Trade Invoicing in the accession countries: Are they suited to the euro?

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Abstract

The accession countries to the euro area are increasingly binding their economic activity, external and internal, to the euro area countries. One direction of this phenomenon concerns the currency invoicing of international trade transactions, where accession countries have reduced their use of the US dollar in invoicing international trade transactions. Theory predicts that the optimal invoicing choices for accession countries depend on the composition of goods in exports and imports and on the macroeconomic fluctuations of trade partners, both bearing on the role of herding and hedging considerations within exporter profitability. These considerations yield country-specific estimates about the optimal degree of Euro-denominated invoicing of exports. It is found that the exporters of some accession countries, even in their trade transactions with the euro zone and other European Union countries, might be pricing a larger-than-optimal share of their transactions in euros rather than in dollars, thus taking on excessive risk in international markets.

Keywords: Exchange rate pass through, invoicing, trade, vehicle currency, accession country, euro area

JEL Classification: F3, F4

I. Introduction

The accession countries to the euro area are increasingly binding their economic activity, external and internal, to the euro area countries. One direction of this phenomenon concerns the currency invoicing of international trade transactions. There has been a substantial shift away from the use of the US dollar on accession country international trade transactions. In this paper, I explore the theoretical drivers of optimal invoicing choices for exporters, highlighting the importance of the composition of goods in exports and imports, and the partner composition of these forms of trade. I explore whether accession country exporters, by closely aligning themselves with the rest of the euro area on trade by invoicing in euros, are pursuing economically optimal strategies. It may be that some of the accession country export transactions are not as optimally suited to euro invoicing, leading producers to expose themselves to excessive risk in international markets by using too great of a euro share in their pricing activity.

The analysis draws on the lessons from the theoretical model of Goldberg and Tille (2005), which presents the determinants of the relative importance of hedging motives and herding motives in currency invoicing (and exchange rate pass through) choices by exporters. We use this model to motivate an empirical application to the accession countries. The model shows that there is a role for macroeconomic volatility and for industry composition in exporter pricing strategies, so that both hedging and herding considerations drive optimal strategies. Macroeconomic volatility considerations have been emphasized in a range of papers, from Giovannini (1988) through recent contributions by Bacchetta and vanWincoop, 2003, Devereux, Engel and Storegaard (2004), Oi, Otani, and Shirota (2004), and Engel (2005). By introducing an explicit role for elasticities of substitution in demand and decreasing returns to scale in pricing, Goldberg and Tille (2005) show that such volatility considerations may mainly play a key role in the pricing and currency invoicing decisions of producers of differentiated products. The role of industry structure, early on emphasized by McKinnon (1979), plays an important role in determining the merits of herding in pricing and currency invoicing decisions. We emphasize that producers in highly competitive industries, and producers facing a high degree of decreasing returns to scale in production, may optimally mimic

the pricing strategies of their competitors in markets in which their goods are sold. This herding activity could be much more important in decision making that the hedging role

We apply these considerations to the trade transactions of the countries aspiring to join the euro area (Bulgaria, Cyprus, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Slovakia, Slovenia). A simple picture motivates the focus of the paper, which explores the extent to which accession country exporters use dollars versus euros versus other currencies in invoicing their international trade transactions.[1] Goldberg and Tille (2005), using mostly data for 2002, examined the share of dollar use in invoicing country exports compared to what might be "expected" purely on the basis of trade with the United States and the composition of country trade. The pattern of this relationship for a broad sample of countries is shown in Chart 1.

As a rough description of the data, if all exports to the United States and all exports of "referenced priced" and "organized-exchange" traded goods ("RW goods") to other countries were invoiced in dollars, the standard currency for pricing most of these transactions, a country would have its observations lie along the 45 degree line in this figure. Many of the accession countries have invoicing patterns above the 45 degree line, suggesting that they have fewer exports invoiced in dollars compared with what would be predicted by this simple metric. Estonia, Slovenia, Slovakia, Hungary, and the Czech Republic fit this description. The exception is Latvia, which was like Greece in that there was considerably more use of dollars in invoicing exports than expected purely on the basis of trade with the United States and its exports of highly substitutable goods.

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[1] This picture also motivates the related question of the optimal import or export price sensitivities to exchange rates.

Chart 1: Vehicle currency use of the dollar and "commodity" type exports
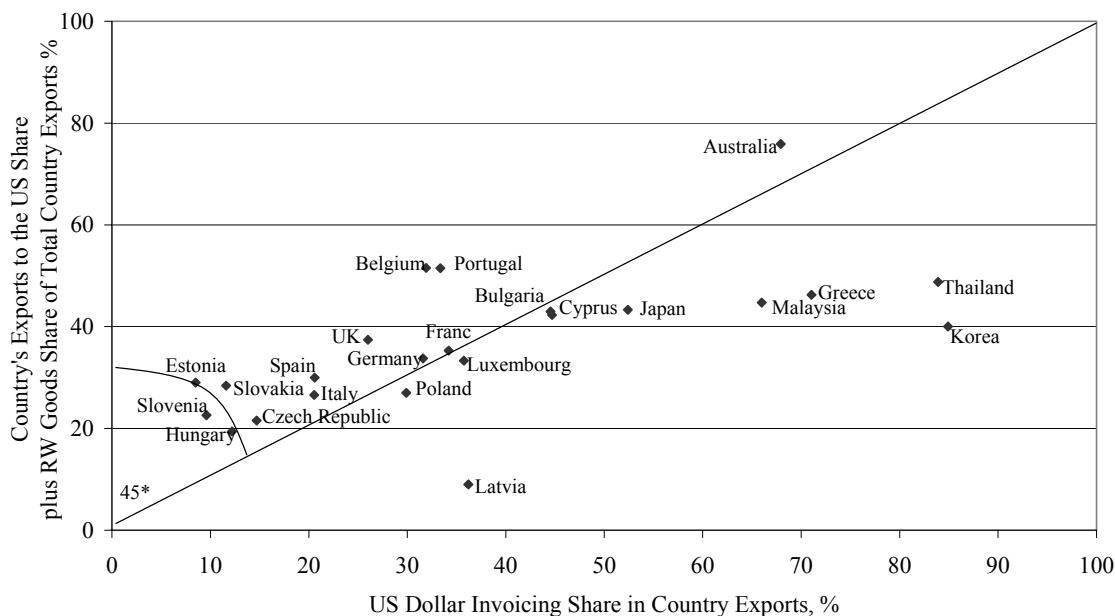
Source: DOTS and various national sources
Euro-area country data, with the exception of Italy data, refer to extra-euro area trade and invoicing

Reproduced from Figure 5, Goldberg and Tille (2005).

What are the consequences of exporters making invoice currency choices that are inappropriate, given observed industry features and given the volatility of macroeconomic conditions? These choices would lead to lower expected profits and more volatile profits than are optimal. As a hypothetical, consider the case of an accession country exporter invoicing in euros when competitors in euro area countries or in the United States are invoicing in dollars. Suppose as well that there is a high degree of product substitutability between the exporter's goods and its competitor's goods. With fluctuations in exchange rates, the exporter's relative price will vary ex post, even if ex ante the common currency expected prices of the goods were identical. An unanticipated dollar appreciation against the euro would lead the exporter to experience a sharp increase in demand for its goods. Given decreasing returns to scale, the exporter would also have an increase in his marginal costs. The net effect on expected profitability will depend on the elasticities of substitution, the returns to scale in his production function, and a mix of covariances between the revenue and cost conditions he faces. In the reverse

case of an unexpected dollar depreciation against the euro, the exporter's goods are ex post excessively expensive, leading to extensive substitution away from his products.

This example shows that, even in cases where accession country exporters are overwhelmingly trading with euro area countries, dollars still might be more optimally selected as invoicing currencies on trade with the euro area for those goods on which dollars are vehicle currencies for pricing. Indeed, exporters in euro area countries use dollars for invoicing similar products even on trade transactions within the euro area, as recently documented by the ECB (2004).

We focus on this question for the accession countries, starting from the model and lessons presenting in the optimal invoicing currency work of Goldberg and Tille (2005). After briefly presenting the theoretical motivation (section II), we turn to the empirics. We detail on the direction of trade of accession countries with respect to euro area countries, the rest of the European Union, the United States markets, and other "dollar bloc" countries. We then present details on the product composition of accession country exports and imports. For this work we apply the Rauch (1999) indices in order to categorize accession country exports and imports according to whether they are best described as differentiated goods, referenced price goods, or good priced in and traded on organized exchanges. Organized exchange trade goods, like commodities, are assumed to be highly substitutable and the theory predicts that producers of such goods should herd in their invoicing choices, with the dollar typically the currency for such herding.

Next, we focus on the role of hedging considerations in optimal invoicing decisions by exporters.[2] The theory predicts that the optimal hedges are those that cover expected shocks to producer marginal costs. In other words, for stable expected profits, a producer should optimally invoice in a currency that yields positive revenue shocks at the same time that the producer faces high marginal costs, either because wages fluctuate or because aggregate demand fluctuates in an environment of non-constant returns to scale. An invoice currency can be selected as optimal if it provides the highest covariance between an exchange rate (on the producer export revenue) and marginal costs. Thus, revenue will be high just at the times that marginal costs are high. For each country, we

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[2] A parallel analysis on the considerations for accession country importers is provided in the paper's appendix.

explore whether the dollar or euro better suits this objective in export transactions to the United States, to the euro area, or to the rest of the European Union.

Based on this analysis, we provide a number of interesting observations.[3] First, there is considerable cross-country heterogeneity in the portion of exports invoiced in dollars versus in euros. On average, more than half of the exports of accession countries are invoiced in euros, with the average share of exports invoiced in dollars closer to 25 percent. Euro use has been increasing, with some of this euro gain matched by declines in dollar use in export invoicing. Indeed, dollar use as an invoicing currency has declined even for some countries that we view as initially having surprisingly low use of dollars by our rough analytical metrics. On accession country exports to countries other than the United States and those outside the euro area, euro invoicing is roughly 37 percent, a lower share than observed for euro area countries. [4]

The United States is not a major export destination for the goods of most accession countries, typically receiving less than 5 percent of these exports. Most of the accession country exports go to the euro area and the rest of Europe. Between 60 and 85 percent of the total exports of accession countries are characterized as differentiated products. While the remaining exports are often in reference priced goods, for example paper, some countries also export substantial amounts of organized exchange traded goods like copper and aluminum. Much of the latter types of exports have dollar pricing worldwide. Controlling both for the structure of partners in trade and the composition of traded goods products, accession countries use euros more heavily and use dollars less frequently in invoicing than do euro area countries.

Our examination of the optimal currencies in invoicing for hedging purposes also yields interesting conclusions for accession country exports to the United States, the euro area, and the rest of the European Union. The covariance analysis for this work compares the desirability of invoicing in euros versus dollars to each destination market. We find

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[3] Throughout, although the exposition concentrates on the exports of accession countries, parallel results for accession country imports are presented in the appendix.

