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THE EURO AS INVOICING CURRENCY IN INTERNATIONAL TRADE

by Annette Kamps

EUROPEAN CENTRAL BANK

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CONTENTS

Abstract

This paper investigates the determinants of currency invoicing in international trade. Although the currency of invoicing is central for the transmission of monetary policy, empirical research on this topic is scarce due to a lack of data. With a new extensive invoicing dataset and a panel model analysis this paper shows that a country's membership or prospective membership of the EU plays a decisive role in the choice of the euro as invoicing currency. The role of the euro as vehicle currency is increasing but still limited when compared to the U.S. dollar. Monetary instability and low product differentiation favour vehicle pricing in U.S. dollar. An increase of euro invoicing due to higher exchange rate volatility supports the role of the euro as vehicle currency, however. High market power defined as the share of a country's total exports to world exports and membership of the euro area make invoicing in the home currency (euro) more likely.

Non-technical Summary

What determines the choice of currency in which international trade is invoiced? This question has attracted the attention of economists worldwide for decades but the limited availability of data has meant that little is actually known beyond a number of broad stylised facts. This study presents a newly constructed dataset on currency invoicing in trade for 42 countries. The paper contributes to the literature by exploring the use of the euro in invoicing of international trade. It provides a comparison of the role of the euro and the role of the U.S. dollar as world vehicle currencies. This study served as background for the special focus of the December 2005 issue of the Review of the International Role of the Euro.

Until recently it was commonly assumed in the theoretical literature that exporters preferred to set prices in their own currency, however, another important phenomenon to consider is the business practice of "pricing to market." This term captures the behaviour of monopolistic firms that, exploiting their ability to take advantage of differences in demand elasticities across countries, are able to set different prices in different national markets. In principle, exporters could price to market regardless of whether they invoice in their own currency (known as "producer currency pricing") or in the currency of the local market where the products are sold ("local currency pricing"). However, the combined effect of flexible exchange rates and the menu costs of changing nominal prices implies that exporters facing a competitive local market may opt to use the local currency in their pricing so as to avoid that exchange rate fluctuations result in a loss of competitiveness. The combination of market power and nominal rigidities has brought the issue of the choice of invoicing currency to centre stage, not least since full local currency pricing of imports would also imply no passthrough from the exchange rate to domestic inflation for the importing country, at least in the short run. The choice of the currency in which international trade is invoiced, thus, has important implications both at the micro- and macroeconomic level. At the firm level, the profit maximization of firms engaged in international trade is affected by their choice of currency while at the macroeconomic level the currency of invoicing in international trade affects business cycle correlations between countries and the transmission mechanism of monetary policy.

The question of what determines the choice of currency in international trade has become all the more topical given the increase seen during recent years in the use of the euro in

international trade by a number of countries, primarily EU Member States and EU acceding and accession countries. There is also some evidence that the increase in the use of the euro may partly reflect the growing role of the euro as a vehicle currency, i.e. a currency used between two counterparties outside the country or area of issuance of the currency.

The main finding of this paper is that the membership or prospective membership of the EU leading to the future introduction of the euro and whether the country is in a hard peg with the euro play a decisive role in the choice of the euro as invoicing currency in its trade. The introduction of the common currency in the euro area increased the invoicing in euro at the expense of the U.S. dollar. The increased invoicing in euro can be found both for vehicle currency pricing and for producer and local currency pricing. The role of the euro as vehicle currency seems to be limited, however, when compared to the U.S. dollar. The estimation results show that higher monetary instability reflected in a high inflation differential, and a low differentiation of exports lead to less euro invoicing, while the contrary is true for the U.S. dollar, which supports the impression that the U.S. dollar is the preferred vehicle currency. There are some signs for the role of the euro as vehicle currency, however. Countries with no forward market for their currency are not only more likely to invoice in U.S. dollar but also to invoice in euro. Also, if a country exhibits high exchange rate volatility vis-à-vis the euro it is more likely to invoice in euro. All in all, the euro is increasingly used as invoicing currency both for bilateral trade and for vehicle currency invoicing. This is particularly true for the countries with the prospect of adopting the euro at some point in the future.

