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Robert Anderton[2], Badi H. Baltagi[3], Frauke Skudelny[4] and Nuno Sousa[5]

In 2005 all ECB publications will feature a motif taken from the €50 banknote.

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2 European Central Bank and Special Professor at School of Economics, University of Nottingham, University Park, Nottingham NG7 2RD, United Kingdom; e-mail: Robert.Anderton@ecb.int

3 Department of Economics, Center for Policy Research, 426 Eggers Hall, Syracuse University, Syracuse, New York, 13244-1020, USA; phone (315) 443-1630, fax (315) 443-1081, e-mail: bbaltagi@maxwell.syr.edu

4 Directorate Economic Developments, European Central Bank, Kaiserstrasse 29, 60311 Frankfurt am Main, Germany; e-mail: Frauke.Skudelny@ecb.int

5 European Commission.

Address
Kaiserstrasse 29
60311 Frankfurt am Main, Germany

Postal address
Postfach 16 03 19
60066 Frankfurt am Main, Germany

Telephone
+49 69 1344 0

Internet
http://www.ecb.int

Fax
+49 69 1344 6000

Telex
411 144 ecb d

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CONTENTS

Abstract

The aim of this paper is to improve our understanding of the key determinants of intra- and extra-euro area imports. Using a simultaneous equation estimation framework, and pooling the data across nine euro area countries as an approximation of the euro area, we estimate intra- and extra-euro area import demand functions and impose various restrictions within and across equations. We find that there are significant substitution effects between intra- and extra-euro area imports due to changes in their relative prices, while exchange rate volatility decreases trade vis-à-vis regions characterised by volatility and leads to substitution of trade away from higher-volatility regions towards lower-volatility regions.

Keywords: intra- and extra-euro area imports, substitution, trade integration, three stage least squares.

JEL Classification: F10, F15.

Non-technical summary

This paper analyses the behaviour of intra and extra-euro area imports of manufactured goods. The main objective is to improve our understanding of the key determinants of intra and extra-euro area imports and to identify the various relationships between the two variables. One contribution of this paper is the analysis of the possible substitution effects between intra- and extra-euro area trade flows – due to changes in relative prices and exchange rate volatility – within a framework of a system of equations.

Our estimation results are based on the period 1989-2000 using quarterly data for intra- and extra-euro area import volumes and prices of manufactured goods for nine euro area countries as an approximation of the euro area (Belgium-Luxembourg, France, Germany, Ireland, Italy, the Netherlands, Portugal and Spain). This period includes various policies which should further enhance European economic integration and encourage intra-euro area trade. For example, the implementation of the Single Market Programme should have fostered further European economic integration. Moreover, the semi-fixed exchange rates of the European Exchange Rate Mechanism - followed by Monetary Union and the launch of the euro in 1999 - may have been a catalyst for growth in intra-area trade by, for example, reducing exchange rate volatility.

What are the stylised facts regarding extra and intra-euro area imports of manufactures and their evolution over time? First, intra- and extra-euro area imports are approximately equal in magnitude - with each accounting for roughly half of total euro area imports of manufactures - while manufactures account for around three-quarters of imports of goods for both intra- and extra-euro area imports. Second, in general, import volumes of manufactures rose significantly over the sample period, with extra-euro area imports generally growing more rapidly than intra-euro area imports. Although this resulted in a decline in the ratio of intra-area imports of manufactures relative to extra-area imports over most of the sample period, there are some signs that the ratio stopped declining after the launch of the euro in 1999.

In many respects, it is not surprising that extra-euro area import volumes of manufactures grew at a faster rate than intra-area imports over most of the sample period and may simply reflect the fact that the rapid pace of world trade integration developed more rapidly than EU integration. This may be partly due to the fact that more and more countries are appearing as

new entrants in world export markets as competitors, thereby providing an ever increasing number of varieties of products, which itself stimulates trade. Moreover, many of the new competitors and market entrants are from emerging market economies characterised by quite diverse comparative advantages in terms of natural resources and wage and skill levels. By contrast, the euro area represents a small number of fairly homogeneous countries whose economies are already highly integrated, where more limited differences in comparative advantage have already been exploited to a significant degree.

In general, our aim is to disentangle the separate impacts of the various factors driving intra and extra-euro area imports - such as changes in relative prices, demand and exchange rate volatility - in order to improve our understanding of intra and extra-euro area trade and to identify the possible relationships between the two variables. For this purpose, we derive a theoretical model for an importing firm based in the euro area which can purchase its inputs from the home market, from the euro area or from outside the euro area. The theoretical model tells us that the firm's choice of import supplier largely depends on the different prices, and degrees of exchange rate volatility, associated with the different locations of the various suppliers. One interesting finding of our empirical work is that intra-area imports seem to be characterised by a greater degree of stability in comparison to extra-area trade (as suggested by a relatively higher estimated parameter for the lagged dependent variable which suggests a higher degree of persistence). We also find that there are significant substitution effects between intra- and extra-euro area imports due to changes in their relative prices, while exchange rate volatility depresses trade vis-à-vis regions characterised by volatility and leads to substitution of trade away from higher-volatility regions towards lower-volatility regions. Accordingly, the elimination of intra-euro area exchange rate volatility due to the formation of the euro should in the long-run increase intra-area imports by getting rid of the trade depressing impact of volatility and by resulting in some substitution towards intra-euro area imports and away from extra-area imports.

Introduction

This paper analyses the behaviour of intra and extra-euro area imports of manufactured goods. The main objective is to improve our understanding of the key determinants of intra and extra-euro area imports and to identify the various relationships between the two variables. A key contribution of this paper is the analysis of the possible substitution effects between intra- and extra-euro area trade flows – due to changes in relative prices and exchange rate volatility – within a framework of a system of equations.

We derive a theoretical model which captures the factors which determine imports as well as the potential interactions between intra and extra-euro area imports, such as substitution effects arising from different degrees of exchange rate volatility, or movements in relative prices, etc. The empirical analysis uses bilateral import data – volumes, values and unit value indices – and provides estimates of intra and extra-area import functions by pooling the data across both the individual euro area countries and their trading partner countries. Separate intra- and extra-area import volume relationships are estimated within a simultaneous estimation framework in order to examine the relationships between intra and extra-area imports. Three Stage Least Squares estimation is used to take advantage of the efficiency gains associated with the possible correlation of disturbances across equations. This simultaneous estimation framework has the added advantage of allowing various cross-equation constraints to be imposed and tested.

Section 1 gives a description of some stylised facts concerning intra and extra-euro area trade and takes us through some mechanisms which may influence intra and extra trade. Section 2 explains our theoretical model of import demand which forms the basis for our econometric specifications, while Sections 3 and 4 give the estimated model and the empirical results. One possibility for future research is to extend the sample period in order to cover the full period since the launch of the euro, thereby allowing the model to be used to evaluate the impact of EMU on intra- and extra-euro area trade.

1. Intra- and extra-euro area imports: mechanisms and stylised facts

Our estimation results are based on 48 quarters spanning the period (1989-2000). This period includes various policies which should further enhance European economic integration and encourage intra-trade. For example, the implementation of the Single Market Programme should have fostered further European economic integration. Moreover, the semi-fixed exchange rates of the European Exchange Rate Mechanism - followed by Monetary Union and the launch of the euro in 1999 - may have been a catalyst for growth in intra-area trade by reducing exchange rate volatility.