[4] Small countries typically have low use of their own currencies in international trade transactions, as reported in Goldberg and Tille (2005). The two accession countries that report this information, the Czech Republic and Latvia, use their home currency on invoicing less than 10 percent of their imports and exports.

that the dollar is the optimal invoice currency on most accession countries exports to the United States. For Estonia, Latvia, and Slovenia, the model also predicts that the dollar should be preferred over the euro as a hedging currency on exports to the euro zone and the rest of the European Union. Exporters in the other accession countries would optimally use the euro on these transactions, or be indifferent to the euro or dollar as an invoice currency choice on these exports.

Overall, if the dollar is the key vehicle currency for many countries on goods we call reference priced and exchange traded, our results suggest that some accession countries may have moved further toward the euro in trade invoicing than potentially optimal. This argument relies, in part, on an assumption that the dollar has retained a central role as a vehicle currency in the goods that are reference priced and traded on organized exchanges.

II. A three-country / three currency model of invoice currencies

Our theoretical exposition closely follows the model of Goldberg and Tille (2005) [hereafter GT] on currency choice for trade invoicing. As exposited above, GT develop the interaction between industry features and macroeconomic variability in a new open-economy macro model with three countries and price rigidities. Their work builds on Devereux, Engel and Storegaard [DES] (2004), which was broader in the sense of being a general equilibrium model. While GT do not derive a general equilibrium version of the DES model, they extend the existing theory is several critical dimensions. First, GT move from the DES two-country / two-currency world to a three-country / three-currency one, allowing for invoicing in a vehicle currency that belongs neither to the exporter or importer home markets. Second, GT develop the contrasting roles in optimal invoice currency selection of *industry characteristics*, such as the substitutability between competitors' goods, and *macro-economic factors*, such as business cycle and exchange rate volatility. The firm's incentive to limit the fluctuations of its relative price by choosing a trade invoicing strategy close to that of its competitors leads to a type of 'herding' behavior in invoice currency choice for the exporters of relatively

homogeneous products. Third, GT introduce decreasing returns to scale in production, so that increases in output increase marginal costs even when wages are not responsive.

Overall, GT conclude that macroeconomic variability is an important consideration in optimal invoicing only when the trade transactions are in differentiated products. The degree of macroeconomic volatility needed to disturb an invoicing status quo for trade in more homogeneous products would need to be exceptionally large. The theoretical prediction is that -- even within a country where all economic agents face the same degree of macroeconomic volatility-- different producers will make different invoice currency choices. Moreover, an exporter with two distinct trading partners is more likely to use distinct currencies on invoicing his exports to these distinct partners when his production is in differentiated goods and when he faces lower levels of decreasing returns to scale in production.

The model set-up. Before turning to the empirical implementation for accession countries, this section presents an abridged version of GT. An exporting firm is assumed to have to post a price for its goods before knowing the realization of various shocks affecting the economy. The exporter is located in country e, produces a brand z, and sells her goods to the destination country d. Goods are produced using a decreasing returns to scale technology:

(1) $\qquad Y_{ed}(z) = (\alpha)^{-1} [H_{ed}(z)]^{\alpha} \qquad , \qquad 0 < \alpha \leq 1$

where $Y_{ed}(z)$ is the output of z, $H_{ed}(z)$ is the labor input, and α is the returns to scale parameter. The firm faces the following demand in destination country d:

(2) $\qquad Y_{d}(z) = [P_{ed}(z)/P_{d}]^{-\lambda} C_{d}$

where C_{d} is the total demand for brands of the relevant sector in country d, $P_{ed}(z)$ is the price, in country d currency, of the brand z produced in country e, and P_{d} is the price index, in country d currency, across all brands of the relevant sector sold in country d. $\lambda > 1$ is the elasticity of substitution between the various brands. According to (2), the

demand for a specific brand depends on its price relative to the prices of other brands in the sector and on the strength of overall demand in the destination market.

The exporter producing brand z sets its price in currency k, $P_{ed}^k(z)$, before the realization of the shocks affecting the economy. The currency of invoicing can be the currency of the country in which the exporter is located ($k=e$), the currency of the country of destination ($k=d$), a third vehicle currency ($k=v$), or a combination of these three currencies. The exporter's price is set in currency k to maximize expected profits:

$$(3) \qquad \Pi_{ed}^k(z) = ED_e \left\{ S_{ek} P_{ed}^k(z) \left[\frac{S_{ek} P_{ed}^k(z)}{S_{ed} P_d} \right]^{-\lambda} C_d - W_e(\alpha)^{\frac{1}{\alpha}} \left[\left[\frac{S_{ek} P_{ed}^k(z)}{S_{ed} P_d} \right]^{-\lambda} C_d \right]^{\frac{1}{\alpha}} \right\}$$

where S_{ek} is the exchange rate between currency e and currency k, in terms of units of currency e per unit of currency k so that an increase corresponds to a depreciation of currency e. D_e is the state-specific discount factor at which profits are evaluated, and W_e is the nominal wage. With its price set in currency k, the unit revenue for the exporter in currency e is $S_{ek} P_{ed}^k(z)$. Similarly, the price in currency d paid by consumers in the destination country is $[S_{ed}]^{-1} S_{ek} P_{ed}^k(z)$.

Optimal invoice currency selection. Following steps detailed in GT, optimal profits are derived as the exporter chooses the currency k in which her goods are invoiced.[5] In this invoicing decision, the exporter regards all the other variables in (3), such as the demand c_d, wage w_e, aggregate price p_d and exchange rate s_{ed} as exogenous to her invoicing decision, with lower case variables denoting log deviations from the steady state by lower case letters ($x = \ln X - \ln X_{ss}$). Without constraining the exporter to invoice entirely in

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[5] We consider that the firm is owned by agents in the exporting country, so profits are discounted using the marginal utility of income for these agents. This is done without loss of generality: while a resident of another country would value profits after converting them in her own currency, this has no impact on the optimal invoicing decision that is the focus of the paper. All we require is that the owner treats her marginal utility of income as independent from the profits of a particular firm, in a similar way as she treats the consumer price index as independent from the price set by a particular firm. This point is discussed in Engel (2005)

any currency *e, d* or *v,* the invoicing decision is a choice of weights of the three available currencies in the invoicing currency basket *k.* Specifically, the weights of currencies *d* and *v* in the invoicing of exports to country *d* are β_d^d and β_d^v respectively, with the weight of currency *e* being $1 - \beta_d^d - \beta_d^v$, and with all weights bounded between 0 and 1. The cases of pricing in one currency only are given by setting the weights to 0 or 1. Specifically, producer currency pricing (PCP) corresponds to $\beta_d^d = \beta_d^v = 0$, while local currency pricing (LCP) corresponds to $\beta_d^d = 1, \beta_d^v = 0$, and vehicle currency pricing (VCP) is the given by $\beta_d^d = 0, \beta_d^v = 1$.

Consider the sensitivity of the relative price between brand *z* and the competing brands, p_d, to exchange rate movements. Some brands are invoiced in currency *d*, so the price paid by the consumers for these brands is unaffected by exchange rate movements. Other brands are invoiced in currency *e*, and the consumer price in currency *d* moves with the exchange rate between the two currencies, s_{ed}, with consumer paying a higher price when currency *e* appreciates (i.e $s_{ed} < 0$). A final set of brands are invoiced in currency *v*, so the price paid by consumers is higher when currency *v* appreciates (i.e. $s_{ed} - s_{ev} < 0$). We denote the share of competing brands invoiced in currency *d* by η_d^d, and the shares invoiced in currency *e* and *v* by η_d^e and η_d^v respectively.

The relative price of the good sold in the destination market becomes:

(4) $$q_{ed}^k = \left(\beta_d^d - \eta_d^d\right)s_{ed} + \left(\beta_d^v - \eta_d^v\right)s_{ev}$$

Expression (4) shows that full stabilization of his relative price requires an exporter to choose weights on the different currencies that exactly correspond to their shares in the industry wide price index: $\beta_d^d = \eta_d^d, \beta_d^v = \eta_d^v$.

The optimal invoicing weights β_d^d and β_d^v are chosen to maximize expected profits, under the constraint that β_d^d, β_d^v and $\beta_d^d + \beta_d^v$ do not fall outside the [0,1]

interval. For the case where an exporter is selling only to one destination market, GT derive the optimal invoicing basket solution as:[6]

(5) $$\beta_d^d = \Omega \eta_d^d + (1-\Omega)\rho(m_{ed}, s_{ed})$$

(6) $$\beta_d^v = \Omega \eta_d^v + (1-\Omega)\rho(m_{ed}, s_{ev})$$

(7) $$\beta_d^e = 1 - \beta_d^d - \beta_d^v = (1-\Omega) + \Omega \eta_d^e - (1-\Omega)[\rho(m_{ed}, s_{ed}) + \rho(m_{ed}, s_{ev})]$$

where: $$\Omega = \frac{\lambda(1-\alpha)}{\alpha + \lambda(1-\alpha)} \qquad , \qquad m_{ed} = w_e + \frac{1-\alpha}{\alpha}c_d$$

The term m_{ed} in (5)-(7) is a covariance reflecting the influence of exogenous factors, for example exporter wages and destination market aggregate demand, on the firm's marginal cost. Because of decreasing returns to scale, a 1 percent increase in demand requires a $1/\alpha$ percent increase in the labor input, hence a $1/\alpha$ percent increase in cost, holding the wage constant. The increase in demand also leads to a 1 percent increase in revenue, holding the price constant. The net increase in the marginal cost is then $1 - 1/\alpha = (1-\alpha)/1$ percent. The terms $\rho(m_{ed}, s_{ed})$ and $\rho(m_{ed}, s_{ev})$ in (5)-(7) are regression coefficients that capture the covariances between marginal cost, m_{ed}, to the exchange rates s_{ed} and s_{ev}.

Interpretation of optimal invoicing. Invoicing in the exporter's currency has the advantage of fully stabilizing the exporter's marginal revenue, as she receives a given amount of her own currency for each unit sold. Yet, this full stabilization ($\beta_d^e = 1$) is not necessarily an optimal choice for two reasons shown in the optimal invoicing equations (5)-(7). The first reason reflects a herding motive, captured by the terms $\Omega \eta_d^d$ and $\Omega \eta_d^v$ in (5)-(7). The exporter optimally limits the movements of her relative price by choosing an invoicing strategy close to that of its competitors. For example, the exporter will place a higher weight on invoicing in the destination currency, β_d^d, when her competitors also invoice a higher share of their own sales in that currency, η_d^d.

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[6] Goldberg and Tille (2005) derive a similar set of intuitions for the case where the exporter is constrained to use a single currency, rather than a basket of currencies, in his optimal selection. The results are qualitatively the same.