1.   Introduction

The choice of the currency in which international trade is invoiced has important implications both at the micro- and macroeconomic level. At the firm level, the profit maximization of firms engaged in international trade is clearly affected by their choice of currency while at the macroeconomic level the currency of invoicing in international trade affects business cycle correlations between countries and the transmission mechanism of monetary policy. The consequences of currency invoicing on the pass-through of the exchange rate have been analysed in a series of theoretical and empirical papers and are at the core of the New Open Economy Macroeconomics literature. While traditional macroeconomics assumed that the price of exports is set in the currency of the exporter so that exchange rate fluctuations lead to expenditure switching away from the appreciating currency's goods, the new macroeconomic literature allows for the possibility of pricing to market, where prices are set in the local currency and do not fluctuate with the exchange rate.[1] While the early literature just assumed that exporters prefer to price in their own currency to avoid price uncertainty (monetary habitat), the more recent theoretical literature models the choice of currency invoicing as a decision between price uncertainty and quantity uncertainty. Exporters pricing in their own currency know the price they will receive, but the quantity they sell is uncertain because the price in the local market fluctuates with the exchange rate. When the demand for the exporter's good is very sensitive to price changes, the exporter may prefer to set the price in the currency of the competitors.

The choice of currency invoicing is, thus, central both for profit maximization at the firm level and for the transmission of monetary policy. Due to a lack of data there have been, however, only a few econometric studies on the choice of invoicing currency so far. These studies consist almost exclusively of country specific evidence on Canada, the Netherlands and Sweden.[2] The use of a macroeconomic multi-country database is, however, important to show the general applicability of the results as compared to single country studies. Goldberg and Tille (2005) give first empirical findings on a broader set of countries. They mainly focus on the role of the U.S. dollar as invoicing currency, though. The dataset compiled for this paper is considerably larger. It consists of 35 countries and more than 150 observations for

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[1] Betts and Devereux were among the first to include PTM into a NOEM model (1996, 2000).

[2] Donnenfeld and Haug (2003) analyse Canadian export invoicing, Wilander (2004) examines Swedish trade and Silva (2004) performs an analysis on Dutch invoicing data.

invoicing in U.S. dollar and of 29 countries and around 150 observations for invoicing in euro. Most data concerning EU countries have been collected by the European System of Central Banks (ECSB). Early data for EU countries and data on non-EU countries was assembled from different national sources like central banks and statistical offices.[3] Besides the new dataset, the main innovation of this paper is that it has a special focus on the role of the euro as vehicle currency. In particular, I analyse whether the launch of the third stage of Economic and Monetary Union (EMU) changed the invoicing patterns in international trade and the potential role of the euro as a vehicle currency. I also shed a light on the question whether an increasing share in euro invoicing is due to economic fundamentals or to the prospects of eventually adopting the euro by most Central and Eastern European Countries.

The main finding is that the membership or prospective membership of the EU leading to the future introduction of the euro and whether the country is in a hard peg with the euro play a decisive role in the choice of the euro as invoicing currency in its trade. The introduction of the common currency in the euro area increased the invoicing in euro at the expense of the U.S. dollar. The increased invoicing in euro can be found both for vehicle currency pricing and for producer and local currency pricing. The role of the euro as vehicle currency seems to be limited, however, when compared to the U.S. dollar. The estimation results show that higher monetary instability reflected in a high inflation differential, and a low differentiation of exports lead to less euro invoicing, while the contrary is true for the U.S. dollar, which supports the impression that the U.S. dollar is the preferred vehicle currency. There are some signs for the role of the euro as vehicle currency, however. Countries with no forward market for their currency are not only more likely to invoice in U.S. dollar but also to invoice in euro. Also, if a country exhibits high exchange rate volatility vis-à-vis the euro it is more likely to invoice in euro. All in all, the euro is increasingly used as invoicing currency both for bilateral trade and for vehicle currency invoicing. This is particularly true for the countries with the prospect of adopting the euro at some point in the future.