The Single Market Programme aimed at removing all remaining barriers to the free circulation of goods, services, people and capital in order to achieve further gains from integration. Regarding trade in goods, measures were taken to eliminate non-tariff barriers and other impediments to trade such as differences in technical standards as well administrative costs related to border controls and any national biases in government procurement. These measures were expected to promote intra-EC trade as they decrease the costs of intra-European exports as well as promoting the substitutability of European goods due to the harmonisation of technical standards.

The Exchange Rate Mechanism resulted in a considerable reduction in exchange rate volatility among European countries, which in turn was expected to promote intra EC-trade (see European Commission 1990). Regarding the general question as to whether exchange rate volatility affects trade, only a few *time series* studies find a significant impact of exchange rate uncertainty on trade, with the effect being very small (eg, Koray and Lastrapes, 1989; Bélanger and Gutierrez, 1988; Bini-Smaghi, 1991; Kenen and Rodrik, 1986; and Sekkat, 1998). Meanwhile, *cross sectional* studies, such as Hooper and Kohlhagen (1978), De Grauwe (1987), Brada and Méndez (1988), De Grauwe and Verfaille (1988), Savvides (1992), Frankel and Wei (1993), Sapir, Sekkat and Weber (1994) and Eichengreen and Irwin (1995), find more evidence of a negative effect of exchange rate uncertainty, but again this effect is, in most cases, relatively small.

Skudelny (2002), however, argues that studies based on *panel* data like Abrams (1980), Thursby and Thursby (1987), Dell'Ariccia (1998), Pugh *et al.* (1999), De Grauwe and Skudelny (2000), Rose (2000), and Anderton and Skudelny (2001), all find negative and significant effects for their proxy of exchange rate uncertainty. In the majority of these studies, the trade loss through exchange rate uncertainty is quite substantial. For example, Dell'Ariccia (1998) finds that the trade gains resulting from the elimination of exchange rate volatility could be between 10 and 13 percent. Meanwhile, Skudelny and Anderton (2001) estimate extra-euro area import functions and find that exchange rate volatility may have reduced extra-euro area imports by around 10%.

The evidence regarding intra-European trade seems to support the notion that reductions in exchange rate volatility have a positive impact on trade. De Grauwe and Verfaille (1988) show that although the EMS decreased exchange rate volatility among its members, growth in trade between member countries of the European Community remained slow between 1979-1985 (slower than trade growth with the rest of the world). However, once factors such as the general economic slowdown in the EC at the time are taken into account, De Grauwe and Verfaille find that the reduction in exchange rate volatility had a positive effect on intra-EC trade. Stokman (1995) carried out a sectoral analysis of the impact of the Exchange Rate Mechanism (ERM) of the European Monetary System on the exports of the original EC members (Germany, France, Italy, Belgium and The Netherlands)[1] and found that the reduction in exchange rate volatility between 1979 and 1990 significantly benefited intra-EC trade for all sectors (except machinery and transport equipment where the results were more mixed). Fountas and Aristotelous (1999) also examined the impact of the reduction in exchange rate variability brought by the ERM on the volume of intra-European exports. An export demand function was estimated for the four largest EC economies (France, Germany, Italy and the United Kingdom) for the period 1973 and 1996 using multivariate cointegration techniques and error-correction models including an exchange rate volatility term and a dummy variable for membership of the ERM. The results point to a negative relationship between exchange rate volatility and intra-European exports. However, the dummy for ERM membership turned out to be insignificant.

Overall, these results show some potential for promoting intra-EU trade with the creation of the EMS and the subsequent reduction in exchange rate volatility. This process continued with the elimination of exchange rate volatility between the euro area countries following the adoption of the euro in 1999. Thus, *a priori* the creation of the single currency may have the potential to trigger an additional intra euro-area trade promotion effect, see Rose (2000).

What does our dataset tell us about recent trends in the evolution of extra and intra-euro area imports of manufactures? In general, import volumes of manufactures rose significantly over the sample period, with extra-euro area imports generally growing more rapidly than intra-euro area imports.[2] This is shown in Chart 1 which shows the general decline in the ratio of intra-

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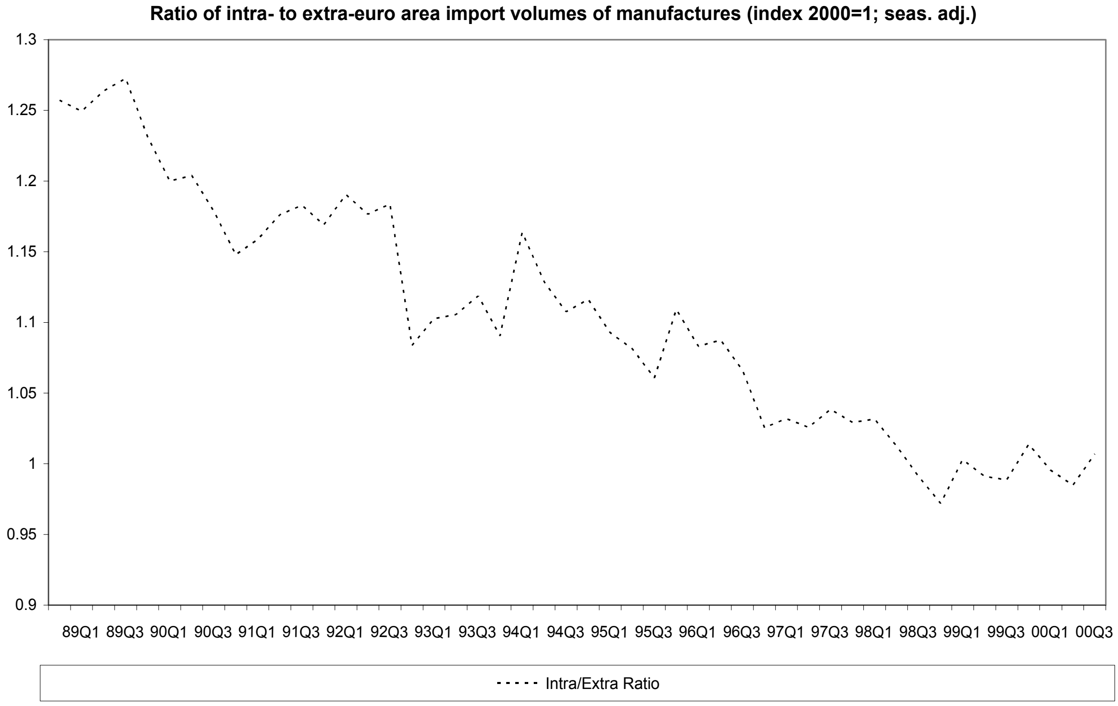
[1] Included sectors are: food and beverages, crude materials and oils, chemicals, manufactures, and machinery and transport equipment.

[2] Note that imports of manufactures account for around three-quarters of imports of goods for both intra- and extra-euro area imports. Moreover, intra- and extra-euro area imports are approximately equal in magnitude.

area imports of manufactures relative to extra-area imports. However, there are some signs that the ratio stopped declining after the launch of the euro in 1999.

Chart 1



In many respects, it is not surprising that extra-euro area import volumes of manufactures grew at a faster rate than intra-area imports over most of the sample period. This may simply reflect the fact that the rapid pace of world trade integration developed more rapidly than EU integration. This may be partly due to the fact that more and more countries are appearing as new entrants in world export markets as competitors, thereby providing an ever increasing number of varieties of products, which itself stimulates trade. Moreover, many of the new competitors and market entrants are from emerging market economies characterised by quite diverse comparative advantages in terms of natural resources and wage and skill levels. By contrast, the EU represents a small number of fairly homogeneous countries whose economies are already highly integrated, where more limited differences in comparative advantage have already been exploited to a significant degree.