The second reason reflects a hedging motive, denoted by the terms $(1-\Omega)\rho(m_{ed}, s_{ed})$ and $(1-\Omega)\rho(m_{ed}, s_{ev})$. In this case, the exporter wants to choose an invoicing strategy that limits the impact of fluctuations in marginal costs on her profits. If she invoices in the destination currency, *d*, a depreciation of her currency vis-à-vis the destination currency ($s_{ed} > 0$) increases the exporter's revenue, in her own currency, from each unit sold. If depreciations of this exchange rate tend to be correlated with increases in marginal costs, i.e. $\rho(m_{ed}, s_{ed}) > 0$, invoicing in the destination currency provides an hedge as marginal revenue and marginal costs then are positively correlated. A similar logic applies to the vehicle currency. Indeed, if we were to consider alternative vehicle currencies, the model implies that the hedging would be best accomplished by using the currency that has an exchange rate that is significantly and more positively correlated with the shocks to exporter costs, arising due to shifts in local currency wages (for example) and to fluctuations in destination market demand in an environment of decreasing returns to scale.

The relative weight on the herding dimension in (5)-(7) is given by the term Ω, which solely reflects the structural parameters of the model, namely the elasticity of substitution between goods, λ, and the degree of returns to scale, α. The herding dimension is more pronounced (Ω is large) in industries where goods are more substitutable (λ is large), as movements in relative prices then leads to large fluctuations in quantities sold. The effect is also stronger the more the technology exhibits decreasing returns to scale (α is small), because fluctuations in output generate large movements in marginal cost.

Clearly, the theoretical exposition shows that optimal invoicing has a set of country-specific dimensions and a set of industry-specific dimensions. The invoicing of exports in industries that are highly differentiated should be relatively more responsive to the pattern of volatility in macro-economic variables, such as wages and demands. By contrast, in industries that produce a more homogenous good, the model predicts that

firms should optimally invoice in a basket of currencies close to that of their competitors.[7]

III. Invoicing Trade for Accession Countries

A recent ECB report[8] provides data on euro invoicing of imports and exports for eight euro zone countries (Belgium, France, Germany, Greece, Italy, Luxembourg, Portugal, and Spain), all ten accession countries (Cyprus, the Czech Republic, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Slovakia, and Slovenia), and Bulgaria, a European Union candidate country. In our analysis below, we include Bulgaria in the same heading as an "accession country", misusing the terminology for brevity purposes.

The ECB data run from 2000 to 2003, with less complete coverage across countries in the early years. We have supplemented the data from the ECB report with data on euro, dollar, and local country invoicing gathered from individual country sources. The accession country data are presented in Table 1, with the top panel providing broad details for 2000, and the lower panel providing details for 2002, the last year for which dollar invoicing data are widely available.

The accession countries invoice their imports and exports largely in euros, with an average euro share well over 50 percent in 2002. However, the cross-country variation in the role of the euro in export invoicing is large, ranging from below 25 percent for Cyprus and Lithuania to over 60 percent for the Czech Republic, Estonia, Hungary, Poland, Slovakia, and Slovenia. With exception of Cyprus, the data indicate a significantly smaller share of exports and imports invoiced in U.S. dollars. Most accession countries do not report local currency invoicing shares. The two countries that do, the Czech Republic and Latvia, report home currency shares for imports and exports at or below 10 percent. Since the sum of euro and dollar are closer to 80 percent than 100 percent for some countries (Cyprus, Czech Republic, Estonia, Lativia, for example), it is evident that some other currencies still play an important role in invoicing trade.

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[7] There is a parallelism between optimal invoice currency selection and observed levels of exchange rate pass through into traded goods prices. Goldberg and Tille (2005) and Engel (2005) show the direct correspondence between models of optimal invoice currency selection under sticky prices and partial exchange rate pass through in the case of flexible prices.

[8] *Review of the International Role of the Euro*, Jan 2005.

Table 1: Dollar and Euro Shares of Trade Invoicing in Accession Countries

Invoicing Patterns in 2000				
	Exports		**Imports**	
	Euro Share	*Dollar Share*	*Euro Share*	*Dollar Share*
average:	**46.0**	**39.3**	**48.5**	**37.8**
Bulgaria	37.0	60.1	47.0	50.2
Czech Republic*	65.4	14.1	63.1	19.7
Latvia**	35.5	43.6	35.5	43.6
Invoicing Patterns in 2002				
	Exports		**Imports**	
	Euro Share	*Dollar Share*	*Euro Share*	*Dollar Share*
average:	**58.6**	**23.1**	**58. 5**	**27.6**
Bulgaria	52.0	44.5	60.0	37.1
Cyprus	21.8	44.7	45.5	34.9
Czech Republic	68.8	14.7	65.0	19.5
Estonia†	70.0	8.5	61.0	22.0
Hungary	83.0	12.2	73.0	18.5
Latvia **	47.7	32.1	47.7	32.1
Lithuania†	22.0		53.0	
Malta			34.7	48.8
Poland	60.0	29.9	60.0	28.6
Slovakia	73.9	11.6	60.1	21.2
Slovenia	87.0	9.6	83.0	13.3

* data from 2001 instead of 2000
† data from 2003 instead of 2002
** Latvian data are for overall invoicing of imports and exports combined
Source: ECB (2002, 2004, 2005) and individual country sources (details in appendix)

There are only a few countries for which invoicing data are available both for 2000 and 2002 and which provide us with perspective on how invoicing patterns are changing over time. The euro has grown in its role as the currency used in invoicing both the export and the import transactions in all of these countries. This pattern is shown in Chart 2, where the left most bars indicate the increase in average annual euro use in invoicing the exports of the accession countries, while the right-most bars provide comparable information for the euro area countries.[9] For the accession countries, the

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[9] The data for the accession countries and Italy cover all exports, while the data for the other euro area countries cover extra-euro area exports only.

biggest increase in euro share is for Bulgaria, at almost 8 percent annually, followed by Latvia at 6 percent, and the Czech Republic at under 4 percent. The increase in euro use on export invoicing by euro area countries has been within a similar range over this time frame, again with variation across countries. Referring back to Chart 1, only Greece and Latvia had an increase in euro use in invoicing that might be expected based on the prior "unexplained" vehicle role of the dollar in its exports.[10]

Chart 2: Average Annual Rise in Euro Invoicing of Exports, 2000-2002*
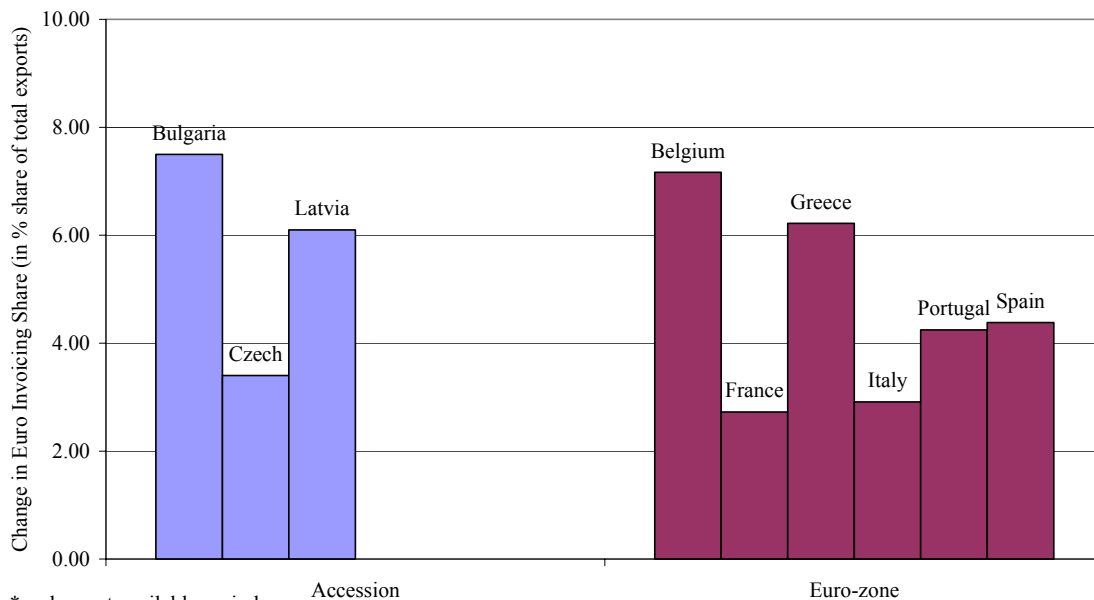
* or longest available period.
The data cover all exports for accession countries and Italy; otherwise, extra euro area exports.
Source: Author's calculations using data from the ECB report and local country sources (details in appendix)

Indeed, Chart 3 shows the extent to which these increases in euro invoicing came at the expense of using the dollar as an invoicing currency. For those countries for which there is comparable data, we show both the average annual increase in the euro and the average annual decline in the dollar in invoicing, both relative to total exports.. For the left-most bars representing the accession countries, the growth of euro use is at the expense of dollar use in invoicing for Bulgaria and Latvia, but not in the case of the Czech Republic. Even in 2002, the Czech Republic had very low (and lower than expected) shares of dollar invoicing of trade. For the euro area countries, much of the

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[10] Appendix Table 1 provides the raw data on invoicing for euro area countries.

recent gains in invoicing by the euro have been due to substitution away from dollar use, except in the case of French exports.

Chart 3: Average Annual Rise in Euro Invoicing and Fall in Dollar Invoicing of Exports, 2000-2002*
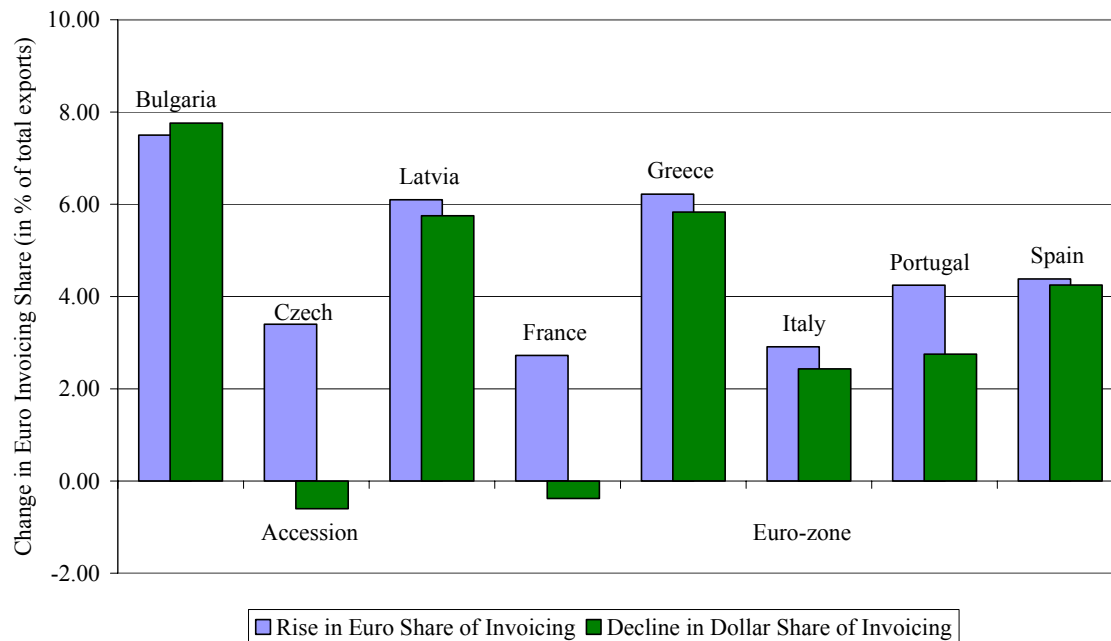

Source: Author's calculations using data from the ECB report and local country sources (details in appendix)

The observation of changing invoicing patterns is not as important for discussions of welfare as are the explanations of these changes. The theoretical section points to the first order importance of the changing composition of trade, direction of trade, or covariance structures in macroeconomic fluctuations. Alternatively, we might see a switch in market invoicing from use of dollars to use of euros on the same products, with the same partners.

