange rate movements and local currency pricing occurs. Thus, mark-ups in the industry can be broken down into two components: an industry-specific fixed effect exogenous to exchange rate changes whose value depends on the specific structure of competition in each industry and a second component which is correlated with exchange rate movements:

$$mkup_t^x = \phi + \Phi e_t \quad [4]$$

in which case we expect $\phi > 0$ and $\Phi < 0$. An additional influence on import price sensitivity could enter through marginal costs, as earlier discussed in the context of imported inputs or commodity prices. We assume that exporters marginal costs of production are increasing as a positive function of demand conditions in the destination country, y_t , and of marginal costs of production (wages) in the exporting country, w_t^x , and commodity prices denoted in foreign currency cp_t^x . If commodity prices are determined in world markets (with invoicing typically in U.S. dollars) then commodity price effects on import prices may differ, since the wage changes may be exporter specific while commodity price changes could have effects common to the exporter and his competitors. This suggests specifying marginal costs as in (5) where the effect of exchange rates on marginal costs (including the effect on commodity prices) enters through the c_2 parameter and the residual commodity price effects enter through c_3 .

$$mc_t^x = c_0 y_t + c_1 w_t^x + c_2 e_t + c_3 cp_t^x \quad [5]$$

Substituting [4] and [5] into [3]:

$$p_t^m = \alpha_1 \phi + (\alpha_0 + \alpha_1 \Phi + \alpha_2 c_2) e_t + \alpha_2 c_0 y_t + \alpha_2 c_1 w_t^x + \alpha_2 c_3 cp_t^x + \varepsilon_t \quad [6]$$

where $\beta = \alpha_0 + \alpha_1 \Phi + \alpha_2 c_2$ is the pass-through rate¹⁰. In empirical specifications, one can allow for delayed effects of exchange rates and marginal costs on import prices by introducing a more dynamic specification, for example through also including lags on right hand side variables.

Equation [6] forms the basis of our empirical model. Empirical implementation requires specification of the appropriate proxy for foreign costs of production (w_t^x and cp_t^x) and the evolution of domestic demand. Campa and González Mínguez (2005) test for alternative specifications of the appropriate market to model pass-through into euro import prices. The cost of serving the domestic market is a function of the opportunity cost of

¹⁰ The exchange rate operating on commodity prices is likely to be a bilateral exchange rate relative to U.S. dollars, the currency used for pricing most commodities. In general, this choice may differ from the effective exchange rate appropriate for the marginal cost considerations, which is a weighting of exchange rates relative to export partners for a particular industry and country.

allocating those same goods to other customers. In markets integrated worldwide, this opportunity cost is reflected in the world price of the product, while in more segmented markets the opportunity cost may vary. For European markets, they conclude that the model that best describes the data is that of an integrated world market for the product. This implies that the appropriate measure proxy of the opportunity cost of exporting is the world market price of the product.

One obvious critique of equation (6) is the endogeneity of variables on both sides of the regression equation. Basic purchasing power parity and arbitrage arguments hold that import prices, exchange rates and foreign prices should be cointegrated, i.e. that a linear combination of these variables should be a stationary process. While hardly contestable on theoretical grounds, on empirical grounds we test the validity of the single equation approach of (6), and explore the possibility of specifying a vector error correction model accounting for a long-run cointegration relationship between import prices, exchange rates and foreign prices. Augmented Dickey Fuller tests on the original series (import unit values, exchange rates and foreign prices) revealed that the null hypothesis of a unit root could not be rejected for about two thirds of all series. Different specifications of the Johansen tests to check for the number of cointegrating vectors failed to reject the hypothesis of no cointegration for a large majority of industries¹¹. This evidence against the presence of a cointegrating relationship leads us to perform the analysis in a single equation framework without introducing biases in our associated parameter estimates.¹²

The empirical model estimated is:

$$\Delta p_t^{ij} = c^{ij} + \sum_{k=0}^4 a_k^{ij} \Delta e_t^{ij} + \sum_{k=0}^4 b_k^{ij} \Delta fp_t^{ij} + v_t^{ij} \quad [7]$$

¹¹ To be more precise we find that a cointegration relationship cannot be rejected in 34% of all combinations of import prices, exchange rates and foreign prices for the nine products and 11 countries in our sample. The cointegration tests were performed in a set-up in which the original series do not have a linear trend and the cointegration equations have intercepts. Lengthening and broadening the sample in comparison with Campa and González-Mínguez (2005) resulted in stronger evidence of cointegration, which in that case could not be rejected just for 14% of all instances.

¹² As a further robustness check, we perform the error correction models on the cases where cointegration could not be rejected. The resulting pass through parameter estimates were not qualitatively different even in these cases (see Table A in the Appendix).

where the superscripts i and j refer, respectively, to an importing country and to an industry. We denote as p_i^j the (log) import unit value index (denominated in local currency) of industry j in country i , $e_t^{i,j}$ is the nominal exchange rate for industry j of country i expressed in terms of units of domestic currency per unit of foreign currency. Finally, fp_i^j stands for the price index of products of industry j into country i in the countries of origin of these imports and expressed in foreign currency. The presumption is that pricing to market occurs at the level of industries and countries, in part in relation to local demand elasticities, as in Corsetti, Dedola and Leduc (2004). The US dollar price of the imports coming from outside the area is taken as the proxy for the foreign price and the bilateral exchange rate between the domestic currency and the US dollar is used as our exchange rate measure¹³. First differenced variables enter the equation in order to control for the possibility of nonstationarity, given the existence of unit roots in some of the time series variables contained in this specification. In the estimation of equation [7], we include a correction for first-order autocorrelation, given the existence of residual autocorrelation in many industries when estimating by OLS.

Estimation yields short-run (one month) and long-run (four months) pass-through elasticities for all the different industry/country combinations, where short-run exchange rate pass-through elasticities are given by the estimated coefficients a_0^j while long-run elasticities are defined as the sum of the pass-through coefficients for the contemporaneous exchange rate and its first four lags, i.e. $\sum_{k=0}^4 a_k^j$. There are two benchmarks of pass-through estimates that we will focus on: 1) zero pass-through, in which there is no reaction from exchange rate movements into import prices, sometimes interpreted as local currency pricing, and 2) complete pass-through, which is consistent with producers pricing exports in their own currency and sometimes called producer currency pricing. Two other sets of tests

¹³ Campa and González-Mínguez (2005) tested for alternative specifications of industry structure that may best describe these euro area markets, yielding the specification used here. It implies that international markets are integrated, meaning that there exists a single market for each product, regardless of its origin, destination or currency of denomination. This leads to select, as appropriate measures of the foreign price and the exchange rate, a proxy of the world price in a common currency and the bilateral exchange rate between the currency in which the foreign price is denominated and the home currency (as opposed to measures for the bilateral

are reported in this section. First, we estimate short-run and long-run pass-through elasticities when the restriction imposed is that these elasticities are the same for all industries within a given country. Second, we estimate while imposing the restriction that exchange rate pass-through rates are the same for a given industry across the eleven countries in the sample.