In general, our aim is to disentangle the separate impacts of the various factors driving intra and extra-euro area imports - such as changes in relative prices, demand and exchange rate volatility – in order to improve our understanding of intra and extra-euro area trade and to identify the possible relationships between the two variables. Therefore, in the next section we derive a theoretical model which explains the main factors determining imports and in the following sections we estimate intra and extra-euro area import functions based on this model.

2. Theoretical foundations of the model

In a similar fashion to Anderton and Skudelny (2001), we introduce exchange rate uncertainty into the utility function of a firm, which buys goods in order to resell them. Our approach builds upon the framework developed by Cushman (1986) who investigates the importance of exchange rate uncertainty for an exporting firm. We apply a similar framework to an importing firm by extending the model so that it captures the various degrees of exchange rate uncertainty associated with different import suppliers. The inputs used by our importing firm can be purchased from three different suppliers: home suppliers, which embody zero exchange rate uncertainty; euro area suppliers, which embody some degree of exchange rate uncertainty prior to 1999 (i.e. intra-euro area trade); and non-euro area suppliers associated with a relatively higher degree of exchange rate uncertainty (extra-euro area trade)[3]. The utility function of the importer can, under the assumption of perfect competition, be written as:

$$U_i = P_i^S Q_i - \sum_{l=i,EA,w} P_{M,il} M_{il} - \theta Var\left(P_i^S Q_i - \sum_{l=i,EA,w} P_{M,il} M_{il} \right) \qquad (1)$$

where U is the utility of the firm, P_i^S is the price for which the firm sells its products and Q_i is the quantity of the final product. P_w, P_{EA} and P_i are the import prices from the non-euro area and euro area countries, and prices for purchases from the domestic market, respectively, expressed in the importer's currency. M_w, M_{EA} and M_i are the inputs bought from extra-euro area countries, euro area countries and the home country, respectively. We assume that the firm's output is characterised by a constant elasticity of substitution (CES) production function of imports from the world (W) and from the euro area (EA), as well as domestic production (i):

[3] In order to keep the theoretical analysis simple, we assume that all imports are invoiced in foreign currency. Anderton and Skudelny (2001) also take into account the invoicing currency. See also Hartmann (1998) for the different invoicing practices in EMU.

$$Q_i = \left(\sum_{l=i,EA,w} M_{il}^{\frac{\phi-1}{\phi}} \right)^{\frac{\phi}{\phi-1}} \tag{2}$$

The last term of equation (1) represents the risk faced by the firm, and is equal to the risk aversion factor of the firm, θ, multiplied with the variance of profits. The risk aversion factor θ is positive when the firm is risk averse.

We assume that exchange rate volatility is the only uncertainty factor faced by the importer, that all contracts are invoiced in the exporter's currency, and that the contract date differs from the payment date. The import prices P_w and P_{EA} are composed of the import prices in the exporter's currency, multiplied with the exchange rate (units of importer's currency per unit of exporter's currency): $P_w = P_w^* S_w$ and $P_{EA} = P_{EA}^* S_{EA}$, with S_w (S_{EA}) the exchange rate of the importer vis-à-vis the exporter (w or EA respectively). Therefore, we can write the variance of profits as:

$$Var\left(P_i^S Q_i - \sum_{l=i,EA,w} P_{M,il} M_{il} \right) = \sum_{l \neq i} \left(P_{M,il}^* M_{il} \right)^2 \mathrm{var}(S_{il}) \tag{3}$$

assuming that $\mathrm{cov}(S_{il}, S_{ik}) = 0$ for any l and k. This assumption might seem somewhat restrictive as exchange rates tend to move together quite often. However, in this context we assume independence only between exchange rate movements of intra- with extra-euro area countries, which is somewhat less restrictive.

The firm will maximise profits with respect to inputs bought at home, in non-euro area and in euro area countries respectively. Using the resulting first order condition of the maximisation problem with respect to imports from country l (l = i, EA, w), and doing some transformations (see Appendix A for more details) yields:

$$M_{iw} = \alpha_1 \frac{Y_i}{P_i^S} + \alpha_2 P_{M,iw} + \alpha_3 P_{M,ii} + \alpha_3 P_{M,iEA} - \alpha_4 \mathrm{var}(S_{iw}) + \alpha_5 \mathrm{var}(S_{iEA}) \tag{4}$$

with

$$\alpha_1 = P_{M,iw0}{}^{-\phi}\left(\sum_{l=i,EA,w} P_{M,il0}{}^{1-\phi}\right)^{-\frac{\phi}{\phi-1}}$$

$$\alpha_2 = \phi\frac{Y_{i0}}{P_{i0}{}^{S}}\left(\sum_{l=i,EA,w} P_{M,il0}{}^{1-\phi}\right)^{-\frac{\phi}{\phi-1}} P_{M,iw0}{}^{-\phi-1}\left[\frac{P_{M,iw0}{}^{1-\phi}}{\sum_{l=i,EA,w} P_{M,il0}{}^{1-\phi}} - 1\right]$$

$$\alpha_3 = \phi\frac{Y_{i0}}{P_{i0}{}^{S}} P_{M,iw0}{}^{-\phi}\left(\sum_{l=i,EA,w} P_{M,il0}{}^{1-\phi}\right)^{-\frac{\phi}{\phi-1}-1} P_{M,il0}{}^{-\phi}$$

$$\alpha_4 = 2\theta_i\phi\left(\frac{P_{M,ii0}}{P_{M,iw0}}\right)^{\phi} P_{M,iw0} M_{iw0} M_{ii0} S_{iw0}{}^{-2}\left[\frac{P_{M,iw0}{}^{1-\phi}}{\sum_{l=i,EA,w} P_{M,il0}{}^{1-\phi}} - 1\right]$$

$$\alpha_5 = 2\theta_i\phi\left(\frac{P_{M,ii0}}{P_{M,iw0}}\right)^{\phi} P_{M,iw0} M_{iw0} M_{ii0} S_{iw0}{}^{-2}$$

Equation (4) states that extra-euro area import volumes of the firm i situated in the euro area are positively affected by real income (deflated by the supply price of the firm), α_1 being positive. Moreover, a rise in the bilateral import price reduces import demand (α_2 is negative), while a rise in the weighted average of import prices from the other suppliers (the home country and the euro area) increases import demand (α_3 is positive). Finally, if the importer is risk averse, i.e. if θ is positive, bilateral exchange rate volatility negatively affects import demand of firm i for imports from outside the euro area, while exchange rate volatility inside the euro area has a positive impact on imports originating from outside of the euro area.