For the accession countries, for example, we ask whether the gain in euro use arose from an increased prominence of the euro area (and decline in the United States or dollar bloc countries) as a destination for exports. The increase in euro use (and decline in dollar use) may be because accession countries have reduced the share of commodity type goods in exports. Alternatively, there may have been a change of invoicing behavior

on the same types of goods sold to identical partners.[11] The unraveling of this behavior in light of initial conditions, and in light of the lessons from theory, permits us to provide perspective on the whether accession countries are changing invoicing orientation to an extent in the direction predicted by the theory.
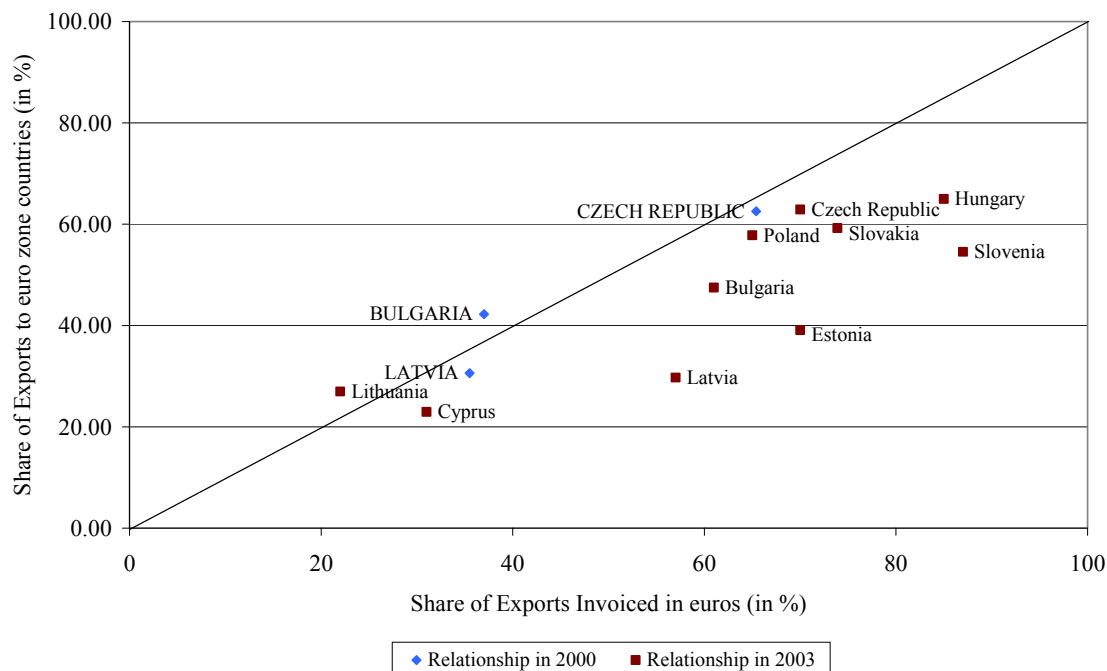
Destinations for Accession Country Exports. Did euro use increase in accession country trade because of an increasingly close trade relationship between these countries and the euro area? Chart 4 provides data on euro share in invoicing exports versus euro area share in total accession country exports for the years 2000 (indicated with lighter points) and 2003 (darker points). If all euro area trade were to be invoiced in euros, we would expect the data points of this chart to lie along the 45* line.

The proximity of the lighter points to the 45 degree line indicate that, for the three countries for which data is available in 2000, the shares of euros in invoicing accession country exports were approximately equal to the shares of the euro zone countries in accession country exports.[12] For 2003 we have more extensive reporting across countries of their invoicing patterns on exports. Those countries also reporting in 2000 expanded their use of euros in invoicing well beyond the expanded share of the euro area in exports. The other accession countries, with the single exception of Lithuania, have euros playing a larger role in export invoicing than would be expected purely due to trade with countries that have adopted the euro (and ignoring at this point the issue of the composition of trade which should reduce this euro share further). Yet, between 2000 and 2003 patterns of exports by region for accession countries are virtually unchanged and would not predict extensive increases in euro invoicing. Those changes in evidence are mild increases in trade share with the euro zone and with non-euro area Europe.

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[11]Another, more mundane explanation is that these results are purely due to translation effects due to changes in the dollar-euro exchange rates between 2000 and 2002. The valuation effects due to the strong dollar during 2000 made the dollar value of exports disproportionately high for euro area countries. If the invoicing data are based on nominal values, not real quantities, the decline in the dollar against the euro through 2002 could reduce the measured dollar invoicing share, even if actual invoicing patterns were unchanged. The dollar appreciated by 3.1 percent from 2000 to 2001 and depreciated by 5.6 percent in 2002. The cumulative change from 2000 to 2002 was a dollar depreciation of 2.3 percent, much smaller than the total average declines in dollar invoicing of exports of 16 percent for accession countries, and 14 percent for euro area countries.

[12] Details for import invoicing are presented in Appendix Chart 3.

Chart 4: Export Invoicing in Euros v. Exports to the Euro Zone, 2000 and 2003

One potential explanation is that accession country exporters are increasingly using euros to invoice exports even in non-euro zone markets, for example in the rest of the European Union. In countries outside of the euro zone, if their competition is invoicing in euros the accession country exporters might achieve steady relative prices by invoicing in the same currency. Indeed, for perhaps similar reasons that the accession countries choose to invoice trade largely in euros, many countries outside of Europe choose to invoice their exports largely in U.S. dollars.[13]

Table 2 provides details on the concentration of accession country trade with European markets, the United States, and other countries heavily using the dollar. In 2003, the euro area share is sometimes only half total accession country exports to all of Europe (which additionally includes all other Western and East-Central European countries).

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[13] As an example of this, Goldberg and Tille (2005) show that among Australia and several East Asian economies, for example, dollar invoicing averages 73% for imports and 75% for exports.

The right most columns of Table 2 contrast the role of Europe with the counterparty role in accession exports of the United States, East Asia (Cambodia, China, Hong Kong, Indonesia, Korea, Malaysia, Philippines, Thailand, Vietnam), and Other Dollar Bloc countries (which for this purpose are treated as: Australia, New Zealand, Canada, Argentina, Bolivia, Brazil, Chile, Colombia, Costa Rica, Dominican Republic, Ecuador, El Salvador, Guatemala, Honduras, Mexico, Nicaragua, Panama, Paraguay, Peru, Uruguay, Venezuela.) [14] With the exception of Malta, the United States purchases less than five percent of euro area exports. This general message of accession countries having low direct links with dollar countries via exports is supported even after we control for their exports to East Asia and other dollar bloc countries.

Table 2 Accession Country Export Shares by Trading Partner, 2003

Country	Euro Area	All Europe	United States	East Asia	Other Dollar Bloc	All Dollar Bloc
Bulgaria	51.3	85.3	6.1	1.4	1.6	9.0
Cyprus	23.0	64.0	1.9	1.7	1.2	4.8
Czech Republic	62.9	93.2	2.5	1.1	0.7	4.3
Estonia	39.1	92.8	2.4	1.6	0.9	4.9
Hungary	65.0	91.7	3.2	0.9	0.7	4.8
Latvia	29.7	92.3	2.9	0.8	1.1	4.8
Lithuania	27.0	94.5	2.8	0.8	0.6	4.2
Malta	23.9	39.8	11.7	14.4	1.8	27.9
Poland	57.8	93.2	2.2	0.9	1.2	4.1
Slovakia	59.3	92.7	4.6	0.7	0.8	6.1
Slovenia	54.5	92.3	3.7	0.6	0.8	5.1

Source: International Monetary Fund, *Direction of Trade Statistics*

We do not have details on euro use on accession country exports to the euro area versus exports to other Europe. Speculatively, given this dominance of trade with the rest of Europe, it is plausible that these might be the markets where accession countries are invoicing in euros. To provide intuition on this point, we construct a hypothetical

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[14] Together these countries account for between 67-99 percent of the exports and 78-98 percent of the imports of the accession countries.

invoicing example to provide upper bounds on this use. Suppose that 100 percent of accession country trade with the euro area is invoiced in euros (ignoring again the validity of this assumption in light of the composition of this trade) and 100 percent of accession country trade with the United States is invoiced in dollars (which GT show is an overstatement for euro area countries on which specific evidence exists). The implied use of euros in the rest of accession country exports, which are primarily directed at the rest of Europe for all accession countries other than Cyprus and Malta, are shown in Chart 5. [15]

These computations imply that euro invoicing occurs on an average of 37 percent of accession exports outside of the euro area and the United States. The variation across countries is large. Lithuania has zero implied euro invoicing on transactions outside the euro area, while Hungary and Slovenia have euro invoicing have shares exceeding 70 percent on transactions outside the United States and euro area. Such statistics can be compared with invoicing patterns of countries already within the euro area, where the euro serves as the producer currency as well as a potential vehicle currency elsewhere. Starting with data on extra-euro area trade, we observe euros used in invoicing approximately 50 percent of extra euro-area exports. Under the assumption that trade with the United States is exclusively in dollars, this would imply that euros are used in invoicing nearly 60 percent of the remaining exports. The range is from a low of 30 percent for Greece to about 75 percent for Germany.

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[15] The share of euro use in extra-euro area exports is constructed as: (share of total exports invoiced in euros – share of total exports sent to euro area) / (100-share of total exports sent to the euro area and the United States), where all shares are in percent.