The results from these various procedures are reported in Table 1, which reports the point estimates for the unrestricted estimates and LCP and PCP tests, Table 2 which reports the tests of restrictions that elasticities are the same across all industries within a country, and Table 3 which reports the results under the restriction that industry elasticities are the same across euro area countries. Columns (3) to (6) in Tables 2 and 3 summarize in a more tractable way the results for all the different industry and country combinations contained in Table 1 by reporting summary statistics of the estimated short- and long-run elasticities for the different industries within a country (Table 2) and for the different countries given an industry (Table 3).

A number of strong results are generated. The main results can be summarized as follows. First, the transmission of exchange rate movements to import prices is incomplete in the short run defined as the month contemporaneous to the exchange rate movement. Unweighted average rates by country and by industry are, respectively, 0.66 and 0.56. The evidence that transmission is high, but incomplete, in the short-run is supported by the rejection *in all cases* of the hypothesis that the estimated elasticities in the first column in Tables 2 and 3 are one or zero¹⁴.

Second, in the long-run, average elasticities of transmission are larger than in the short-run, with values of around 0.8 across countries (column 2 both in Tables 2 and 3). More importantly, the hypothesis that the transmission is complete in the long run is rejected for a majority of countries and products. More precisely, this hypothesis is not supported by the data in 8 out of 11 economies and 6 out of 9 products. It is interesting to realize that those cases for which this hypothesis is not rejected coincide with economies

exchange rate and the foreign price which are contingent, for a given destination country, on the countries in which these imports originate).

¹⁴ The exception is Spain, for the hypothesis that ERPT is equal to one.

which have traditionally moved along a path of higher inflation (Italy, Portugal and Spain) and with industries in which commodity imports predominate, consistent with tendencies suggested *a priori* by theoretical models.

Third, the results of the tests of zero and full transmission when the same elasticity is imposed for all industries in each country, or for all countries in a given industry, are replicated quite closely when the pass-through coefficients are allowed to vary by country or by product (columns 3 into 6 in Tables 2 and 3). It is remarkable that only for one country (Austria) and for one industry (beverages and tobacco) full transmission in the long run is rejected in a majority of cases. The hypothesis that pass through is either zero or one in the short-run can be rejected for a vast majority of industries in most countries (Table 2, columns 3 and 4), as can the hypothesis that pass-through is zero in the long-run. The hypothesis that the pass-through is complete in the long-run can be rejected in less than one third of all industries in every country but Austria and France.

The last four columns in Table 3 show (as a counterpart to the columns in Table 2) that, in the short-run, the hypothesis that industry-specific pass-through is either zero or one is rejected for a vast majority of countries. In the long-run, zero pass-through is again rejected for most industries, but full pass-through is rejected in a minority of industries.

Finally, we perform tests for the equality of pass-through rates across countries and industries, both in the short and the long run (Table 4). In general, one can reject that ERPT rates in the short-run are equal for all industries within a given country and for a given industry across the eleven countries in our sample. In the long-run, the equality of the elasticities of transmission among the different industries of a country can be rejected only in the cases of Germany and Spain. The equality of industry pass-through across countries is rejected only in two of the nine industries: basic manufactures, and machinery and transport equipment. The latter result supports the idea that exporters price discriminate to a larger extent in manufacturing than in commodities, since these industries are more likely to show product differentiation and, thus, different degrees of pass-through in different countries. This finding is consistent with the theoretical predictions of Bacchetta and van Wincoop (2002) and Goldberg and Tille (2005).

The estimated pass-through elasticities reported here are in line with previous estimates reported in the literature. Campa and Goldberg (forthcoming) find elasticities of ERPT into aggregate import prices for a sample of 23 OECD countries which average 0.46 and 0.64 in the short and long run, respectively. The corresponding average elasticities for the ten euro area countries reported in this broader sample (all but Greece and Luxembourg) are, respectively, 0.47 and 0.70. These reported estimates of ERPT are slightly lower, but not significantly different from those reported here in Table 1 of 0.66 and 0.80 respectively. These latter estimates are the same as those reported in Campa and González-Mínguez (2005) for the same countries but shorter time period (1989:1 to 2001:3). The average unweighted elasticities for the euro area countries reported in that paper are 0.66 and 0.81 in the short and long run, respectively¹⁵. Anderton (2003), using a somewhat different approach, estimates an average long-run ERPT between 0.5 and 0.7 for the aggregate manufacturing sector in the euro area. This slightly lower estimate is not surprising given that the estimation explicitly excludes commodity industries for which pass-through rates are expected to be substantially larger.¹⁶

The difference between average elasticities reported here and the aggregate elasticities reported in Campa and Goldberg (forthcoming) highlight the importance of the different point estimates across importing industries and the importance of each industry in the aggregate imports of the countries. The weighted average pass-through elasticities for each country computed using the disaggregated industry elasticities reported in Table 2 are significantly lower. The average of these weighted elasticities for the 11 EU countries is 0.52 in the short-run and 0.72 in the long-run¹⁷. These weighted estimates are very close to the 0.47 (0.70) reported in Campa and Goldberg for the short-run (long-run) euro area countries in their sample. As that study demonstrated, pass-through elasticities differ by industry and estimates of aggregate pass-through elasticities are dependent on the industry structure of imports of each country.

¹⁵ The averages without Greece, in order to make comparable these figures with those in Campa and Goldberg (forthcoming) are 0.68 and 0.81, respectively.

¹⁶ Anderton (2003) focuses on a model of imperfect competition among euro and non-euro area producers in which foreign exporters to the euro area set their prices partly as a mark-up on their production costs (which represents the degree of ERPT) and partly holding them in line with those of their euro area competitors (pricing-to-market). The paper focuses on industries where imperfect competition may exist and thus chooses to exclude from the estimation commodity industries for which the law of one price is more likely to hold.

III.3. The euro and the stability of the exchange rate pass-through

The literature suggests several reasons why the rate of pass-through may have changed for the euro area members as a result of the introduction of the euro. Firstly, the process of monetary union has entailed some convergence of average inflation rates in euro area Member States towards the levels of countries with historically lower inflation. Since higher inflation levels and volatility contribute, theoretically, to higher exchange rate pass through, the countries that have experienced the largest declines in inflation and nominal volatility may have seen the largest reductions in pass through elasticities.