Analogously, we can write for imports of firm i from the euro area:

$$M_{iEA} = \beta_1\frac{Y_i}{P_i^S} + \beta_2 P_{M,iEA} + \beta_3 P_{M,iw} + \beta_3 P_{M,ii} - \beta_4 \operatorname{var}(S_{iEA}) + \beta_5 \operatorname{var}(S_{iw}) \quad (5)$$

with

$$\beta_1 = P_{M,iEA0}^{-\phi}\left(\sum_{l=i,EA,w} P_{M,il0}^{1-\phi}\right)^{-\frac{\phi}{\phi-1}}$$

$$\beta_2 = \phi\frac{Y_{i0}}{P_{i0}^{S}}\left(\sum_{l=i,EA,w} P_{M,il0}^{1-\phi}\right)^{-\frac{\phi}{\phi-1}} P_{M,iEA0}^{-\phi-1}\left[\frac{P_{M,iEA0}^{1-\phi}}{\sum_{l=i,EA,w} P_{M,il0}^{1-\phi}} - 1\right]$$

$$\beta_3 = \phi\frac{Y_{i0}}{P_{i0}^{S}} P_{M,iEA0}^{-\phi}\left(\sum_{l=i,EA,w} P_{M,il0}^{1-\phi}\right)^{-\frac{\phi}{\phi-1}-1} P_{M,il0}^{-\phi}$$

$$\beta_4 = -2\theta_i\phi\left(\frac{P_{M,ii0}}{P_{M,iEA0}}\right)^{\phi} P_{M,iEA0} M_{iEA0} M_{ii0} S_{iEA0}^{-2}\left[\frac{P_{M,iEA0}^{1-\phi}}{\sum_{l=i,EA,w} P_{M,il0}^{1-\phi}} - 1\right]$$

$$\beta_5 = 2\theta_i\phi\left(\frac{P_{M,ii0}}{P_{M,iEA0}}\right)^{\phi} P_{M,iEA0} M_{iEA0} M_{ii0} S_{iEA0}^{-2}$$

3. The estimated model

We use a quarterly bilateral trade dataset spanning the sample period 1989Q1 to 2000Q4. This consists of the imports of the majority of the individual euro-area countries (France, Germany, Belgium/Luxembourg, The Netherlands, Italy, Spain, Portugal and Ireland) - separated into imports originating from other euro-area partners (intra-euro-area imports) and imports originating from third countries (extra euro-area imports).[4] This allows us to obtain estimates of the extra and intra-euro area import functions shown below in specifications (6) and (7) by pooling the data across the individual euro area importing countries. Accordingly, the subscript ix (in) represents total extra-area (intra-area) manufacturing imports of euro area country i.

$$\begin{aligned} \ln MV_{ixt} &= \alpha_{ix0} + \alpha_{x1}\ln MV_{ix,t-1} + \alpha_{x2}\ln MP_{ixt} + \alpha_{x3}\ln PP_{it} + \alpha_{x4}\ln MP_{\text{int}} \\ &\quad + \alpha_{x5}\ln TFE_{it} + \alpha_{x6}\ln(1+VOL_{ixt}) + \alpha_{x7}\ln(1+VOL_{\text{int}}) + \sum_t \alpha_{x8t} TD_{xt} \end{aligned} \tag{6}$$

[4] Although Austria and Finland form part of the euro-area, they are excluded from our sample due to data limitations. Greece is excluded as it was not yet a member of the euro area during the sample period.

$$\ln MV_{int} = \alpha_{in0} + \alpha_{n1}\ln MV_{in,t-1} + \alpha_{n2}\ln MP_{int} + \alpha_{n3}\ln PP_{it} + \alpha_{n4}\ln MP_{ixt} + \alpha_{n5}\ln TFE_{it} + \alpha_{n6}\ln(1+VOL_{int}) + \alpha_{n7}\ln(1+VOL_{ixt}) + \sum_t \alpha_{n8t}TD_{nt} + \alpha_{n9}\ln PP93_{it} \quad (7)$$

A priori, we expect:

$\alpha_{x1}, \alpha_{n1} > 0;$ $\alpha_{x2}, \alpha_{n2} < 0;$ $\alpha_{x3}, \alpha_{n3} > 0;$ $\alpha_{x4}, \alpha_{n4} > 0;$ $\alpha_{x5}, \alpha_{n5} > 0$
$\alpha_{x6}, \alpha_{n6} < 0;$ $\alpha_{x7}, \alpha_{n7} > 0.$

where MV_{ixt} (MV_{int}) are the extra (intra) import volumes of euro area country i from all extra (intra) euro-area import suppliers in period t; MP_{ix} (MP_{in}) is the extra euro-area (intra euro-area) import price for extra (intra) imports of country i; PP_{it} is the domestic producer price of importing euro-area country i; TFE_{it} is total final expenditure in constant prices of importer i (which proxies domestic demand); α_{ix0} and α_{in0} represent fixed country effects; and TD_{xt} (TD_{nt}) represents quarterly time dummies; i.e. we have one dummy per quarter, which is equal to one in that quarter and zero otherwise.[5] $PP93_i$ are producer prices multiplied with a dummy which is equal to zero before 1993 and one afterwards, which captures some impacts possibly associated with the Single Market (this will be explained in greater detail later). We introduce dynamic adjustment into the model by including a lagged dependent variable

Finally, the model also allows for the possible impact of exchange rate volatility: VOL_{ixt} measures the degree of extra euro-area exchange rate volatility and is expected to have a negative (positive) sign for the extra (intra) euro-area import equation as it captures both the absolute trade depressing impact effect of volatility on extra-area imports (α_{x6}) as well as any substitution between extra and intra euro-area imports due to differences in volatility (α_{n7}). Similarly, the parameter for VOL_{int} – which represents the degree of intra-euro area exchange rate volatility – is expected to have a negative (positive) sign for the intra (extra) euro-area import equation with parameters α_{n6} and (α_{x7}) respectively. All variables are seasonally adjusted. Appendix B gives the detailed description of the data and the sources.

The above model is estimated in a simultaneous equation framework using three-stage least squares (3SLS). This allows us to take advantage of the efficiency gains associated with the possible correlation of disturbances across equations. We treat the lagged dependent variables as endogenous and instrument them using the lagged values of the exogenous variables. The individual country intra and extra-euro area import demand equations are then estimated simultaneously and each importing country is allowed a different country intercept (fixed effects), while the slope coefficients across the individual countries are imposed to be the same.[6] However, we allow the coefficients of each variable to be different for the intra and extra euro-area import equations. This simultaneous estimation framework has the added advantage that it allows various cross-equation constraints to be imposed and tested.

Given the low power of unit root tests and cointegration tests in small samples, it was deemed that following a "cointegration-type approach" was inappropriate for our analysis given our short sample period.[7] Moreover, the main advantage of testing for unit roots and carrying-out cointegration analyses is to avoid the problem of spurious regression. However, spurious regression is not so likely to be an important problem in panel estimation (see Phillips and Moon, 1999).

Modelling exchange rate volatility

We define exchange rate volatility as the quarterly variance of the weekly nominal exchange rate return between countries i and j. In order to obtain the total extra- (intra-) euro area exchange rate volatility, we take the weighted average of this variance with respect to the main extra (all intra) countries:

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[5] We drop three dummies for the extra equation and four for the intra equation to avoid multicolinearity for both equations.

[6] One might argue that it is restrictive to impose the same parameters, apart from fixed effects, for the import demand function for all euro area countries. However, this is an accepted methodology in the trade literature as there are several papers which impose the same parameters across somewhat heterogeneous countries (see, for example, Kinal and Lahiri, 1993). In addition, the intention here is to pool the data across countries such that we obtain results which approximate the parameters of the euro area. At the same time, the restrictions implied by the pooling of data across countries combined with the systems estimation methodology allows us to easily impose and test cross-equation restrictions so that "economic" constraints are satisfied (for example, that the elasticity capturing the substitution between extra- and intra-euro area imports due to a change in their relative price is the same in both the intra- and extra-euro area import equations).