Chart 5: Euro Invoicing Share of extra-Euro Zone Exports, 2003*
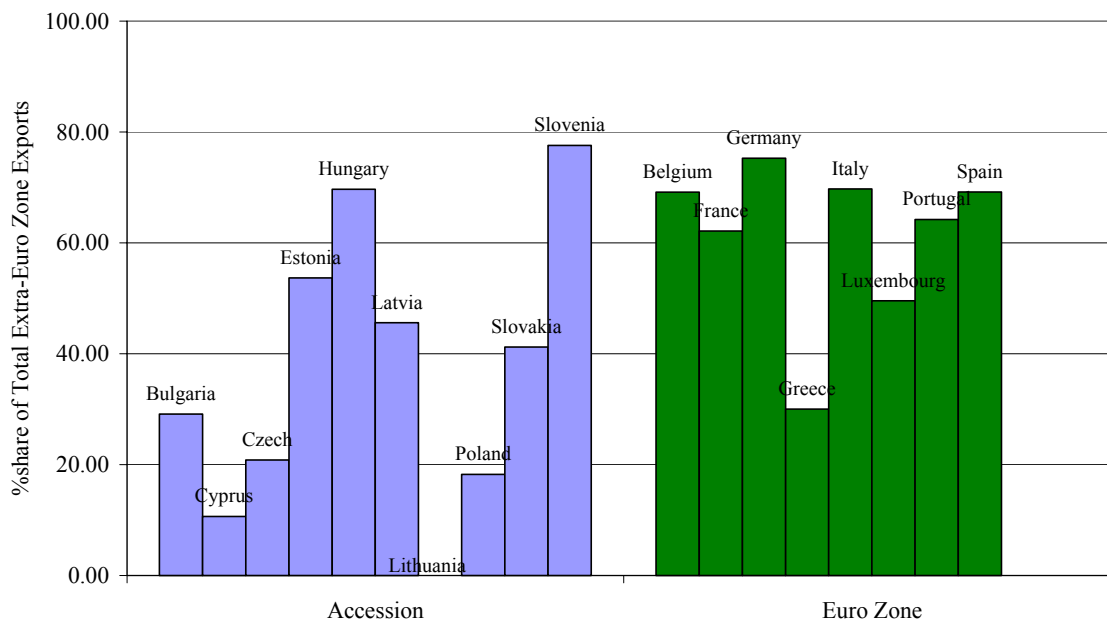
* * With Accession country shares estimated assuming that 100% of exports to the euro zone are invoiced in euros and 100% of exports to
the U.S. are invoiced in dollars. Slovakia data for 2002. Lithuania adjusted to zero from an extimated share of -7.4%.

The Composition of Accession Country Exports. The theory exposition argued that
herding in invoice currency choice would be preferred by producers whose goods have
high elasticities of substitution with those of other producers. We provide country
specific context to this point by applying to the trade of accession countries the Rauch
(1999) categorization of goods as being differentiated "N" (as are many manufactured
goods), as having uniform prices referenced in industry periodicals "R" (used for uniform
goods not widely traded enough to have a world market), or more Walrasian and
homogeneous with world market prices established on organized exchanges "W".[16]
Specifically, we apply the Rauch index to 4-digit SITC data on the composition of
exports and of imports for each accession country. Box 1 shows examples of these types
of goods, with specific reference to exports of accession countries.

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[16] Examples of differentiated goods are manufactured or specialty goods. Reference-priced goods include
uniform products that are not traded in an organized world market, for example paper. Organized exchange
traded products are mainly commodities traded in an open world market, such as raw ores and metals.

Box 1 Sample Industry Profiles and the Rauch Classification System

Copper: a world market priced good

Rauch classifies commodity 6821, "Copper and copper alloys, refined or not, unwrought" (SITC rev. 2 4-digit classification), as world priced and commodity 6822, "Copper and copper alloys, worked," as referenced priced. While the accession countries export large quantities of both types of copper product, $1.38 billion in 2003 (as reported by UN Comtrade), below are some details pertaining specifically to unwrought copper.

The main world market for copper is the London Metal Exchange (LME), with industry profiles and reports referencing the LME prices. The official prices quoted by the LME are in U.S. dollars per ton. The LME also trades aluminium, which is an equally major export for the accession countries ($2.04 billion in 2003), suggesting potential similarities in pricing and invoicing across both commodity categories.

The largest accession copper exporters are Bulgaria and Poland (copper comprises 6.2% of Bulgaria's total exports by value in 2003). Almost all of Bulgaria's copper is smelted at Pirdop, which is owned by Umicore, a Belgian company. The smelt copper is then exported to Umicore's headquarters in Belgium to be refined. So, Bulgaria's "export" prices aren't set by a market because they're just transfers within a corporation.

Poland's main copper producer is KGHM Polska Miedz, which supplies 6% of the worlds copper according to AME Mineral Economics. KGHM posts a lot of information about its pricing structure on its website. They base their price on the LME and add a "producers premium" which they base on the annual price announcements of Codelco (the biggest world copper producer), which are also made in dollars. KGHM reports that "within copper producers and buyers circulates opinion that Polish copper is one of the more expensive but it is worth the higher price due to its quality."

KGHM reports that the vast majority of copper sales are based on annual contracts where buyers agree to buy a certain tonnage a month whatever the market conditions, then pay each month based on the average market price over that month. A small share of sales is made with "spot contracts" to deal with unexpected shifts in supply or demand.

Paper: a reference priced good

Paper is another major export of the accession countries. In 2003 Estonia, Poland, Slovakia, and Slovenia all had paper make up more than 2% of their total exports by value. Pricing information is a little vaguer for this industry because, by definition, there is not an open world market with frequent published price quotes. While industry publications, such as Paperloop and Pulp & Paper Week, list monthly or quarterly market prices for various grades of paper, these prices are usually only made available to subscribers.

These periodicals publish prices for specific markets. Newsprint and pulp only have world markets listed, but the industry publications list printing and writing paper prices separately for North American and European markets (and sometimes Asian markets). When specific prices were mentioned, Asian markets and North American markets were quoted in U.S. dollars and Europe markets were quoted in euros. One publication listed a full table of prices from FOEX (Finnish Options Exchange) which were all in euros.

This is suggestive evidence of developing euro-priced market for some reference priced goods.

Table 3 presents the resulting shares of differentiated, reference priced, and organized exchange traded goods in each country's exports. The shares of differentiated products in exports range from 62 to 83 percent. Organized exchange traded goods are typically a small proportion of the remaining exports than reference priced goods. These organized exchange traded goods, typically priced in dollars, are generally lower than 8 percent of exports.[17] Reference priced goods are often between 15 percent and 30 percent of each accession country's exports. Cyprus, Estonia, Latvia, and Lithuania all have reference-priced products accounting for at least 25 percent of their exports.

Table 3 The Composition of Accession Country Exports in 2003, by Pricing Method

Country	Differentiated	Reference-Priced	Organized Exchange
Bulgaria	64.9	20.5	14.7
Cyprus	61.7	30.6	7.7
Czech Republic	83.0	14.5	2.5
Estonia	70.2	26.0	3.8
Hungary	81.8	13.7	4.5
Latvia	64.8	30.1	5.1
Lithuania	68.2	25.6	6.2
Malta*	80.3	6.3	13.4
Poland	75.5	18.7	5.8
Slovakia	82.0	14.6	3.4
Slovenia	80.8	16.7	2.5

* Source: Trade data from UN Comtrade, and author's calculations. Malta data from 2000

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[17] Differentiated products comprise about three quarters of 2003 imports. See the associated appendix table.

Combining the information on the direction of trade and the composition of trade is useful for considering theoretical minimum shares of dollars use in invoicing country exports, on the assumption that trade in these RW goods and trade with the United States are priced in dollars. These considerations are pulled together in Table 4. Taken together the shares of reference-prices and organized exchange traded goods represent between 17 and 35 percent of accession country exports. While these shares typically have declined since 2000, and may have accounted for some of the decline in dollar use in invoicing exports of accession countries, RW goods still represent a large portion of accession country exports (and imports). In some cases, the share of dollars used in invoicing total country exports is below the share of RW goods in the export basket (Czech Republic, Estonia, Hungary, Latvia, Slovakia, Slovenia).

Table 4: Share of Reference- and World-priced goods in Trade, 2000 and 2003

	RW share of Exports		Dollar bloc share of exports		Observed dollar share in invoicing exports	
	2000	2003	2000	2003	2000	2003
Bulgaria	42.5	35.1	6.1	7.3	60.1	44.5*
Cyprus	62.0	38.3	4.2	4.8		44.7*
Czech Republic	19.5	17.0	4.7	4.2	14.1	14.7*
Estonia	35.0	29.8	3.9	4.8		8.5
Hungary	19.8	18.2	6.8	4.7		12.2*
Latvia	36.1	35.2	5.3	4.8	43.6	32.1*
Lithuania	52.2	31.8	5.9	4.2		
Malta	19.7	--	31.1	27.8		
Poland	28.5	24.5	5.6	4.3		29.9*
Slovakia	22.0	18.0	2.5	6.1		11.6*
Slovenia	21.9	19.2	4.6	5.1		9.6*

* Dollar share data from 2002 instead of 2003
Source: col 1 and 2: Trade data from UN Comtrade, and author's calculations; col 3 and 4: IMF, *Direction of Trade Statistics*; col 5 and 6: individual country sources (details in appendix).

If these RW goods are invoiced in dollars in European markets, the model would suggest that many accession countries have been under-utilizing dollars in export transactions in 2003. Even though accession country exporters conduct much of their trade with other European countries, they are still competing with producers around the world, many of whom are likely invoicing these types of goods in dollars. The examples of pricing of copper, aluminum and paper pulp, shown in Box 1, illustrate the pervasiveness of dollar pricing on some products in these categories. If the accession country exporters are in fact invoicing less of their RW type goods in dollars and instead invoicing these goods in euros, they may be exposing themselves to excess profit risk under circumstances of movements of the euro-dollar exchange rate.

The role of hedging considerations in accession country invoicing. The theory exposition of Section II also demonstrated that macroeconomic variances and covariances also should have an impact on producer pricing and invoicing, in particular for producers of goods with lower elasticities of substitution, the goods we classify and interpret in our empirical exercise as being differentiated. In equations (5) to (7) we captured the key relationships in hedging motives as entering through covariances between the alternative exchange rates between the exporter's currency and those of destination market and vehicle currencies with $m_{ed} = w_e + \dfrac{1-\alpha}{\alpha} c_d$. Recall that w_e is the log deviation of production costs from steady state values, α is a parameter indicating the degree of diminishing returns to scale in production, and c_d is captures the business cycle conditions of the destination market.

Using data from the accession countries drawn from Eurostat and the International Financial Statistics (IMF) over the period 1995Q1-2004:Q4, we derive the values for w_e, c_d, m_{ed} and their regression coefficients with the respective exchange rates. We confine our analysis to a discussion of the dollar and the euro, and the United States, the euro area, and the rest of Europe as destination markets. Exporter wages are nominal

quarterly data (Eurostat) converted into logarithms[18] to yield w_e, the period by period value of this series, by accession country. Three destination markets d for accession country exports are introduced: the euro area, non-euro zone Europe, and the United States (potentially with other "dollar bloc" countries). In the data, destination market demand conditions, c_d, are constructed as the quarterly series of nominal real consumption expenditure for each of the three destination markets over the sample period.[19] Thus, for each country, there are three values of m_{ed} constructed, each corresponding to the relevant destination market[20] and each construction assuming α equal to 0.65.[21] Finally, each series m_{ed} is correlated with the accession country exchange rates with respect to the dollar and the euro.