Secondly, EMU induced changes in the pattern of trade could influence exchange rate pass through into import prices. The creation of EMU has resulted in a higher proportion of trade being done in the common currency. Thus, a smaller proportion of industry output is exposed to the exchange rate fluctuations associated with trade with non-euro area countries. Some recent research suggests that the creation of EMU might have stimulated intra-area trade at the expense of that taking place with the rest of the world (Faruqee, 2004). Such trade diversion could have led to a change in the transmission of exchange rate movements to import prices by reducing the market power of exporters from outside the euro area. From a pure accounting perspective, the transmission of exchange rates into import prices would have declined as the proportion of final demand of the area satisfied with extra-EMU imports diminished. Likewise, the transmission from exchange rates to import prices is lower the larger the share of imports denominated in local currency. To the extent that the creation of a large-scale monetary union, such as the EMU, has favoured an expansion of the euro as a currency of denomination of its external trade, ERPT rates to import prices would have tended to reduce. The European Central Bank (2005) reports that the proportion of extra-euro trade denominated in euro has increased for all EU members. This change in currency invoicing is particularly apparent with respect to former accession countries like Poland and Estonia. We discuss each of these arguments in more detail.

¹⁷ For these calculations we have used the import share for each industry in 1998.

III.3.1. Convergence in inflation rates.

As previously indicated, one of the reasons for differences across countries in ERPT has been the inflation history of the country. Those countries which are currently members of EMU and which experienced higher nominal inflation and larger exchange rate depreciations during the eighties and nineties had larger ERPT rates, especially in the short-run. To the extent that these countries share now the same currency, it could be the case that the differences among their short-run pass-through rates have tended to attenuate. In order to explore this hypothesis, we performed separate estimations for two subperiods (1989:01 to 1997:12 and 1998:1 to 2004:5) and then correlated the change in average inflation between the two periods for each country with the change in the ERPT. The results of this exercise show that changes in both variables are basically uncorrelated¹⁸. The correlation across countries between changes in average short-term (long-term) pass-through rate and changes in inflation were -0.34 (-0.09). This is a crude exploration that neither takes into account the significance in the estimated changes in pass-through nor introduces other control variables. Nevertheless, the results are consistent with changing inflation regimes not being a primary driver of changes in rates of exchange rate pass-through into import prices.

III.3.2. Changes in the share of extra-EMU imports

The introduction of the single European currency has resulted in a change in the respective shares of trade exposed to exchange rate fluctuations. Trade conducted among EMU economies is increasingly done in the same currency, although evidence on the pervasiveness of this phenomenon across manufactured goods versus commodities is largely lacking. Furthermore, the elimination of the risk associated to the fluctuations in nominal exchange rates in intra-EMU flows or the reduction in transaction costs suggest that monetary union might have stimulated trade among EA Member States at the expense of trade with non-EMU countries (*trade diversion*), or even net of any diversion effect. For instance, small-sized firms for which the existence of the transaction costs associated with multiple currencies posed barriers to their participation in international trade might have

¹⁸ The selection of 1997:12 as the break point between subsamples is somewhat arbitrary. Disinflation was a common feature in current euro area members since 1996. This was not only the result of policies in inflation-

decided to enter euro-area markets after the beginning of EMU (*trade creation*). A lower share of foreign currency imports in total industry supply should lead to higher pass-through rates.

Evidence accumulated since the inception of the euro does not show extensive changes in the composition of import flows into the area according to the country of origin (Faruqee, 2004). Indeed, observed changes seem to run in the opposite direction. In particular, as shown in Chart 1 the share of imports coming from outside the area has increased in seven of the eleven Member States, whether measured as a proportion of total imports or a proportion of GDP by country¹⁹. The ratio of extra-EMU imports to GDP has increased in all Member States except Ireland and, to a lesser extent, Portugal.

Even if the total share of imports coming from the rest of the world into the euro area has not changed significantly, changes in the product composition of those flows could have occurred. In this way, if transmission elasticities from exchange rate variations into import prices were to differ substantially by product categories, possible modifications in the structure of imported goods since the start of EMU might significantly alter overall ERPT rates as observed for the broader OECD countries since the 1970s. While possible, Chart 2 demonstrates that the size of such variations in the structure of imports according to the type of product has been relatively limited since the start of EMU. In particular, the shares of energy products and, to a lesser extent, machinery and transport equipment within total imports have increased, while those of food, other commodities and basic manufactures have declined.

III.3.3. The currency of price denomination in international trade.

Engel (2005) and Goldberg and Tille (2005) show that there is a direct mapping between the determinants of the currency of denomination of international trade and those of exchange rate pass through rates. Within the euro area, if foreign exporters tend to fix their prices in their own currency, the degree of transmission of exchange rate movements into the prices in euros will be high. If, alternatively, extra-EMU exporters tend to fix their

prone countries as a result of efforts to fulfill the corresponding convergence criterion, but also a more general phenomenon related to the negative oil price shock at the time.

prices in euros, a relatively reduced transmission of exchange rate movements into euro area prices and activity will be observed. There are two key factors explaining the currency in which exporters fix their prices: hedging exchange rate and cost volatility, and the degree of market competition or elasticity of substitution in foreign demand for an exporter's goods which influences a producer's willingness to deviate from the invoicing patterns of the rest of his competitors. Based on Goldberg and Tille (2005) and Bacchetta and van Wincoop (2002), the choice of invoice currency is expected to differ across industries, even in trade transactions between common partner countries. The role of macroeconomic variability will matter most for invoice currency selection among producers of goods facing low elasticities of substitution. Macro variability will not be important for transactions in commodities or highly substitutable products, which may even choose a vehicle currency for their transactions. Within a monetary union, the relevant market shares are not those of domestic and foreign producers within each country, but those of producers of all countries sharing the same currency and of the exporters from the rest of the world. Thus, the larger the area of influence of a given currency, the larger the share of foreign trade denominated in that currency. For this reason, the creation of EMU likely resulted in a larger proportion of imports denominated in euro within total imports in comparison with the joint share of the euro area constituent currencies. This argument would be particularly relevant for producers of differentiated goods, since producers of commodities priced in world markets in dollars may continue this pricing standard, even with the advent of the euro.

Existing evidence regarding the use of the euro as the currency of denomination of international trade is incomplete. Since the beginning of EMU, data shown in Table 5 point to an increase in the share of imports coming from (and share of exports going to) outside the area with prices denominated in euros. An increased use of the euro as the currency of denomination has been observed in trade in both goods and services²⁰. This finding is consistent with an expectation of lower exchange rate pass through into EMU country import prices.

¹⁹ Belgium and Luxembourg are treated as a single country in this data.

²⁰ In the case of France, a decrease was recorded between 2002 and 2003 in the shares of euro-denominated imports of both goods and services and euro-denominated exports of goods.