[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 Ziao, 1999). As our sample period extends only from 1989Q1-2000Q4, we only have a maximum of 48 observations. Doornik, Hendry and Nielson (1999) note the empirical lack of power of unit root tests when the number of quarterly observations is equal to, or less than, 100.

$$VOL_{in,q} = \frac{1}{J}\sum_{j}\left\{ w_{ij}\,\frac{100}{13}\sum_{w=1}^{13}\left[\left(\frac{S_{ij,w}}{S_{ij,w-1}}-1\right)-\frac{1}{13}\sum_{w\in q}\left(\frac{S_{ij,w}}{S_{ij,w-1}}-1\right)\right]^{2}\right\}$$

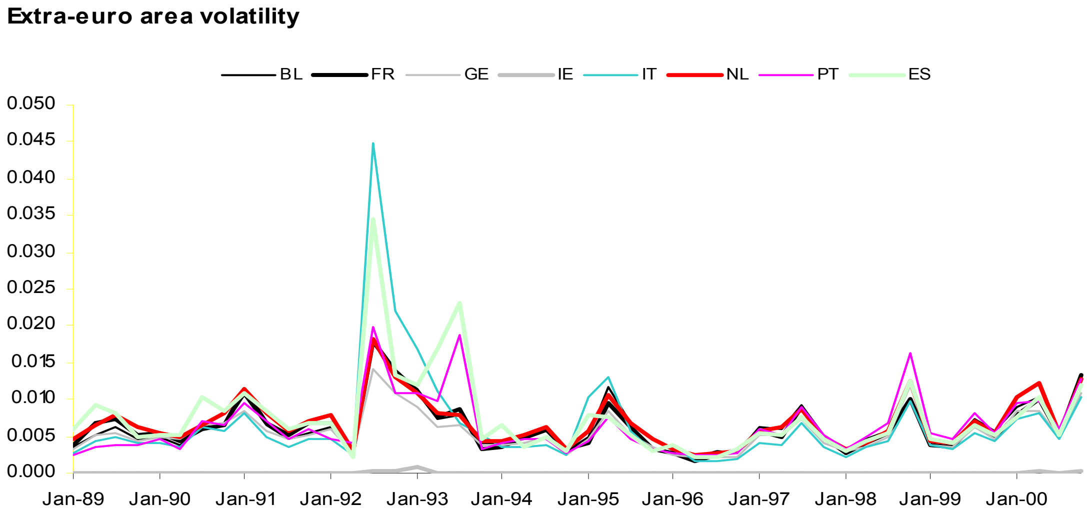
and

$$VOL_{ix,q} = \frac{1}{K}\sum_{k}\left\{ w_{ik}\,\frac{100}{13}\sum_{w=1}^{13}\left[\left(\frac{S_{ik,w}}{S_{ik,w-1}}-1\right)-\frac{1}{13}\sum_{w\in q}\left(\frac{S_{ik,w}}{S_{ik,w-1}}-1\right)\right]^{2}\right\}$$

with $w_{ij} = \frac{M_{ij}}{\sum_j M_{ij}}$ for the intra-euro area weights, and $w_{ik} = \frac{M_{ik}}{\sum_k M_{ik}}$ for the extra-euro area weights, j being countries situated inside the euro area, and k the main extra-euro area trading partners (United States, United Kingdom, Sweden, Switzerland, Denmark and Japan).

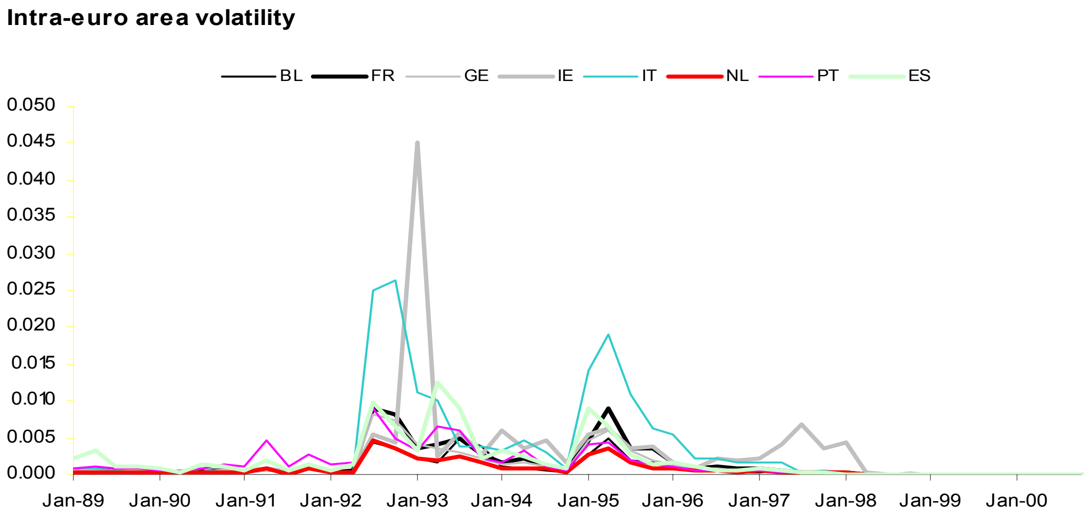
Charts 2 and 3 show the evolution of extra-and intra-euro area volatility from 1989 to 2000. When estimating the import demand equations including the exchange rate volatility terms, many previous studies use a measure of volatility for the *current period*. However, in our model it is the perception of the importer of the likelihood of being negatively affected by exchange rate volatility that is important. Hence we assume that the importer uses information from the past as well as the current period for assessing the relative risks associated with exchange rate volatility vis-à-vis different suppliers. Therefore we experiment with various moving-average measures of exchange rate volatility as such a variable not only captures current volatility, along with some history of past volatility, but also eventually forgets episodes of volatility when they become old enough to be irrelevant.

Chart 2



Source: BIS and own calculations

Chart 3



Source: BIS and own calculations

4. Empirical results

The first three columns of Table 1 show our 3SLS estimates for the intra and extra trade equations (6) and (7).

Table 1 Intra and Extra Import Equation Estimates

	Coefficient	t-Statistic	LR-coef	Imposing Price Homogeneity Coefficient	t-Statistic	LR-coef
Intra:						
MV_{t-1}	0.816	36.542		0.825	37.602	
MP_n	-0.106	-2.162	-0.577	-0.117	-3.451	-0.669
MP_x	0.085	3.006	0.460	0.081	2.935	0.463
PP	-0.126	-4.197	0.183	-0.114	-3.862	0.205
PP93	0.160	3.862		0.150	5.045	
TFE	0.170	4.956	0.923	0.160	4.794	0.917
VOL_n	-0.168	-4.913	-0.913	-0.161	-4.748	-0.922
VOL_x	0.097	2.511	0.528	0.091	2.389	0.524
Extra:						
MV_{t-1}	0.677	19.484		0.671	19.445	
MP_x	-0.362	-6.114	-1.119	-0.306	-5.825	-0.929
MP_n	0.093	1.706	0.287	0.133	2.761	0.405
PP	0.124	3.058	0.384	0.172	5.314	0.524
TFE	0.329	7.178	1.018	0.307	6.873	0.933
VOL_x	-0.123	-2.507	-0.380	-0.087	-1.929	-0.265
VOL_n	0.127	3.141	0.392	0.127	3.205	0.387
Wald test	Restrictions: $\alpha_{x2} = -(\alpha_{x3} + \alpha_{x4})$; $\alpha_{n2} = -(\alpha_{n3} + \alpha_{n4})$					
Chi-squared	3.807					
Probability	0.149					

MV: import volumes, MP: import prices, PP: producer prices, PP93: producer prices multiplied with a dummy with a value of 1 from 1993 onwards and 0 otherwise (i.e, the long-run parameter for PP is the sum of both the PP and the PP93 parameters); TFE: total real final expenditure; VOL: exchange rate volatility; subscript n for intra-euro area, subscript x for extra-euro area. LR-coeff= long-run coefficient. Quarterly time dummies are included in the estimated equations, but their parameters are not reported due to lack of space. Three Stage Least Squares estimation carried out by pooling the data across the individual euro area countries with MV_{t-1} treated as endogenous and therefore instrumented using the lagged values of the exogenous variables as instruments. Sample period 1989Q1-2000Q4. Note that parameter α_{n4} in the restriction refers to the sum of the parameters for PP and PP93 in the intra equation.