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[3] For an overview of the data and its sources see the section on data description as well as table A1 of the appendix.

2. Theoretical Literature

The main focus of the early literature on currency invoicing in international trade focused primarily on transactions costs and the stability and attractiveness of the major currencies. Already in 1968, Swoboda established that the U.S. dollar could be considered a vehicle currency as it was used in trade even if the U.S. was not involved. Swoboda (1968) argued that highly liquid currencies with low transactions costs will be chosen as medium of exchange. In the same way McKinnon (1979) argues that homogenous goods and primary commodities are likely to be invoiced in a single vehicle currency with low transaction costs. Setting the prices of these goods in one currency increases the international comparability of these prices and the transparency of the market. The advantage of a vehicle currency like the U.S. dollar, McKinnon argues, is also due to its long history and familiarity. Similar lines of reasoning can be found in Magee and Rao (1980). They make a distinction between strong and weak currencies according to low and high inflation currencies. The intuition behind this being that in trade between low inflation industrial and high inflation developing countries, the low inflation currency of the industrial country dominates. Also, for trade in primary products a vehicle currency might be optimal. The importance of the choice between different currencies came back into the economic discussion when major exchange rates became flexible after the breakdown of Breton Woods in 1973. The first question of interest was then, who was to bear the exchange rate risk in trade when exchange rates were flexible. It was assumed that a risk-averse exporter preferred to invoice in his own currency - producer currency pricing (PCP). This was then considered the dominant strategy as the exporter was the one who initiated and first set the trade contract. Also, importers were assumed to be more indifferent towards the pricing strategy as imports tend to be a lower proportion of importer's spending than export sales are for exporter's revenues (Page 1977, 1981). Viaene and de Vries (1992) take strategic bargaining considerations into account and introduce a forward market. In their model, exporters and importers bargain over the invoicing currency. Both are assumed to prefer their own currency, respectively. Viaene and de Vries find that the dominance of the exporter's currency can be due either to the first mover advantage of the exporting firm or to the monopoly power of the exporter who is more likely to have bargaining power as the firm faces a wide spread demand and not many competitors. Summing up the early literature, the main findings are that traders seek to avoid currency risk

by using their own currency and that, in trade between industrialised countries exporters are in general more likely to be able to avoid the currency risk.

When currencies are free to fluctuate there is, however, not only the issue of price uncertainty but also *demand uncertainty*. If prices are set before the exchange rate fluctuations are known and orders are placed after the shock to the exchange rate[4] then the exporter faces demand uncertainty if he prices in his own currency (PCP) as the "seller does not know the effective price at the time the importer will make its purchases" (Baron 1976, p.427). There is, thus*, price uncertainty* when exports are priced in the local currency (LCP) as the exporter does not know which price (in his own currency) he will receive and *demand uncertainty* when the exporter chooses producer currency pricing (PCP). McKinnon (1979) provides the intuition on what could be the decisive factor in the choice between price and demand uncertainty. He distinguishes two types of tradables. For a differentiated good a firm can set the market price as it faces a downward sloping demand curve, while for homogenous goods the exporter is a price taker and more likely not to choose the own currency. There are therefore two distinctive sets of determinants for invoicing. One reason to choose a specific currency of invoicing can be to avoid demand uncertainty due to exchange rate fluctuations (LCP is chosen). The choice of LCP is therefore determined by *microeconomic considerations* concerning the demand and cost structure of the exporting firm as will be illustrated in the following. If an exporter is more concerned about price uncertainty because the demand for his goods is less price sensitive *macroeconomic considerations* as discussed before and further formalized in the theoretical literature will play the decisive role.