It is useful to note, however, that the creation of EMU may have had different effects on different industries. In commodity markets and for “reference priced goods”, goods with a large degree of homogeneity are traded. For these goods, a single world market exists, in which imports into the area are denominated neither in euros nor in the exporters' currency, but usually in dollars (Goldberg and Tille, 2005). These markets are characterised by the fact that the location of buyers and sellers is irrelevant as far as the price of transactions is concerned. In this case, it is unlikely that the creation of EMU has caused, so far, relevant changes in invoicing patterns. Consequently, reductions in exchange rate pass through into import prices in EMU countries might be more a feature of differentiated goods than it is of highly substitutable goods.

III.3.4 Evidence on the existence of a structural break

To determine whether evidence exists that a break took place around the time of the decision to fix permanently the exchange rates among the euro countries, we perform tests on the time stability of the estimated pass-through elasticities. Alternatively, a break might have occurred with the actual adoption of the euro among these countries. We perform two types of tests for the time stability of the estimated parameters. First, we follow the approach by Andrews (1993) and Andrews and Ploberger (1994) to detect endogenously structural changes in the pass-through relationship assuming that the break point is unknown. This procedure essentially searches for the strongest break point any time during the sample period. It is an appropriate test mainly to the extent that structural breaks in the data are large and discrete (Elliott and Muller 2005). For each estimation (i.e. for every pair-wise combination of country and industry), we perform two tests of structural breaks: a test that the contemporaneous coefficient on the exchange rate is stable (i.e. that short-run pass-through is stable) and a test that the sum of all coefficients on the exchange rate is stable (i.e. that there is a structural break in long-run pass-through).

We find little evidence in favour of the existence of a (statistically significant) structural break in the transmission of exchange rate movements into import prices across euro area countries. Table 6 reports those instances in which the null hypothesis of no structural break is rejected. In those instances, the p-value of the tests appears in parenthesis

and the suggested break date is reported in italics. An empty cell means that, for that combination of product and country, the hypothesis of absence of a structural break cannot be rejected either in the short or the long run. There is very little evidence in favour of the alternative hypothesis that the transmission is not stable (7 out of 198 cases). This evidence is concentrated in the estimated long-run elasticities. Only two of the identified structural breaks took place around the dates of the creation of the euro (Oils, fats and waxes in the Netherlands, and Mineral fuels in Finland). The two breaks detected in the case of Ireland might be linked to pricing policies of British exports after the sterling left the ERM. For the remaining instances, it is more difficult to find any plausible explanation.

Given the low power of the Andrew and Ploberger tests in small samples, and the large confidence intervals around indicated structural break points (Elliott and Muller, 2005), we also perform Chow tests of the hypothesis that a structural break took place at the time of the adoption of the euro. We select May 1998, the month on which the parities among currencies replaced by the euro were announced, as the date for the break. The white cells in Table 6 represent those combinations of industry and country for which this test rejects the stability of transmission rates, both in the short and the long-run.

The Chow test results do not systematically reject the hypothesis of stability of rates of transmission of exchange rates into European import prices. The test rejects stability, in the short-run, for 20 out of the 99 combinations of industry and country. Stability is rejected more frequently among manufacturing industries (Basic manufactures, Machinery and transport equipment, and Other manufactures), which is consistent with the expectation that changes in ERPT should be rather expected in industries producing differentiated goods. Across countries, the stability is rejected more frequently (in three or four industries) for the countries which composed the core of the EMS (France, Germany, Belgium-Luxembourg and the Netherlands). As far as long-term elasticities are concerned, the stability of the relationship can only be rejected in 6 out of 99 cases. This is, approximately, what should be statistically expected at a 5% confidence level. Jointly considered, this evidence suggests that a significant change in transmission rates has not taken place as a result of the introduction of the euro. Tendencies toward instability are more prevalent within manufactured goods.

The results reported in Table 6 do not provide evidence on whether this change in pass-through has implied an increase or a decline in pass-through rates. The point estimates strongly suggest that a decline in pass-through rates may be taking place. Estimated short-run (long-run) pass-through rates were lower in the post-euro period for 69 (61) out of 99 cases. This evidence would be consistent with the arguments put forward in Section III.3 of a decline in pass-through. As discussed above, this evidence is not statistically significant in most cases. What is more revealing is that the change in pass through is negative in all but one of the instances where the Chow test rejects stability²¹.

IV. Conclusions

This paper has performed an empirical analysis of transmission rates from exchange rate movements to import prices of the countries in EMU. The paper has estimated short and long-run elasticities for all euro countries, allowing them to change according to the type of product imported. The results obtained confirm that this transmission is high, although incomplete, in the short-run, and different across industries and countries. Long-run elasticities are higher, although estimated elasticities are still lower than unity, except for the traditionally more inflationary economies and for commodities. In general, the equality of pass-through elasticities among the different industries in each country or for the different countries given an industry cannot be rejected in the long-run.

One of the aims of this chapter has been to evaluate to what extent the start of the monetary union has implied a structural break in the transmission of exchange rate movements in the currencies of Member States to their import prices. Several reasons point towards the possibility that a change might have taken place. These reasons include the move to an environment characterised by higher macroeconomic stability and lower inflation rates for several Member States, a hypothetical increase in the share of intra-EMU trade at the expense of trade with countries outside the euro area, possible modifications in the competitive structure of the markets for tradable products, and the impact that the creation of the euro might have had on the currency of denomination of imports coming

²¹ More precisely, in the short-run, in 19 out of the 20 cases for which the pass-through rate is significantly different between both periods, point estimates indicate a reduction in pass-through. This is also the case for 5 of the 6 statistically significant changes in long-run pass-through.

from the rest of the world. Some of these factors may be occurring. Average inflation rates have declined, and the share of trade in goods and services against third countries whose prices are fixed in euros has increased substantially for all Member countries. The evidence is not so clear for other predictions. The creation of the euro has not implied a decline in the share of extra-EMU imports within total imports.