The results show that the individual price terms all have the expected signs and are statistically significant. For example, the imported good's own price elasticity is always negative, while the competing imported good's elasticity is always positive.[8] With respect to domestic producer prices, we find the expected positive coefficient (i.e., a rise in producer prices for country i results in substitution away from domestic production towards both extra and intra-area imports). However, for intra-euro area imports we only find this positive relationship after 1993. This may be partly due to the implementation of the '1992' Single Market Programme. The latter created conditions for increased competition across the European Union and may have increased the degree of substitutability between goods across the different countries of the EU. Meanwhile, as expected, the coefficient for the demand variable (TFE) is positive and significant for both the intra and extra euro-area import demand equations. We also find that the long-run TFE parameter is smaller for intra euro-area imports relative to extra, reflecting the slower growth of intra euro-area import volumes relative to extra-area import volumes over our sample period.

Similarly, the coefficients of the exchange rate volatility terms are all statistically significant and have the expected sign. For example, extra-euro area imports decline in response to an increase in extra-area exchange rate volatility (i.e, the "trade depressing" and substitution impact of volatility) and rise in reaction to an increase in intra-area volatility (i.e., substitution effect), while intra-euro area imports decline in response to an increase in intra-area volatility and rise in reaction to an increase in extra-area volatility.[9] These results imply that exchange rate volatility associated with a particular region has a negative impact on trade vis-à-vis that region and also leads to trade being substituted away from that region towards lower-volatility regions.

Another general result evident from Table 1 is that the parameter estimate for the lagged dependent variable is larger for intra-area imports in comparison to extra euro-area imports. This finding seems to indicate that intra imports have a higher degree of persistence (stability) than extra-area imports (i.e. intra imports always remain closer to their previous lagged values than extra-area imports).

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[8] Although it is possible that intra and extra-area imports may be complements, the empirical results are in line with our assumption that they are substitutes.

[9] We experimented with different moving averages of the volatility term and found that a moving average over four years seems to be most appropriate, both in terms of the size of the effect and in the explanatory power of the equation. This is similar to the exchange rate volatility measures used in Anderton and Skudelny (2001).

The last three columns of Table 1 show the same equations but with price homogeneity imposed [i.e., $\alpha_{x2} = -(\alpha_{x3} + \alpha_{x4})$; and $\alpha_{n2} = -(\alpha_{n3} + \alpha_{n4})$].[10] The corresponding Wald test of this restriction is reported at the bottom of the first three columns of table 1 and indicates that we do not reject the null hypothesis. The overall parameters and results change only slightly with respect to the unrestricted version. A formal test of parameter stability over the period since 1998Q1 was carried out using the Gujarati (1970) dummy variable variant of the split sample Chow test. The resulting Wald test statistics for both of the equations reported in Table 1 failed to provide any evidence of parameter instability over this period.[11]

Another way of imposing price homogeneity which also facilitates the imposition of theoretically valid cross-equation restrictions, is to estimate equations (8) and (9) where prices are expressed in *relative* terms (i.e., the first term is the import price relative to country i's domestic producer price, while the second term is the relative price of intra and extra-area imports):

$$\begin{aligned} \ln MV_{ixt} = \beta_{ix0} + \beta_{x1} \ln MV_{ix,t-1} + \beta_{x2} \ln(MP_{ixt} / PP_{it}) + \beta_{x3} \ln(MP_{ixt} / MP_{\text{int}}) + \\ \beta_{x4} \ln TFE_{it} + \beta_{x5} \ln(1 + VOL_{ixt}) + \beta_{x6} \ln(1 + VOL_{\text{int}}) + \sum_t \beta_{x7t} TD_{xt} \end{aligned} \quad (8)$$

$$\begin{aligned} \ln M_{\text{int}} = \beta_{in0} + \beta_{n1} \ln M_{in,t-1} + \beta_{n2} \ln(MP_{\text{int}} / PP_{it}) + \beta_{n2'} \ln(MP_{\text{int}} / PP_{it}) * D93 \\ + \beta_{n3} \ln(MP_{\text{int}} / MP_{ixt}) + \beta_{n4} \ln TFE_{it} + \beta_{n5} \ln(1 + VOL_{\text{int}}) \\ + \beta_{n6} \ln(1 + VOL_{ixt}) + \sum_t \beta_{n7t} TD_{nt} \end{aligned} \quad (9)$$

A priori, we expect:

$$\beta_{x1}, \beta_{n1} > 0;\ \beta_{x2}, (\beta_{n2} + \beta_{n2'}) < 0;\ \beta_{x3}, \beta_{n3} < 0;\ \beta_{x4}, \beta_{n4} > 0;\ \beta_{x5}, \beta_{n5} < 0;\ \beta_{x6}, \beta_{n6} > 0;$$

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[10] Among other things, imposing price homogeneity ensures the logical result that a 1% increase in all prices has no impact on imports. Imposing price homogeneity also ensures that a 1% increase (decrease) in the dependent variable's own price elasticity has the same impact as a 1% decrease (increase) in all competitor good's prices. There is no guarantee that these theoretically intuitive properties are maintained if we do not impose price homogeneity.

[11] Gujarati (1970) stability tests for Table 1 equations are as follows: Wald test without price homogeneity imposed $\chi^2_{14} = 22.82$; Wald test with price homogeneity imposed $\chi^2_{14} = 22.80$.

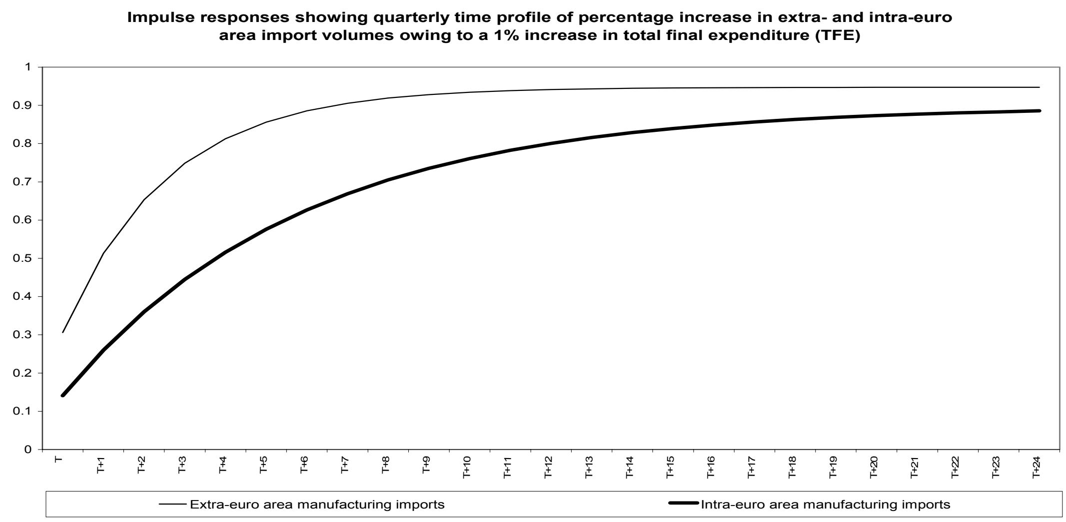
Table 2 Intra and Extra Import Equation Estimates Using Relative Prices