Donnenfeld and Zilcha (1991) present a first formal model in which a firm's choice of invoicing currency is analysed. They are also among the first to develop a model on the microeconomic level in which the firm optimizes its profits.[5] The main finding of Donnenfeld and Zilcha is that LCP is optimal for the exporting firm if the total revenue curve is concave in the foreign price. This is the case when the sensitivity of demand with respect to prices is not much higher the higher the price level.[6] That is, if the price is set in producer currency and increases (in foreign currency) due to an appreciation of the exporting firm's currency, profits

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[4] This is the assumption usually made in the theoretical literature.

[5] Giovannini (1988) presents a similar model; his emphasis is, however, not on the firm's invoicing decision.

[6] When the "elasticity of the slope of demand for exports is not too large" (Donnenfeld and Haug 2003, p.335)

will fall because demand will be reduced by more than the increase in profits due to the higher price received. In the case of a depreciation, demand is not extended enough to compensate for the lower price the exporting firm receives, because demand is less sensitive to the price at the lower price level. If this is the case, higher variability in foreign prices, which comes with higher volatility in the exchange rate under PCP, lowers expected profits. Thus, under these conditions, high exchange rate volatility would lead the exporting firm to choose LCP.

Friberg (1997) extends the literature by including into the model a forward currency market and the possibility to set prices in a third currency: vehicle currency pricing (VCP). As in Donnenfeld and Zilcha the choice of the optimal currency setting is closely linked to the price elasticity of foreign demand. The second best currency pricing strategy depends on the relative exchange rate volatilities. If the exchange rate towards the vehicle currency exhibits low volatility compared to the bilateral exchange rate of the exporter and importer, VCP is preferred and vice versa.

Johnson and Pick (1997) elaborate on the Donnenfeld and Zilcha model by including the possibility of VCP and introducing competition from other countries' exporters. Like in Donnenfeld and Zilcha the exporting firm has power of price discrimination, but it now faces competition from another exporting firm (this is mostly the case in commodity markets where there are two sorts or brands of goods). Now, even under LCP the demand for the firm's product is uncertain because the competitors might not price in local currency. In such a case fixing the relative price of the competing products can be important to the exporters so they might choose a common vehicle currency.

This finding of choosing the currency of the competitor is also common to a number of other studies. In particular, Bacchetta and van Wincoop (2002) use a NOEM model to analyse the optimal pricing strategy of exporters.[7] In a very elaborate general equilibrium framework that also takes into account exchange rate dependent costs they derive similar conclusions to those of Donnenfeld and Zilcha. The driving factors for exporters to care about their relative prices are the demand sensitivity of costs and the price sensitivity of demand. It can be said that the higher the product differentiation, the lower the price sensitivity of demand. Exporters

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[7] One of the main assumptions in NOEM is that prices are sticky. Hence, in the short run the exporter's price can only stay the same under exchange rate movements if it is set in the local currency. This explains the close relationship between the PTM literature and the currency invoicing literature.

will, thus, prefer to invoice in their own currency if their products are highly differentiated, while they will pay attention to holding their relative prices constant if their products are less differentiated. This does not mean that less differentiated products are always invoiced in LCP, however. Bacchetta and van Wincoop build into their model the market share of the exporting country in the foreign market – that is, the share of the market that is accounted for by firms from a particular country or monetary area. Demand risk is minimized by invoicing in the currency that is most "similar" to the average invoicing currency chosen by competitors (Bacchetta and van Wincoop 2002, p. 15). For a monetary union, it is the market share of the entire currency union that matters and not the market share of an individual country. Exports of a monetary union are therefore more likely to be priced in producer currency, and imports to a monetary union more likely to be priced in local currency, because the monetary union's market share is more likely to be dominant.

Goldberg and Tille (2005) call this behaviour of choosing the currency of the competitor a "herding effect". In their partial equilibrium three country model a dominant share of a currency other than the one of the exporter or the importer can make vehicle currency pricing the optimal choice. This herding effect takes place for industries with homogeneous goods where producers aim at keeping their prices relative to the competitors stable. Goldberg (2005) elaborates on this model by including a covariance between marginal cost and exchange rates. There is then also a "hedging motive" to choose a currency so that the exchange rate is correlated in such a way to shocks to exporters' costs that marginal costs are positively correlated with marginal revenue.