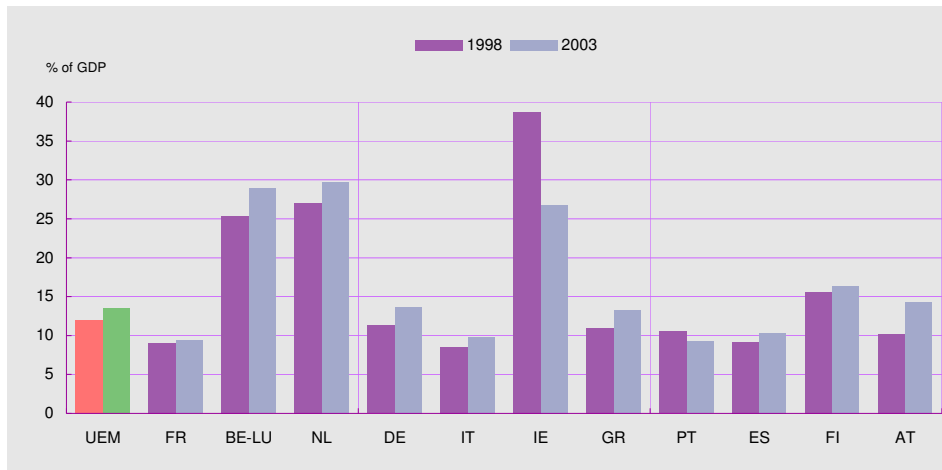
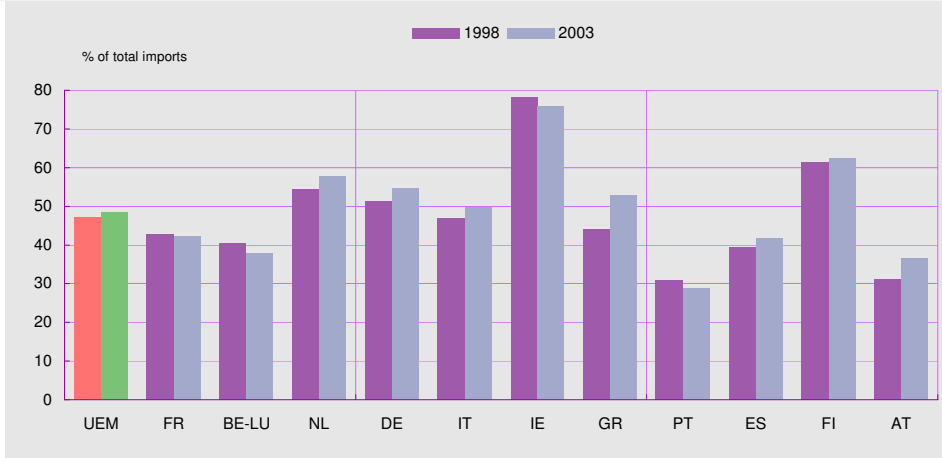
We have tested for structural changes in pass-through rates since the introduction of the euro. There is an apparent decline in the estimated point elasticities for two-thirds of the industries. However, this evidence is not statistically significant. At this point, we find that there is a statistically significant trend towards lower pass-through rates for manufacturing industries. Tests for structural break are known to have very low power, especially in short samples like the recent history of the creation of the euro. A wider decline in pass-through may be taking place, but it is too early to ascertain whether this change is taking place and too early to determine the structural explanations for such declines. Exchange rate changes continue to lead to large changes in import prices across euro area countries. While pass through is clearly incomplete, on average it remains more than 60 percent one quarter after exchange rate moves and 80 percent over the course of a year.

References:

- Andrews, D.W.K., 1993, "Tests for Parameter Instability and Structural Change With Unknown Change Point," *Econometrica* 61, pp. 821-856.
- Andrews, D.W. K. and W. Ploberger, 1994, "Optimal Tests When a Nuisance Parameter Is Present Only Under the Alternative", *Econometrica* 62, pp. 1383-1414.
- Anderton, Robert. 2003. "Extra-euro area manufacturing import prices and exchange rate pass-through", ECB working paper no. 219 March 2003.
- Bacchetta, Philippe, and Eric van Wincoop, 2002, "A Theory of the Currency Denomination of International Trade," National Bureau of Economic Research, working paper no. 9039. *Journal of International Economics*, forthcoming.
- Bacchetta, Philippe, and Eric van Wincoop, 2003, "Why Do Consumer Prices React Less Than Import Prices to Exchange Rates," *Journal of the European Economics Association* 1, 662-670.
- Baily, Martin N. 2002. "Persistent Dollar Swings and the US Economy." In *Dollar Overvaluation and the World Economy*, eds. C. Fred Bergsten and John Williamson. Washington: Institute for International Economics.
- Burstein, Ariel, Martin Eichenbaum, and Sergio Rebelo. 2002. "Why are Rates of Inflation so low after large devaluations?" NBER working paper #8748 (February).
- Burstein, Ariel, Joao Neves, and Sergio Rebelo (2003), "Distribution costs and real exchange rate dynamics during exchange rate based stabilisations", *Journal of Monetary Economics* 50, 1189-1214.
- Campa, Jose and Linda Goldberg, 2005. "Distribution Margins, Imported Inputs, and the Insensitivity of the CPI to Exchange Rates" manuscript.
- Campa, Jose and Linda Goldberg. Forthcoming. "Exchange Rate Pass Through into Import Prices." NBER working paper 8934. *Review of Economics and Statistics*.
- Campa, Jose and J.M. González-Mínguez, 2005, "Differences in Exchange Rate Pass-Through in the Euro Area", *European Economic Review*, forthcoming.
- Corsetti, Giancarlo and Luca Dedola. 2002. "Macroeconomics of International Price Discrimination". European Central Bank working paper no. 176.
- Corsetti, Giancarlo, Luca Dedola, and Sylvain Leduc. 2004. "Pass Through and Exchange Rate Fluctuations in a DGSE model of price discrimination". Manuscript.

- Corsetti, Giancarlo, and Pesenti, Paolo. 2005. "International Dimensions of Optimal Monetary Policy." *Journal of Monetary Economics*, Vol. 52, no. 2, pp. 281-305.
- Devereux, Michael, 2001, Monetary Policy, Exchange Rate Flexibility and Exchange Rate Pass-through. In *Revisiting the Case for Flexible Exchange Rates* (Bank of Canada) 47-82.
- Devereux, Michael and Charles Engel. 2001. "Endogenous Currency of Price Setting in a Dynamic Open Economy Model". NBER working paper no. 8559.
- Devereux, Michael, Charles Engel, and Peter Storgaard. 2004. "Endogenous exchange rate pass-through when nominal prices are set in advance" *Journal of International Economics*, Vol. 63, no. 2, July, pp. 263-291.
- Dornbusch, R., 1987. "Exchange Rates and Prices", *American Economic Review* 77, 93-106.
- Elliott, Graham and Ulrich Muller. 2005. Confidence Sets for the Date of a Single Break in Linear Time Series Regressions. Manuscript, Princeton University.
- Engel, Charles. 2005. "Equivalence Results for Optimal Pass-Through, Optimal Indexing to Exchange Rates, and Optimal Choice of Currency for Export Pricing." NBER working paper no. 11209
- European Central Bank. 2003. *Review of the international role of the euro*, December.
- European Central Bank. 2005. *Review of the international role of the euro*, January.
- Faruqee. Hamid, 2004, "Measuring the Trade Effects of the EMU," International Monetary Fund Working Paper WP/04/154.
- Froot, Ken and Paul Klemperer. 1989. "Exchange Rate Pass-Through When Market Share Matters," *American Economic Review* (September), 637-54.
- Gagnon, Joseph and Jane Ihrig. 2001. "Monetary Policy and Exchange Rate Pass-Through." Board of Governors of the Federal Reserve System, International Finance Discussion Papers #704 (July).
- Giovannini, Alberto. 1988. "Exchange Rates and Traded Goods Prices," *Journal of International Economics* vol.24, pp.45-68.
- Goldberg, Pinelopi and Michael Knetter, 1997, "Goods Prices and Exchange Rates: What Have We Learned?", *Journal of Economic Literature*, vol. 35, 1243-92.
- Goldberg, Linda and Cédric Tille. 2005. "Vehicle Currency Use in International Trade", NBER working paper 11127, February.