From equations (5) to (7) the herding component of destination market currency in invoicing exports is $(1-\Omega)\rho(m_{ed}, s_{ed})$. A vehicle currency is used in the hedging component depending on the size of $(1-\Omega)\rho(m_{ed}, s_{ev})$.[22] Abstracting from country-specific Ω, which is related to the shares of RW goods in total exports, the ranking of regression coefficients terms provides insights into where there are greater incentives for hedging through dollar use versus euro use. In the trade transactions of an accession country with the United States, we compare the regression coefficients with the dollar exchange rate and with the euro exchange rate to judge the relative importance of invoicing in the alternative currencies in order to hedge the export profit fluctuations of the accession countries. According to the theory, the larger the correlation, the better the hedge provided by a specific currency. Since the coefficient difference could be large but

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[18] As a robustness check, we also recomputed this entire section using real wages, real consumption, and real exchange rates.

[19] For the European countries, this is Final Consumption demand summed across relevant countries and deflated by a harmonized cpi. For the United States we use a comparable definition of real demand, corresponding to the sum of Household Consumption and Government Consumption, a quarterly series in billions of US$, deflated by the US cpi.

[20] $\Omega = \dfrac{\lambda(1-\alpha)}{\alpha + \lambda(1-\alpha)}$, $m_{ed} = w_e + \dfrac{1-\alpha}{\alpha}c_d$

[21] The value α=0.65 correspondences to a markup of 20 percent over production costs.

[22]
(5) $\qquad \beta_d^d = \Omega\eta_d^d + (1-\Omega)\rho(m_{ed}, s_{ed})$

(6) $\qquad \beta_d^v = \Omega\eta_d^v + (1-\Omega)\rho(m_{ed}, s_{ev})$

(7) $\qquad \beta_d^e = 1 - \beta_d^d - \beta_d^v = (1-\Omega) + \Omega\eta_d^e - (1-\Omega)[\rho(m_{ed}, s_{ed}) + \rho(m_{ed}, s_{ev})]$

accompanied by large standard errors on the coefficients, in Table 5 we present the difference between coefficients on the dollar exchange rate and the euro exchange rate with local currency from the following regression:

(8) $M_{ed,t} = a_o + a_1 \, trend + a_2 \, local \, currency \, per \, dollar_t + a_3 \, local \, currency \, per \, euro_t + residual_t$

where the exchange rate terms are in logarithms. A positive and significant value on the difference between regression coefficients a_2 and a_3 means that the invoicing decision on differentiated goods would favor the dollar. A negative and significant value on a_2 minus a_3 means that the invoicing decision by a particular accession country exporter export transaction would favor the euro.

The results reported in the first data column of Table 5 show that, *according to the hedging motive,* the dollar is the better invoicing currency on accession country exports to the United States on all types of products. The results are highly statistically significant for all countries except for Estonia and Slovakia, where neither the dollar or the euro appear to provide significant hedges against local marginal cost fluctuations. The next two data columns compare the hedge properties of using the dollar versus using the euro in accession country exports to the euro area or to the rest of the European Union. In general, the lack of statistical significance of these reported results indicate that accession country exporters generally should be indifferent to the dollar or euro as invoicing currencies on these transactions. The three countries that are exceptions in this care are Estonia and Bulgaria where the euro is predicted to be favored for hedging (and where exchange rate regimes already have sharp links to the euro), and Poland where the dollar is predicted to be favored.

Table 5: Dollars versus Euros as Hedge in Accession Country Exports

	US as export destination	Euro area as destination	Other Europe as destination
	Regression coefficient $\rho(m_{edus},s_{edollar})$ $-\rho(m_{edus},s_{e,euro})$	*Regression coefficient* $\rho(m_{edeuroz},s_{edollar})$ $-\rho(m_{edeuroz},s_{e,euro})$	*Regression coefficient* $\rho(m_{edotherEU},s_{edollar})$ $-\rho(m_{edotherEU},s_{e,euro})$
Bulgaria	-0.51	**-1.52****	**-1.33****
Czech Republic	**0.97****	-0.07	0.17
Estonia	-1.32	**-2.28*****	**-2.87*****
Hungary	**0.97****	-0.06	0.23
Latvia	**0.80*****	-0.25	0.09
Lithuania	**1.17*****	0.07	0.50
Poland	**1.59*****	**0.52***	**0.90*****
Slovakia	0.73	-0.35	0.15
Slovenia	**1.33****	0.07	0.44

Note: Assumes α = 0.65. Malta and Cyprus are excluded from this computation because of missing wage data needed for the analysis.
*, **, and *** denote significance at 10, 5, and 1 percent levels, respectively.

Overall conclusions on the empirics of accession country invoicing. This final subsection pulls together the insights from the prior sections to generate suggestive conclusions on accession country export invoicing. We collect this information in Tables 6a and 6b, showing the share of reference-priced and organized-exchange-traded goods (as representative of high elasticity of substitution goods likely to be priced in dollars), the share of accession country exports directed at the euro zone, all Europe, and the United States (or "dollar bloc" countries), and the hedging currency results. Table 6a provides perspective on whether the use of dollars in this export invoicing appears to be relatively high or low, while Table 6b provides similar intuitions concerning euro use in invoicing accession country exports.

The theoretical prediction is that, as long as RW goods are priced in dollars worldwide (an assumption that can of course be questioned), the RW share provides a floor for dollar shares in export invoicing. Indeed GT show that with reasonable production parameters the herding results should dominate invoicing, even for lower elasticity of substitution goods than implied by our RW versus differentiated goods distinction.

Table 6a: 2003 Dollar Invoicing on Exports Higher or Lower than Predicted?

	RW share in exports	Observed dollar invoicing share	Dollar bloc share in exports	Hedging consideration favoring dollar on Europe trade?	Is dollar share lower than theoretically optimal?
Bulgaria	35.1	44.5*	7.3	NO	NO
Cyprus	38.3	44.7*	4.8	--	NO
Czech Republic	17.0	14.7*	4.2	--	YES
Estonia	29.8	8.5	*4.8*	NO	YES
Hungary	18.2	12.2*	4.7	--	YES
Latvia	35.2	32.1*	4.8	--	YES
Lithuania	31.8		4.2	--	--
Malta	--		27.8	--	--
Poland	24.5	29.9*	4.3	YES	YES
Slovakia	18.0	11.6*	*6.1*	--	YES
Slovenia	19.2	9.6*	5.1	--	YES

* Dollar share data from 2002 instead of 2003
Source: Trade data from UN Comtrade, author's calculations;: IMF, *Direction of Trade Statistics*;
individual country sources (details in appendix).

Pulling together these theoretical considerations in Table 6a, the share of dollars in export invoicing is lower than the RW share in exports for the Czech Republic, Estonia, Hungary, Latvia, Poland, Slovakia, and Slovenia. If the RW share in imports were more finely computed, and the role of the dollar in price setting in these markets found to be considerably lower, the calculus might be more balanced for the Czech Republic and for Latvia, but would unlikely change much for the other countries. The next columns additionally show the share of "dollar bloc" countries as destination markets for accession country exports (of which a portion are also likely the RW share). Since small countries almost exclusively invoice their exports to the United States using U.S. dollars, these exports would likely compel additional dollar use in invoicing accession country exports. Finally, we introduce a column to indicate when the dollar appears to be a better hedging currency than the euro on export transactions from the accession countries. Only in the case of Poland does the dollar also appear to be a better hedging currency on trade transactions with the European Union, adding extra impetus to using the dollar on these trade transactions. The final column of the table lists the seven

countries for which this analysis predicts that the use of dollars in invoicing export transactions is lower than expected, especially based on the assumption that herding activity is done using dollars.

Table 6b: Euro Invoicing of Exports Higher or Lower than Predicted?

	RW share in exports	*Euro zone share in exports*	*All Europe share in exports*	*Observed euro invoicing share*	*Currency Favored for hedging EU trade?*	*Is euro share higher than theoretically predicted?*
Bulgaria	35.1	51.3	85.3	52.0	Euro favored	--
Cyprus	38.3	23.0	64.0	21.8	--	--
Czech Republic	17.0	62.9	93.2	68.8	--	--
Estonia	29.8	39.1	92.8	70.0	Euro favored	--
Hungary	18.2	65.0	91.7	83.0	--	YES
Latvia	35.2	29.7	92.3	47.7	--	--
Lithuania	31.8	27.0	94.5	22.0	--	--
Malta	--	23.9	39.8		--	--
Poland	24.5	57.8	93.2	60.0	Dollar Favored	YES
Slovakia	18.0	59.3	92.7	73.9	--	
Slovenia	19.2	54.5	92.3	87.0	--	YES

2003 data. maximum theoretical prediction= (all Europe share) (1-RW share). Source: Trade data from UN Comtrade, and author's calculations; IMF, *Direction of Trade Statistics*; authors computations: individual country sources

Table 6b considers the same set of issues from the perspective of data on the euro share in invoicing accession country exports. The share of European markets as an export destination multiplied by (1 – RW share) is the theoretical maximum share of the euros in invoicing exports (under the presumption that most other countries more extensively use dollars in invoicing). Using the all Europe share in exports, this maximum compared with actual euro invoicing share predicts that the euro share is too high in invoicing exports in the cases of Hungary, Poland, and Slovenia. The predicted overuse is euros is higher still for Poland, where hedging considerations weigh in favor of

more extensive use of dollars for hedging marginal cost shocks. The relative role of the euro is more difficult to assess for the other accession country exporters.

IV.   Concluding remarks

This paper has considered the issue of invoicing of trade transactions by accession countries. Many accession countries have moved sharply away from the U.S. dollar as a currency for invoicing trade, reaching levels that appear low compared with both the role of the United States as a trading partner and the composition of accession country trade. Our analysis of herding and hedging influences on invoicing predicts that the observed dollar share on invoicing accession country exports is too low and the euro share too high in the exports of Hungary, Poland, and Slovenia. On the basis of the model, dollar use on invoicing accession country exports appears to be too low for the Czech Republic, Estonia, Latvia, and Slovakia, without the euro share being predicted to be too high. Suboptimal invoicing exposes producers to suboptimal fluctuations and yields lower expected profits.