The most elaborate model so far was introduced by Devereux, Engel and Storegaard (2003). Using a two-country dynamic general equilibrium model with sticky prices, these authors analyse the implications of endogenous exchange rate pass-through. Their results show that the degree of pass-through depends on the relative stability of monetary policy; countries with relatively low monetary volatility experience low rates of exchange rate pass-through. The reason is that firms in both countries have an incentive to set their prices in the currency of the country with the low monetary volatility.[8] As a consequence, the country with low monetary volatility is shielded against exchange rate movements.

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[8] This result is comparable to the general equilibrium model by Bacchetta and van Wincoop (2002) where they find that inflationary currencies are less likely to be used as invoicing currency.

Engel (2005) analyses the export pricing behaviour of firms in a static model, both in an environment with flexible and with fixed prices. He shows that the choice between producer currency pricing and local currency pricing is independent of the degree of sluggishness in price adjustment. Under flexible price adjustment, producer currency pricing is optimal if the variance of the export price in the firm's own currency is less than the variance of the price in the local currency of the importer. The same holds in an environment of fixed prices.

Summing up the theoretical literature, the most important finding is that the optimal pricing strategies are very sensitive to the set of assumptions. In particular, the level of risk aversion and the existence of forward markets to hedge exchange rate risks matter for the results. First and foremost, however, the sensitivity of foreign demand to prices matters, which can be approximated by the homogeneity or differentiation of the product. When demand is sensitive to prices the market share of the exporting country, or more specifically, the currency used by the competitors matters. When the optimal currency choice depends on the currency used by competitors, herding in the same currency is optimal. Also, currencies of countries with monetary stability are more likely to be chosen as invoicing currency.

3. Stylized Facts and the Empirical Literature

Data on currency invoicing has been very scarce to date. This is the reason why many studies rely on simple and often static comparisons of data and anecdotal evidence. Other studies analyse the pass-through of exchange rates to import and export prices because this data is more readily available. The data on exchange rate pass-through can provide some evidence on PCP and LCP. If the pass-through is complete as assumed by most early models this indicates full PCP, whereas zero pass-through stands for LCP as prices do not react to the exchange rate. To my best knowledge, there are only four econometric studies on currency invoicing. The first one is Donnenfeld and Haug (2003) who present an analysis on Canadian import invoicing. Wilander (2004) and Silva (2004) are yet unpublished studies on the invoicing practices in Swedish exports and Dutch Trade respectively. These three studies use industry specific micro data on a disaggregated level. The most comprehensive study on the determinants of currency invoicing in terms of empirical data is Goldberg and Tille (2005). Here, aggregated data on invoicing practices is collected for 25 countries. Donnenfeld and

Haug (2003) and Wilander (2004) use multinomial logit (probit) models for their analysis, while Silva (2004) uses fixed and random effects and GLS estimations. Goldberg and Tille (2005) perform a cross section regression.

Before I elaborate on the econometric findings of these formal econometric invoicing studies, I present an overview of the early literature and conclusions drawn from the exchange rate pass-through (ERPT) literature.[9] In 1968 Swoboda established the vehicle currency hypothesis claiming that the use of a currency in trade was mainly determined by transactions costs. The dominant role of the U.S. dollar was taken as evidence. The first empirical finding on local versus producer currency pricing by Grassman (1973) regarding Swedish foreign trade was that Swedish exports are mostly invoiced in Swedish kronas and Swedish imports are mostly invoiced in the exporter's currency, while the U.S. dollar was not often used as invoicing currency. These findings contradicted the vehicle currency hypothesis and were later generalized and called Grassman's law. This law states that PCP is dominant for manufacturing trade between industrialized countries. Trade in primary products is mostly denominated in U.S. dollar, while trade between developing and industrialized countries is predominantly invoiced in the industrialized country's currency. The intuition behind Grassman's law is that a firm with more bargaining power will choose its own currency to avoid exchange rate risk.[10]