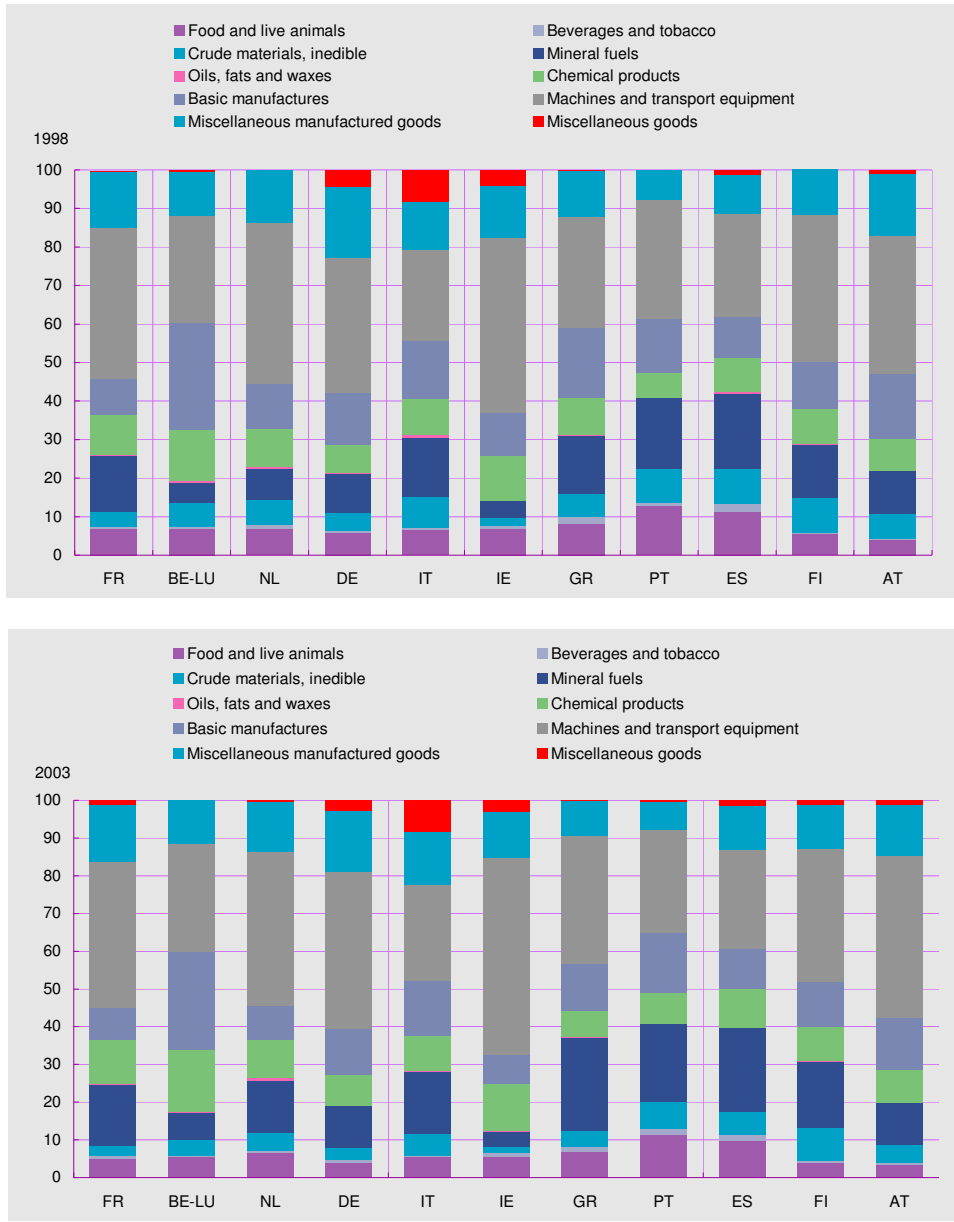
- Hellerstein, Rebecca. 2004. "Who Bears the Cost of a Change in the Exchange Rate? The Case of Imported Beer." Staff Reports no. 179 (February), Federal Reserve Bank of New York.
- Marazzi, Mario, Nathan Sheets, Robert Vigfusson, Jon Faust, Joseph Gagnon, Robert Martin, Jaime Márquez, Trevor Reeve, and John Rogers. 2005. "Exchange Rate Pass-through to U.S. Import Prices: Some New Evidence", International Finance Discussion Papers no. 833 (April), Federal Reserve Board of Governors.
- Marston, Richard. 1990. "Pricing to Market in Japanese Manufacturing." *Journal of International Economics*. Vol. 29, 217-36.
- Obstfeld, Maurice, and Kenneth Rogoff. 1995. "Exchange Rate Dynamics Redux," *Journal of Political Economy* 103, 624-60.
- Taylor, John B. 2000. "Low Inflation, Pass-Through, and the Pricing Power of Firms." *European Economic Review*, June volume 44 issue 7, 1389-1408.



SOURCES: Eurostat and national statistics.

COMPOSITION BY PRODUCT OF EXTRA-EMU IMPORTS OF GOODS

CHART 2



SOURCE: Eurostat.