According to the theoretical exposition, whether or not an accession country is well suited to the euro in export invoicing should depend on the partners in trade, the composition of trade, and the structure of shocks facing that exporter. If accession countries turn more toward the euro area as destination markets for exports, the role of the euro in invoicing may increase. But, potentially more important for this consideration is the composition of these products and the norms in invoicing by competitors to accession countries. At least in the case of commodity exports and highly substitutable goods, dollar invoicing on some trade may continue to be desirable even within the euro area. If exchange rates between accession country currencies and the euro are stabilized or fixed, and if exchange rates with the dollar covary positively with local shocks (so that the accession country currency or euro depreciate against the dollar when the accession country exporter faces high marginal costs), the model predicts greater use of dollars in invoicing euro area trade even as exchange rates are fixed with respect to the euro area. Alternatively, if exchange rates with the dollar covary negatively with local shocks (so

that the accession country currency or euro appreciate against the dollar when the accession country exporter faces high marginal costs), the model predicts a further movement away from accession country invoicing in dollars on euro area trade when exchange rates are fixed with respect to the euro area.

A broader question for the suitability of the euro for the trade invoicing of accession countries stems directly from the force of herding in a particular currency in the destination market for goods sold. This paper has often used the presumption that the U.S. dollar is the vehicle currency on pricing many international trade transactions, especially in highly substitutable goods. Evidence from a range of countries and a range of markets has supported such an assumption. An important consideration, though, is that the theoretical arguments, made in a partial equilibrium analysis, do not pin down which single currency – for example, dollars or euros or an alternative– will be selected by market participants for such herding.

While this herding has in recent decades been via the U.S. dollar, the stability of this equilibrium is important to consider. In particular, it would be useful to determine what types of shocks could lead to an unseating of the dollar in its vehicle currency role. In theoretical work, the answer to this question depends on what modeling assumptions are made in order to move from our partial equilibrium solution to a general equilibrium solution. The role of transaction costs in trading in different currencies might be the drivers of the equilibrium choice. This point was exposited by Swoboda (1968, 1969), and then elegantly developed by Rey (2001) in a three-country general equilibrium model emphasizing that "thick market externalities" arise from a currency's large presence in global international trade and low transaction costs of exchange. Krugman (1980) importantly pointed to the presence of inertia in vehicle currency selection, arguing, as we have, that when a currency is established as the dominant one in a market, a particular firm has no incentive to invoice in an alternative currency as this would lead to higher transaction cost and more volatile sales because of movements in its price relative to its competitors'. Once a currency has acquired a prominent role, because of low transaction costs for instance, it may keep this role even if another currency with similarly low costs emerges.

The exclusive role of macroeconomic volatility considerations in invoicing have been emphasized in recent general equilibrium papers, as in by Bacchetta and vanWincoop, 2003, Devereux, Engel and Storegaard (2004), Oi, Otani, and Shirota (2004), and Engel (2005). Yet, once a currency has been established as dominant in invoicing or as a vehicle currency and has lower transaction costs, the thick market externalities may make the conditions for overcoming the inertia difficult to satisfy.

Future theoretical work could bring these insights transaction cost and volatility considerations together to yield predictions for the future optimality of invoicing in dollars, euros, or other currencies for exporters worldwide. Future work could also consider the conditions for segmented markets to arise in herding, perhaps leading to multiple dominant currencies but either across industries or across locations.

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Appendix Table 1: Dollar and Euro Shares of Trade Invoicing in Euro Zone Countries**

Invoicing Patterns in 2000				
	Exports		Imports	
	Euro Share	*Dollar Share*	*Euro Share*	*Dollar Share*
Average:	**44.6**	**43.0**	**43.5**	**46.8**
Belgium*	46.7		46.6	
France	50.3	33.4	37.5	46.1
Greece*	15.6	76.9	25.4	65.3
Italy	66.2	24.8	59.8	34.3
Portugal	39.6	38.9	47.9	40.0
Spain	49.3	41.3	43.7	48.2
Invoicing Patterns in 2002				
Average:	**50.7**	**36.0**	**49.5**	**38.8**
Belgium	53.9	31.9	54.4	33.5
France	55.8	34.2	48.6	43.3
Germany	49.0	31.6	48.0	34. 5
Greece	21.8	71.1	31.0	62.0
Italy†	74.9	17.5	70.2	24.9
Luxembourg	44.0	35.7	31.7	38.0
Portugal	48.1	33.4	57.8	34.5
Spain	58.1	32.8	54.7	39.5

* data from 2001 instead of 2000
† data from 2003 instead of 2002
** currency shares for euro zone countries are for extra-euro zone trade only except for Italy
Source: ECB report and individual country sources (details in appendix)

Appendix Table 2 Euro Zone Country Exports by Trading Partner, 2003

Country	Euro Area Share	All Europe Share	United States Share	East Asia Share	Other Dollar Bloc Share
Austria	55.1	85.9	4.9	2.6	2.1
Belgium	63.3	80.6	6.7	2.6	2.2
Finland	32.8	73.0	8.2	5.4	3.7
France	50.5	72.2	6.8	3.4	3.1
Germany	43.3	74.0	9.3	5.4	3.4
Greece	37.7	80.4	6.5	1.6	1.9
Ireland	41.2	67.1	20.6	3.4	2.4
Italy	44.9	71.3	8.5	4.3	4.3
Luxembourg	73.0	91.0	1.9	2.1	0.9
Netherlands	63.7	85.3	4.5	2.2	1.6
Portugal	66.9	83.8	5.7	1.0	2.1
Spain	60.4	79.4	4.1	1.9	5.0

Source: International Monetary Fund, *Direction of Trade Statistics*.

Appendix Table 3 Euro Zone Country Imports by Trading Partner, 2003

Country	Euro Area Share	All Europe Share	United States Share	East Asia Share	Other Dollar Bloc Share
Austria	63.3	90.7	2.3	2.7	0.7
Belgium	61.1	77.3	5.9	5.0	2.8
Finland	37.6	84.6	3.7	4.8	2.5
France	57.6	76.5	5.4	4.5	2.3
Germany	41.0	72.8	7.3	8.3	2.5
Greece	47.3	69.5	5.2	9.9	1.5
Ireland	22.2	63.7	15.7	6.4	2.4
Italy	50.3	73.4	4.0	6.1	3.3
Luxembourg	72.4	78.0	2.2	13.0	0.6
Netherlands	42.1	61.6	8.0	12.5	4.3
Portugal	71.1	83.9	1.9	2.1	3.6
Spain	58.3	74.5	3.0	5.8	4.1

Source: International Monetary Fund, *Direction of Trade Statistics*.

Appendix Table 4 Euro Zone Country Exports by Pricing Method, 2003

Country	Differentiated Products	Reference-Priced Products	Organized Exchange Products
Austria	79.7	17.4	3.0
Belgium	71.6	23.6	4.8
Finland	60.9	35.5	3.6
France	75.2	19.3	5.4
Germany	85.6	11.7	2.7
Greece	63.6	30.0	6.3
Ireland	84.9	11.5	3.6
Italy	87.0	10.8	2.2
Luxembourg	62.7	32.6	4.7
Netherlands	62.1	30.3	7.6
Portugal	74.0	23.4	2.6
Spain	75.7	20.5	3.8

Source: Trade data from UN Comtrade, and author's calculations.

Appendix Table 5 Euro Zone Country Imports by Pricing Method, 2003

Country	Differentiated Products	Reference-Priced Products	Organized Exchange Products
Austria	77.2	15.9	6.9
Belgium	65.4	24.0	10.6
Finland	65.6	21.0	13.4
France	70.2	17.5	12.3
Germany	73.7	15.4	10.9
Greece	65.7	14.7	19.6
Ireland	81.1	14.9	4.1
Italy	64.9	17.2	17.9
Luxembourg	68.3	22.0	9.7
Netherlands	61.0	21.4	17.6
Portugal	65.5	17.4	17.2
Spain	68.3	17.7	14.0

Source: Trade data from UN Comtrade, and author's calculations.

Appendix Table 6 Accession Country Imports by Trading Partner, 2003

Country	Euro Area Share	All Europe Share	United States Share	East Asia Share	Other Dollar Bloc Share
Bulgaria	52.9	84.0	1.7	4.4	3.5
Cyprus	44.8	63.9	4.2	8.2	1.8
Czech Republic	54.9	81.2	3.1	8.9	1.4
Estonia	40.1	81.2	2.9	7.3	1.0
Hungary	50.5	75.2	3.2	12.7	1.5
Latvia	39.1	94.1	1.7	1.9	0.5
Lithuania	34.9	85.0	3.0	5.3	1.3
Malta	48.1	68.2	4.0	10.0	1.0
Poland	53.4	83.7	2.6	6.9	1.7
Slovakia	50.8	95.9	0.5	1.7	0.3
Slovenia	63.5	87.5	2.4	4.1	2.1

Source: International Monetary Fund, *Direction of Trade Statistics*.

Appendix Table 7 Accession Country Imports by Pricing Method

Country	Differentiated Products 2003	Reference-Priced Products 2003	Organized Exchange Products 2003	RW share of Imports	
				2000	2003
Bulgaria	79.4	15.2	5.4	43.0	20.6
Cyprus	73.9	14.8	11.3	40.5	26.1
Czech Republic	76.0	15.4	8.6	29.6	24.0
Estonia	77.6	18.9	3.5	24.4	22.4
Hungary	84.3	12.0	3.7	16.0	15.7
Latvia	73.4	21.9	4.7	28.0	26.6
Lithuania	64.6	13.3	22.1	43.9	35.4
Malta	--	--	--	34.2	--
Poland	73.1	15.6	11.4	33.7	26.9
Slovakia	74.8	13.8	11.4	33.2	25.2
Slovenia	73.1	20.3	6.6	34.5	26.9

Source: Trade data from UN Comtrade, and author's calculations.

Appendix Table 8 2003 Dollar Import Invoicing Higher or Lower than Predicted?

|	RW share in imports	Dollar bloc share in imports	Hedging consideration favoring dollar on Europe trade?	Observed dollar invoicing share	Is dollar share lower than theoretically optimal?
Bulgaria	20.6	11.1		37.1*	
Cyprus	26.1	14.2		34.9*	
Czech Republic	24.0	13.4		19.5*	
Estonia	22.4	11.2		22.0	
Hungary	15.7	17.4		18.5*	
Latvia	26.6	4.2		32.1*	
Lithuania	35.4	9.6		--	
Malta	--	15.0		48.8*	
Poland	26.9	11.2		28.6*	
Slovakia	25.2	2.5		21.2*	
Slovenia	26.9	8.7		13.3*	

* Dollar share data from 2002 instead of 2003
Source: Trade data from UN Comtrade, author's calculations;: IMF, *Direction of Trade Statistics*; individual country sources (details in appendix).

Appendix Table 9 2003 Euro Import Invoicing Higher or Lower than Predicted?