	Coefficient	t-Statistic	LR-coef	Imposing cross-equation restriction Coefficient	t-Statistic	LR-coef
Intra:						
MV_{t-1}	0.843	39.641		0.842	40.156	
MP_n / MP_x	-0.084	-3.016	-0.531	-0.067	-4.149	-0.423
MP_n / PP	0.082	2.859	-0.281	0.087	3.049	-0.298
MP_n / PP93	-0.126	-3.141		-0.134	-3.441	
TFE	0.141	4.248	0.897	0.160	5.507	1.012
VOL_n	-0.122	-3.796	-0.777	-0.123	-3.874	-0.777
VOL_x	0.077	1.999	0.489	0.080	2.095	0.505
Extra:						
MV_{t-1}	0.677	19.478		0.675	19.603	
MP_x / MP_n	-0.123	-2.547	-0.380	-0.137	-4.088	-0.423
MP_x / PP	-0.168	-5.143	-0.520	-0.164	-5.366	-0.504
TFE	0.306	6.853	0.947	0.316	7.315	0.975
VOL_x	-0.095	-2.141	-0.294	-0.092	-2.138	-0.284
VOL_n	0.134	3.416	0.416	0.133	3.426	0.411
Wald test:	Restriction: β_{x3} / (1 - β_{x1}) = β_{n3} / (1 - β_{n1})					
Chi squared	0.314					
Probability	0.575					

MV: import volumes, MP: import prices, PP: producer prices, PP93: producer prices multiplied with a dummy with a value of 1 from 1993 onwards and 0 otherwise (i.e, the long-run parameter for PP is the sum of both the PP and the PP93 parameters); TFE: total real final expenditure; VOL: exchange rate volatility; subscript n for intra-euro area, subscript x for extra-euro area. Quarterly time dummies are included in the estimated equations, but their parameters are not reported due to lack of space. Three Stage Least Squares estimation with MV_{t-1} treated as endogenous and therefore instrumented using the lagged values of the exogenous variables as instruments. Sample period 1989Q1-2000Q4.

The first three columns of Table 2 show the 3SLS estimates for equations (8) and (9). In particular, these estimates show that the relative price terms are all statistically significant and negative. This means that extra (intra) imports can be substituted for either domestic production or for intra (extra) imports.[12] For example, *ceteris paribus,* a decline in the price of extra imports would lead to a decline in the *relative* price of extra imports vis-à-vis both domestic production and intra imports. Hence, in the short-run, extra imports would increase by β_{x2} plus β_{x3}, while intra imports would decline by β_{n3}. However, as the long-run impact on both intra and extra-area imports arising from the substitution between the two import sources due to a change in their relative price should be equal and opposite in sign, the following cross-equation constraint should be imposed: $\beta_{x3}/(1-\beta_{x1}) = \beta_{n3}/(1-\beta_{n1})$. The Wald test (at the bottom of the first three columns of Table 2) indicates that we do not reject this restriction. The results after imposing this constraint are shown in the final three columns of Table 2. The key message of these latter results is that, after imposing price homogeneity along with sensible cross-equation restrictions, the general features and characteristics of intra and extra-area imports remain roughly the same as in the earlier results.[13] In particular, changes in relative prices result in substitution between intra and extra-area imports; exchange rate volatility depresses trade vis-à-vis regions characterised by volatility and leads to substitution of trade away from higher towards lower-volatility regions; and intra-area imports are characterised by a greater degree of stability in comparison to extra-area trade (as suggested by a higher estimated parameter for the lagged dependent variable). The latter point also means that shocks to the explanatory variables affect extra-euro area import volumes more rapidly than intra-euro area import volumes. This is clear from the impulse responses illustrated in Chart 4 which shows the quarterly time profile of the impact on the import volumes of manufactures of a 1% increase in total final expenditure.[14] Although the long-run impacts are very similar in magnitude, it only takes about two quarters for half of the impact on extra-euro area import volumes to come through, while it takes around four quarters for half of the impact to feed through to intra-euro area imports.

Chart 4:



[12] Note that for the intra imports equation, we include another term for producer prices multiplied by a dummy with a value of 1 from 1993 onwards, and zero otherwise.
[13] In addition, both sets of the equations reported in Table 2 showed no evidence of parameter stability over the final three years of the sample period according to formal Gujarati (1970) stability tests: Wald test for unrestricted equation $\chi^2_{12} = 17.2$; Wald test imposing cross-equation restriction $\chi^2_{12} = 16.1$.

[14] We only show the impulse response for total final expenditure as the impulse responses of the other explanatory variables are identical as the time profile of the response is driven by the parameter of the lagged dependent variable.

The statistically significant exchange rate volatility terms imply a positive impact on intra-area imports from the formation of the euro. For example, the estimated parameters for the volatility terms in the system of equations suggest that: (a) the launch of the euro will increase intra-euro area imports by eliminating the "trade depressing" impact of intra-euro area exchange rate volatility, and (b) the elimination of intra-euro area exchange rate volatility due to the formation of the euro will result in some substitution towards intra-euro area imports and away from extra-area imports. Furthermore, this may be only part of the story as some of the other estimated parameters, combined with various other mechanisms, suggest that monetary union might cause an increase in intra-area trade. For example, the increased transparency of intra-euro area trade prices within the euro area after the creation of the euro may lead to greater price competition with respect to intra-area trade. Such an impact could bring down the price of intra-area imports relative to extra-area imports and, using the estimates for relative price elasticities reported above, could lead to substitution away from extra-area imports to intra-area imports. Finally, there might be a so-called "Rose effect" whereby sharing the same currency causes a substantial increase in trade over and above the impact of eliminating exchange rate volatility (see Rose, 2000). However, these are issues which we hope to address in future research as we intend to extend our data period to cover the full period since the launch of the euro, thereby allowing our model to be used to evaluate the impact of the euro on intra- and extra-euro area trade.

5. Concluding remarks

The aim of this paper is to improve our understanding of the key determinants of intra- and extra-euro area trade. More specifically, we investigated possible substitution effects between intra- and extra-euro area imports due to differences in prices and in exchange rate volatility. For this purpose, we derive a theoretical model for an importing firm based in the euro area which can purchase its inputs from the home market, from the euro area or from outside the euro area. The theoretical model tells us that the firm's choice of input supplier largely depends on the different prices, and degrees of exchange rate volatility, associated with the different locations of the various suppliers.

We use data for intra- and extra-euro area import volumes and prices of manufactured goods for eight euro area countries as an approximation of the euro area (Belgium-Luxembourg, France, Germany, Ireland, Italy, the Netherlands, Portugal and Spain). Using a simultaneous equation estimation framework, we estimate intra- and extra-euro area import demand functions and impose various theoretically appealing restrictions within and across equations. One interesting finding is that intra-area imports seem to be characterised by a greater degree of stability in comparison to extra-area trade (as suggested by a relatively higher estimated parameter for the lagged dependent variable which suggests a higher degree of persistence). We also find that there are significant substitution effects between intra- and extra-euro area imports due to changes in their relative prices, while exchange rate volatility depresses trade vis-à-vis regions characterised by volatility and leads to substitution of trade away from higher-volatility regions towards lower-volatility regions. Accordingly, the elimination of intra-euro area exchange rate volatility due to the formation of the euro should increase intra-area imports by getting rid of the trade depressing impact of volatility and by resulting in some substitution towards intra-euro area imports and away from extra-area imports.