Table 1 ELASTICITIES OF EXCHANGE RATE PASS-THROUGH INTO IMPORT PRICES IN THE SHORT- RUN AND LONG-RUN

Country Industry		France	Belgium – Luxembourg	Netherlands	Germany	Italy	Ireland	Greece	Portugal	Spain	Finland	Austria	Pool
0	SHORT RUN	0.72 *+	0.61 *+	0.55 *+	0.60 *+	0.49 *+	0.22 +	0.28 +	1.12 *	0.58 *+	0.48 *+	0.32 **+	0.54*+
	LONG RUN	0.73 *+	0.98 *	0.85 *	0.96 *	0.89 *	0.43 *	0.55 +	0.57	1.02 *	0.87 *	0.77 *	0.78*+
1	SHORT RUN	0.23 +	0.44 *+	0.21 +	0.15 *+	0.70+	0.16 +	0.78 **	0.52 *++	2.47 *+	0.19 +	0.51 **++	0.56*+
	LONG RUN	0.37 +	0.55 *+	0.33 **+	0.26 *+	0.85 *	-0.08 +	0.50	0.78 *	2.15 *+	0.17 +	0.46	0.64*+
2	SHORT RUN	0.73 *+	0.92 *	0.65 *+	0.65 *+	0.58 *+	0.35 *+	0.07 +	0.69 *+	0.78 *+	0.57 *+	0.43 *+	0.57*+
	LONG RUN	1.03 *	1.07 *	0.85 *	0.87 *	1.06 *	0.81 *	0.73 *	0.94 *	1.09 *	0.82 *	0.71 *+	0.93*
3	SHORT RUN	1.07 *	0.60 *+	1.26 *+	0.83 *+	0.92 *	0.64 *	0.68	0.81 *	0.77 *+	0.98 *	0.57 *+	0.85*+
	LONG RUN	1.12 *	0.93 *	0.84 *	0.94 *	1.03 *	1.10 *	1.52 *	0.89 *	1.08 *	0.97 *	0.71 *+	1.02*
4	SHORT RUN	0.88 *	0.52 *+	0.78 *++	0.62 *+	0.49 *+	0.24 +	0.82 *	0.54	1.18 *	0.63 *	0.22 +	0.64*+
	LONG RUN	0.83 *	0.74 *	1.06 *	0.88 *	0.98 *	0.46	0.75	1.08 *	1.00 *	0.39	0.43	0.84*
5	SHORT RUN	0.61 *+	0.72 *+	0.58 *+	0.97 *	0.85 *	1.25 *	-0.42 +	0.58 **	0.48 *+	0.43 *+	0.50 *+	0.62*+
	LONG RUN	0.85 *	1.03 *	0.74 *	1.09 *	0.94 *	0.97	0.48	0.18	0.78 +	0.76 *	0.62	0.78*+
6	SHORT RUN	0.58 *+	0.62 *+	0.71 *+	0.42 *+	0.56 *+	0.61 *+	0.35 **+	0.36 *+	0.51 *+	0.24 *+	0.31 *+	0.50*+
	LONG RUN	0.89 *	0.97 *	1.11 *	0.73 *+	1.07 *	0.58 *+	0.85 *	0.94 *	0.98 *	0.66 *+	0.56 *+	0.87*+
7	SHORT RUN	0.60 *+	0.46 *+	0.91 *	0.58 *+	0.56 *+	1.04 *	0.04 +	0.22 **+	0.36 *+	0.34 *+	0.14 +	0.51*+
	LONG RUN	0.58 *+	0.92 *	1.07 *	0.81 *	0.99 *	1.26 *	0.18 +	0.65 *++	0.75 *+	0.76 *	0.04 +	0.76*+
8	SHORT RUN	0.62 *+	0.60 *+	0.76 *+	0.60 *+	0.65 *+	0.51 *+	0.08 +	0.58 *	0.58 *+	0.18 *+	0.23 *+	0.50*+
	LONG RUN	0.62 *+	0.84 *	1.02 *	0.74 *+	0.84 *	0.55	0.19 +	0.91 *	0.76 *	0.39 *+	0.23 +	0.64*+

*(**) the null hypothesis $H_0 : a_0 = 0$ (short run) or $\sum_{i=0}^4 a_i = 0$ (long run) is rejected at 95% (90%) level. +(+++) the null hypothesis $H_0 : a_0 = 1$ or $\sum_{i=0}^4 a_i = 1$ is rejected at 95% (90%) level.

The product disaggregation is as follows: 0. Food and live animals, 1. Beverages and tobacco, 2. Crude materials, inedible, 3. Mineral fuels, 4. Oils, fats and waxes, 5. Chemical products, 6. Basic manufactures, 7. Machines and transport equipment, 8. Miscellaneous manufactured goods.

Table 2 DIFFERENCES IN RATES OF EXCHANGE RATE PASS-THROUGH INTO IMPORT PRICES BY COUNTRY

Country	Pass-through rates by country		Percentage of total industries for which the specified hypothesis can be rejected (a)			
	(1) Short-run	(2) Long-run	Short-run		Long-run	
			(3) Pass-through rate is zero	(4) Pass-through rate is one	(5) Pass-through rate is zero	(6) Pass-through rate is one
France	0.77 *+	0.79 *+	0.89	0.78	0.89	0.44
Belgium-Luxembourg	0.58 *+	0.83 *+	1.00	0.89	1.00	0.11
Netherlands	0.76 *+	0.79 *+	0.89	0.89	1.00	0.11
Germany	0.63 *+	0.75 *+	1.00	0.89	1.00	0.33
Italy	0.69 *+	0.94 *	0.89	0.78	1.00	0.00
Ireland	0.50 *+	0.56 *+	0.67	0.67	0.56	0.22
Greece	0.47 *+	0.78 *+	0.33	0.67	0.33	0.33
Portugal	0.80 *+	0.82 *	0.89	0.44	0.78	0.11
Spain (b)	0.81 *	1.04 *	1.00	0.88	0.88	0.25
Finland	0.75 *+	0.77 *+	0.89	0.78	0.78	0.33
Austria	0.54 *+	0.77 *+	0.78	1.00	0.44	0.56
Average	0.66	0.81				

Sources: Eurostat (Comext database) and own calculations.

(a) The total number of industries is 9.

(b) Excluding Beverages and tobacco.

*/+ :It can be statistically rejected at 5% level that the pass-through rate is zero/one.

Table 3 DIFFERENCES IN RATES OF EXCHANGE RATE PASS-THROUGH INTO IMPORT PRICES BY INDUSTRY

Industry	Pass-through rates by industry		Percentage of countries for which the specified hypothesis can be rejected (a)			
	(1) Short-run	(2) Long-run	Short-run		Long-run	
			(3) Pass-through rate is zero	(4) Pass-through rate is one	(5) Pass-through rate is zero	(6) Pass-through rate is one
Food and live animals	0.54 *+	0.78 *+	0.82	0.91	0.82	0.18
Beverages and tobacco (b)	0.31 *+	0.44 *+	0.50	0.90	0.50	0.60
Crude material, inedible	0.57 *+	0.93 *	0.91	0.91	1.00	0.09
Mineral fuels	0.85 *+	1.02 *	0.91	0.45	1.00	0.09
Oils, fats and waxes	0.64 *+	0.84 *	0.73	0.55	0.64	0.00
Chemical products	0.62 *+	0.78 *+	0.91	0.64	0.64	0.09
Basic manufactures	0.50 *+	0.87 *+	1.00	1.00	1.00	0.36
Machines and transport equipment	0.51 *+	0.76 *+	0.82	0.82	0.82	0.36
Miscellaneous manufactured goods	0.50 *+	0.64 *+	0.91	0.91	0.73	0.45
Average	0.56	0.79				

Sources: Eurostat (Comext database) and own calculations.