	RW share in imports	Euro zone share in imports	All Europe share in imports	Currency Favored for hedging EU trade?	Observed euro invoicing share
	2003	*2003*	*2003*		*2003*
Bulgaria	20.6	52.9	84.0		60.0
Cyprus	26.1	44.8	63.9		45.5
Czech Republic	24.0	54.9	81.2		65.0
Estonia	22.4	40.1	81.2		61.0
Hungary	15.7	50.5	75.2		73.0
Latvia	26.6	39.1	94.1		47.7
Lithuania	35.4	34.9	85.0		53.0
Malta	--	48.1	68.2		34.7
Poland	26.9	53.4	83.7		60.0
Slovakia	25.2	50.8	95.9		60.1
Slovenia	26.9	63.5	87.5	--	83.0

maximum theoretical optimum (all Europe share) (1-RW share), Source: Trade data from UN Comtrade, and author's calculations; IMF, *Direction of Trade Statistics*; authors computations: individual country sources

Appendix Chart 1: Average Annual Rise in Euro Invoicing of Imports, 2000-2002*
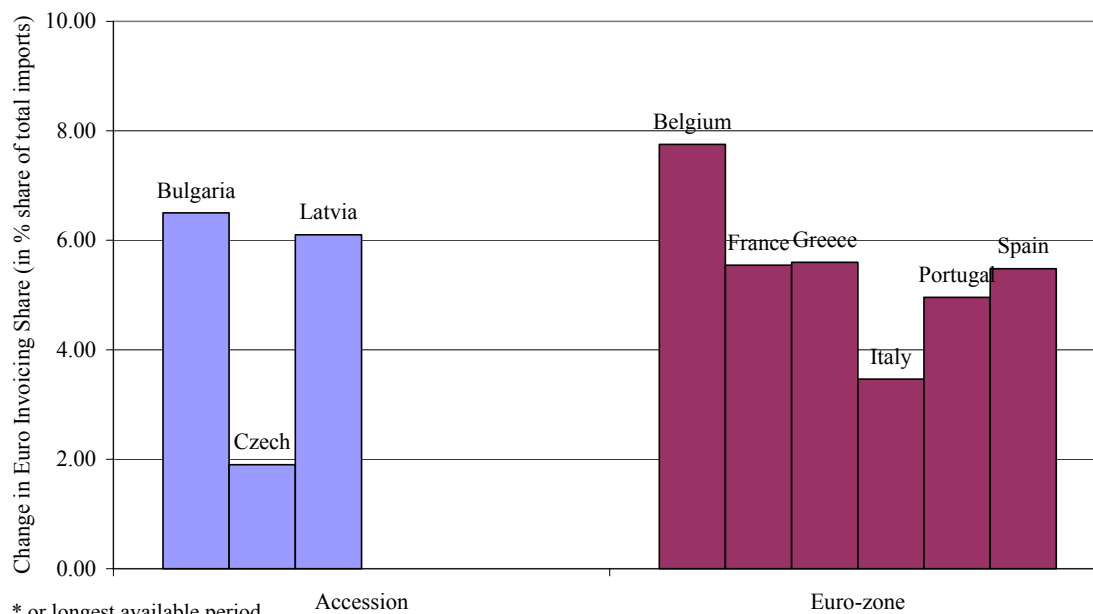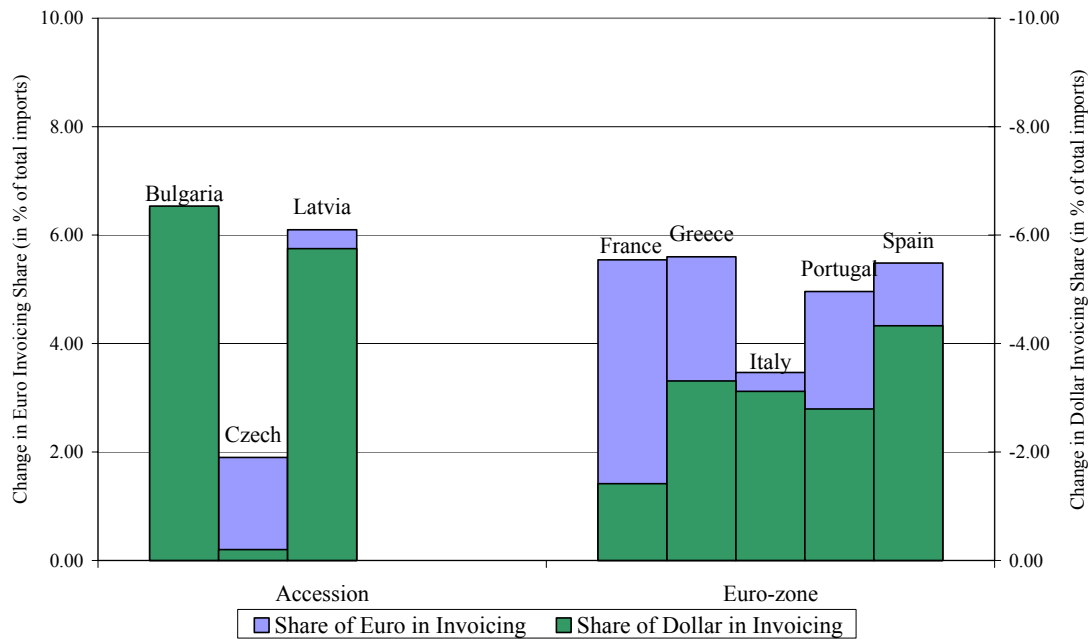

* or longest available period.
The data cover all exports for accession countries and Italy; otherwise, extra euro area exports.
Source: Author's calculations using data from the ECB report and local country sources (details in appendix)

Appendix Chart 2: Average Annual Change in Euro and Dollar Invoicing of Imports, 2000-2002*

Source: Author's calculations using data from the ECB report and local country sources (details in appendix)

Appendix Chart 3: Import Invoicing in Euros v. Imports to the Euro Zone, 2000 and 2003
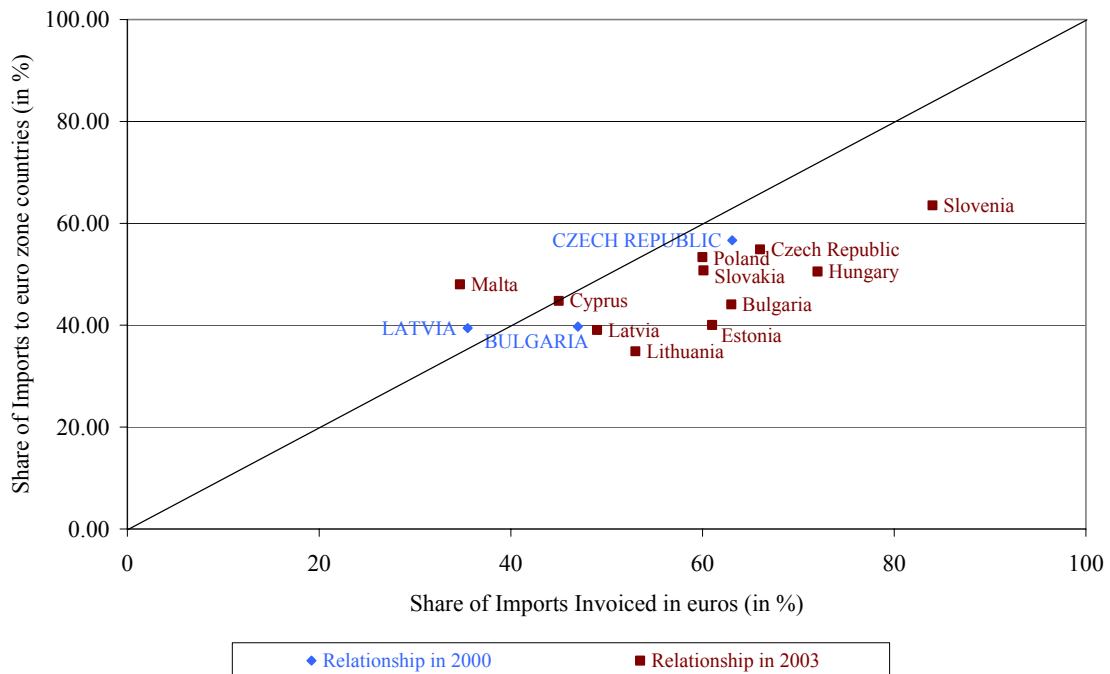
Documentation on Trade, Currency Invoicing, and Macroeconomic Data

Country	Euro Share Data Source	Dollar Share Data Source
Bulgaria	ECB publication, Review of the International Role of the Euro, Jan 2005	Bulgarian National Bank
Cyprus	from ECB, by special request	from ECB, by special request
Czech Republic	Czech Statistical Office	Czech Statistical Office
Estonia	ECB publication, Review of the International Role of the Euro, Jan 2005	from ECB, by special request
Hungary	ECB publication, Review of the International Role of the Euro, Jan 2005	from ECB, by special request
Latvia	Latvijas Banka (Latvian Central Bank)	Latvijas Banka (Latvian Central Bank)
Lithuania	ECB publication, Review of the International Role of the Euro, Jan 2005	
Malta	ECB publication, Review of the International Role of the Euro, Jan 2005	
Poland	ECB publication, Review of the International Role of the Euro, Jan 2005	from ECB, by special request
Slovakia	ECB publication, Review of the International Role of the Euro, Jan 2005	from ECB, by special request
Slovenia	ECB publication, Review of the International Role of the Euro, Jan 2005	from ECB, by special request
Belgium	ECB publication, Review of the International Role of the Euro, Jan 2005	from ECB, by special request
France	from ECB, by special request	from ECB, by special request
Germany	ECB publication, Review of the International Role of the Euro, Jan 2005	from ECB, by special request
Greece	ECB publication, Review of the International Role of the Euro, Jan 2005	from ECB, by special request
Italy	Ufficio Italiano dei Cambi, by special request	Ufficio Italiano dei Cambi, by special request
Luxembourg	ECB publication, Review of the International Role of the Euro, Jan 2005	from ECB, by special request
Portugal	from ECB, by special request	from ECB, by special request
Spain	from ECB, by special request	from ECB, by special request

Documentation on Data for Covariance Calculations

Data	Source	Frequency	Coverage	Countries	Notes
CPI	IFS	quarterly	1995q1-2004q4	all	index, 2000=100.
Final Consumption Expenditure	Euro Stat	quarterly	1995q1-2004q4	all accession countries except Malta, plus the euro-zone.	Equals Household Consumption + Government Consumption. Reported in millions of euro, not seasonally adjusted.
Government Consumption	IFS (Malta) BLS (U.S.)	quarterly	1995q1-2004q4	United States And Malta	in billions of US$ or in millions of Malta liri, not seasonally adjusted. Summed with Household Consumption to create Final Consumption
Household Consumption	IFS (Malta) BLS (U.S.)	quarterly	1995q1-2004q4	United States and Malta	in billions of US$ or in millions of Malta liri, not seasonally adjusted. Summed with Government Consumption to create Final Consumption
Wages	Euro Stat	quarterly	1995q1-2004q4	all	Not Seasonally Adjusted, nominal, reported in percent change over previous period. NACE industries C to K (Industry and services, excluding public administration).
Exchange Rates	IFS	quarterly	1995q1-2004q4	all	reported as nominal exchange rates, units of local currency per US$