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Appendix A Theoretical foundations of the model

The firm maximises profits with respect to inputs bought at home, in the non-euro area and in the euro area countries respectively. The first order condition of the maximisation problem with respect to imports from country l (l = i, EA, w) is:

$$P_i^S \left(\sum_{l=i,EA,w} M_{il}^{\frac{\phi-1}{\phi}} \right)^{\frac{1}{\phi-1}} M_{il}^{-\frac{1}{\phi}} = P_{M,il} + 2\theta_i \left(P_{M,il}^{*} \right)^2 M_{il} \operatorname{var}(S_{il}) \tag{10}$$

Using (10) for imports of each region i, EA and w and combining EA with i and w with i, respectively:

$$M_{iEA} = \left(\frac{P_{M,ii}}{P_{M,iEA} + 2\theta_i \left(P_{M,iEA}^{*} \right)^2 M_{iEA} \operatorname{var}(S_{iEA})} \right)^{\phi} M_{ii} \tag{11}$$

and:

$$M_{iw} = \left(\frac{P_{M,ii}}{P_{M,iw} + 2\theta_i \left(P_{M,iw}^{*} \right)^2 M_{iw} \operatorname{var}(S_{iw})} \right)^{\phi} M_{ii} \tag{12}$$

In order to make (11) and (12) linear in M_{iEA} and M_{iw}, we use a first order Taylor series approximation around $M_{il} = M_{il0}$ and $\operatorname{var}(S_{il}) = 0$, using the fact that $P_{M,iEA}^{*} = \dfrac{P_{M,iEA}}{S_{iEA}}$:

$$M_{iEA} = \left(\frac{P_{M,ii}}{P_{M,iEA}} \right)^{\phi} M_{ii} - V_{iEA}^{D} \tag{13}$$

with $V_{iEA}^{D} = 2\theta_i \phi \left(\dfrac{P_{M,ii}}{P_{M,iEA}} \right)^{\phi-1} M_{iEA0} M_{ii0} \dfrac{\operatorname{var}(S_{iEA})}{S_{iEA}^{2}}$

Analogously, for M_{iw} we obtain:

$$M_{iw} = \left(\frac{P_{M,ii}}{P_{M,iw}} \right)^{\phi} M_{ii} - V_{iw}^{D} \tag{14}$$

with $V_{iw}^{D} = 2\theta_i\phi\left(\frac{P_{M,ii}}{P_{M,iw}}\right)^{\phi} P_{M,iw}M_{iw0}M_{ii0}\frac{\text{var}(S_{iw})}{S_{iw}^{\ 2}}$

The importer's revenue Y_i is given by:

$$Y_i = P_i^{S} Q_i \tag{15}$$

Substitute (13) and (14) into (2) substituting Y_i/P_i^S for Q_i from (15):

$$\frac{Y_i}{P_i^S} = \left\{ M_{ii}^{\frac{\phi-1}{\phi}} + \left[\left(\frac{P_{M,ii}}{P_{M,iEA}}\right)^{\phi} M_{ii} - V_{iEA}^{D}\right]^{\frac{\phi-1}{\phi}} + \left[\left(\frac{P_{M,ii}}{P_{M,iw}}\right)^{\phi} M_{ii} - V_{iw}^{D}\right]^{\frac{\phi-1}{\phi}} \right\}^{\frac{\phi}{\phi-1}} \tag{16}$$

The first order Taylor series expansion of this term around $M_{il} = M_{il0}$

$$M_{ii} = \frac{Y_i}{P_i^S} P_{M,ii}^{\ -\phi} \left(\sum_{l=i,EA,w} P_{M,il}^{\ 1-\phi}\right)^{-\frac{\phi}{\phi-1}} + P_{M,ii}^{\ -\phi} \left(\sum_{l=i,EA,w} P_{M,il}^{\ 1-\phi}\right)^{-1} \left(\sum_{l=EA,w} P_{M,il} V_{il}^{D}\right) \tag{17}$$

Substitute (17) into (13):

$$M_{iEA} = \frac{Y_i}{P_i^S} P_{M,iEA}^{\ -\phi} \left(\sum_{l=i,EA,w} P_{M,il}^{\ 1-\phi}\right)^{-\frac{\phi}{\phi-1}} + \left(\sum_{l=i,EA,w} P_{M,il}^{\ 1-\phi}\right)^{-1} P_{M,iEA}^{\ -\phi} \sum_{l=EA,w} P_{M,il} V_{il}^{D} - V_{iEA}^{D} \tag{18}$$

Substitute (17) into (14):

$$M_{iw} = \frac{Y_i}{P_i^S} P_{M,iw}^{\ -\phi} \left(\sum_{l=i,EA,w} P_{M,il}^{\ 1-\phi}\right)^{-\frac{\phi}{\phi-1}} + \left(\sum_{l=i,EA,w} P_{M,il}^{\ 1-\phi}\right)^{-1} P_{M,iw}^{\ -\phi} \sum_{l=EA,w} P_{M,il} V_{il}^{D} - V_{iw}^{D} \tag{19}$$

We make a first order Taylor series expansion of (19) around $Y_i/P_i^S = Y_{i0}/P_{i0}^S$, $P_{m,il} = P_{M,il0}$, and $V_{il}^D = 0$ before the empirical estimation and obtain the final equation (4), knowing that

$$\left(\frac{\partial V_{il}^{D}}{\partial P_{M,ii}} + \frac{\partial V_{il}^{D}}{\partial P_{M,il}} + \frac{\partial V_{il}^{D}}{\partial S_{ii}} + \frac{\partial V_{il}^{D}}{\partial \operatorname{var}(S_{il})} \right) \Bigg|_{P_{M,il}=P_{M,il0}, S_{il}=S_{il0}, \operatorname{var}(S_{il})=0} =$$

$$2\theta_i \phi \left(\frac{P_{M,ii0}}{P_{M,il0}} \right)^{\phi} P_{M,il0} M_{il0} M_{ii0} \frac{\operatorname{var}(S_{il})}{S_{il0}^{\ 2}} \stackrel{def}{=} V_{il0}^{D}$$

Appendix B Data Definitions and Sources

Data for bilateral import values, volumes and unit value indices in ECU's/euros are from Eurostat and relate to trade in goods (source: COMEXT database). These trade data are the main reason for the fairly short sample period of the study as the imports data are only available from 1989Q1 onwards. Import prices are proxied by import unit value indices, while imports data for Belgium and Luxembourg are combined (as in the COMEXT database).

Producer price series are taken from various sources: International Monetary Fund (IMF) International Financial Statistics; Organisation for Economic Cooperation and Development (OECD), Main Economic Indicators; and Eurostat. The raw data in national currency are converted into ECU's/euros in order to be compatible with the trade data and calculated as an index, base year 1995.

Total final expenditure expressed in constant prices is from the OECD, Quarterly National Accounts.

All data are seasonally adjusted using the moving average method.

The *weekly* exchange rate data used to compile the volatility term are taken from the Bank for International Settlements (BIS). The exchange rates vis-à-vis the USD are then converted into bilateral exchange rates between the trading partners.

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