(a) The total number of countries is 11.

(b) Excluding Spain.

*/+ :It can be statistically rejected at 5% level that the pass-through rate is zero/one.

Table 4 TEST OF THE EQUALITY OF SHORT AND LONG-RUN PASS-THROUGH ESTIMATES (P-values)

This table reports the p-values from a test of the restrictions that the estimated short-run and long-run pass-through elasticities are the same for all industries within each country (left panel) and that they are constant for a given industry in the eleven countries in the sample (right panel).

COUNTRY	EQUALITY ACROSS INDUSTRIES WITHIN EACH COUNTRY	
	SHORT RUN	LONG RUN
France	0.00	0.11
Belgium-Luxembourg	0.43	0.39
Netherlands	0.00	0.45
Germany	0.00	0.00
Italy	0.00	0.98
Ireland	0.01	0.08
Greece	0.19	0.45
Portugal	0.47	0.86
Spain	0.00	0.00
Finland	0.00	0.40
Austria	0.72	0.78
% of rejections (at 5% level)	63.6%	18.2%

INDUSTRY	EQUALITY ACROSS COUNTRIES WITHIN EACH INDUSTRY	
	SHORT RUN	LONG RUN
0. Food and live animals	0.00	0.28
1. Beverages and tobacco	0.54	0.52
2. Crude material, inedible	0.00	0.52
3. Mineral fuel	0.13	0.83
4. Oils, fats and waxes	0.21	0.89
5. Chemical products	0.00	0.73
6. Basic manufactures	0.02	0.02
7. Machines and transport equipment	0.00	0.02
8. Miscellaneous manufactured goods	0.04	0.20
% of rejections (at 5% level)	66.7%	22.2%

**Table 5 SHARE OF THE EURO AS THE CURRENCY OF DENOMINATION OF EMU TRADE WITH THE REST OF THE WORLD
(As a % of the total) (a)**

	IMPORTS								EXPORTS							
	Goods				Services				Goods				Services			
	2000	2001	2002	2003	2000	2001	2002	2003	2000	2001	2002	2003	2000	2001	2002	2003
Belgium (b)	43.6	47.2	53.6	57.0	44.4	44.4	57.7	64.3	42.0	46.7	53.5	55.3	45.4	-	55.5	64.4
France	35.0	39.8	46.8	45.1	47.6	54.6	54.7	51.7	48.0	49.2	55.3	52.4	57.3	60.4	56.9	57.9
Germany	-	-	48.0	55.2	-	-	-	-	-	-	49.0	63.0	-	-	-	-
Greece	-	29.3	35.8	39.6	-	15.3	16.8	20.1	-	23.5	39.3	47.3	-	11.3	13.3	16.3
Italy	-	40.8	44.2	44.5	-	49.9	56.1	62.9	-	52.7	54.1	58.2	-	50.7	57.0	62.1
Luxembourg	-	-	35.3	41.7	-	-	28.5	36.0	-	-	51.5	52.7	-	-	40.4	43.0
Portugal	47.0	53.6	57.5	60.2	53.7	55.6	58.3	64.3	40.1	43.5	48.4	54.6	37.4	37.4	44.1	48.6
Spain	44.0	49.7	55.8	60.3	42.4	45.3	49.4	54.6	49.0	52.0	57.5	60.8	50.5	52.9	59.5	63.8

Source: ECB (2003 and 2005).

(a) Data refer to the use of the euro as a settlement currency, except for Germany (invoicing currency).

(b) Data for 2000 and 2001 for Belgium refer to Belgium and Luxembourg.

Table 6 STRUCTURAL BREAK TESTS (a)

Product Country	0 Food and live animals	1 Beverages and tobacco	2 Crude materials, inedible	3 Mineral fuels	4 Oils, fats and waxes	5 Chemical products	6 Basic manufactures	7 Machines and transport equipment	8 Miscellaneous manufactured Goods
France	SR-C						SR-C	SR-C	SR-C
Belgium- Luxembourg	SR-C LR-C				LR-S 1992:9 (0.10)		SR-C	SR-C LR-C	SR-C
Netherlands					LR-S 1998:12 (0.10)		SR-C	SR-C	
Germany	SR-C LR-C						SR-C	SR-C LR-C	SR-C
Italy	LR-C						SR-S 1991:10 (0.03)	SR-C	
Ireland							LR-S 1993:1 (0.02)	LR-S 1993:3 (0.00)	
Greece			SR-C						
Portugal	SR-C								
Spain		SR-C							
Finland			LR-S 2002:10 (0.02) LR-C	LR-S 1998:9 (0.07)					
Austria						SR-C			

(a) SR-S (LR-S) stands for a rejection of the null hypothesis of absence of an endogenous structural break in the short (long) run. The break takes place at the date shown in italics. In parenthesis, p-value of the test.

SR-C (LR-C) stands for a rejection of the null hypothesis of absence of a structural break in May 1998 in the short (long) run

Appendix:

Table A: Vector Error Correction Model Results for Exchange Rate Pass Through Elasticities in the Import Price Equation

Industry		France	Belgium-Luxembourg	Netherlands	Germany	Italy	Ireland	Greece	Portugal	Spain	Finland	Austria
0. Food and live animals	SHORT RUN											
	LONG RUN											
1. Beverages and tobacco	SHORT RUN					0.61	0.52		0.70			
	LONG RUN					0.56	-0.04		0.85			
2. Crude material, inedible	SHORT RUN					0.33						
	LONG RUN					1.12						
3. Mineral fuel	SHORT RUN		0.73		0.05	1.57		0.56	1.05	0.77	0.25	
	LONG RUN		0.96		1.04	1.07		1.15	1.03	1.11	0.94	
4. Oils, fats and waxes	SHORT RUN						0.01	0.95			-0.11	0.53
	LONG RUN						0.74	0.01			0.25	0.70
5. Chemical products	SHORT RUN				0.09	0.33	-0.06	0.44	0.10	0.25		
	LONG RUN				1.05	0.84	1.18	0.11	0.33	0.92		
6. Basic manufactures	SHORT RUN											
	LONG RUN											
7. Machines and transport equipment	SHORT RUN	-0.01	0.35	0.11	0.39	0.39		0.35	0.27	0.39		
	LONG RUN	1.08	1.06	0.92	1.07	0.90		0.31	0.70	0.72		
8. Miscellaneous manufactured goods	SHORT RUN	0.62			0.06			0.54	-0.15		0.13	
	LONG RUN	1.32			1.00			1.62	0.65		0.42	

Note: Estimation results are shown only for those cases in which it can be rejected that there is no cointegration.

VECM are specified assuming that (i) there is only one cointegration equation, (ii) there is no linear trend in the series, (iii) the cointegration relationships include an intercept, (iv) two lags of the first differences of the variables are included in the specification.