There is anecdotal evidence linking the use of a currency to the level of product differentiation. Tavlas (1991) finds that PCP is more likely if products are differentiated. He gives this as an explanation why invoicing in Deutschmark increased from 1980 to 1987 even though Germany reduced its trade with developing countries which per se would lead to a reduction in PCP. Oi, Otani and Shirota (2004) who discuss possible influences on Japanese export invoicing strategies find that the Yen is more often used in industries with differentiated products like the automobile industry. Sasaki (2002) and Sato (2003) find in an exchange rate pass-through analysis that PTM elasticities are highest in Japanese exports to the USA. Sasaki draws the conclusion that this is due to the U.S. market and U.S. products

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[9] There are several empirical studies on the exchange rate pass through (ERPT) which are closely related to the invoicing literature. There are two studies on the ERPT into Japanese export prices (Sasaki 2002, Sato 2003), one on the ERPT into Korean exports by Fukuda and Ono (2004) and one study by the Bank of Finland on the ERPT in Finnish trade. Campa and Goldberg (2005) present a study on ERPT in 25 OECD countries.

[10] For overviews on stylized facts regarding currency invoicing see also Bilson (1983) and Hartmann (1998).

being more competitive than the Japanese market and Japanese products, so that Japanese exporters are forced to price in local currency or in a vehicle currency, notably the U.S. dollar in the Asian Region. In their ERPT analysis on Korea, Fukuda and Ono (2004) highlight the importance of market share. Exporters would want to price their goods in the currency of the competitor to reduce quantity uncertainty, because then demand for their product is less sensitive to exchange rate movements. If the market share of local firms is small and the competitors are other foreign firms as is the case in some import goods to Korea, then pricing in a vehicle currency can be optimal. These findings confirm the theoretical results that firms prefer to price in their own currency so that they do not bear the exchange rate risk if they have market power and demand is more insensitive to their prices, while they prefer to use the same currency as their competitors (either LCP or VCP) in case they do not have market power and the demand for their product is very price sensitive.

There is also some evidence that monetary stability and financial institutions play a role. Tavlas (1997) provides some support for the dominance of stable currencies. Germany has had a very stable currency and monetary policy for a long time and German imports and exports were mostly invoiced in DEM before EMU. The DEM was also the only currency apart from the U.S. dollar which was used more often in trade than the share of world trade would indicate and thus might be called a vehicle currency (Page 1977, 1981). Tavlas argues that the currency also has a store of value function and thus currencies with low inflation and inflation variability will be preferred as invoicing currency. However, Campa and Goldberg (2005) find in their ERPT analysis that inflation and monetary growth cannot explain cross-country differences.

Most models in the ERPT literature make an explicit assumption as to whether all exports are either invoiced in the local currency (LCP and PTM) or in the producer currency (PCP). Under complete LCP or VCP there is zero pass through from exchange rates to export prices; while under PCP there is full pass-through to export prices. Freystätter (2003) and Campa and Goldberg (2005) provide econometric evidence on the incomplete pass through of exchange rates. Campa and Goldberg (2005) show in a country study for 25 OECD countries that neither complete LCP nor complete PCP is plausible which stands in contrast to the theoretical literature where mixed exchange rate strategies are mostly sub optimal.

The first econometric analysis on the currency choice of Canadian imports was performed by Donnenfeld and Haug (2003). They claim to find support for the finding by Donnenfeld and Zilcha (1991) that higher exchange rate risk promotes the use of LCP and discourages the use of PCP and VCP. Their results are, however, fragile as almost all estimates are statistically insignificant.[11] They run a multinomial logit model on the choice of currency in different industries in Canada. Their explanatory variables consist of exchange rate risk, a distance variable and the size of the partner country. Out of 24 estimations on local currency pricing (2 estimations on 12 industry levels, one including trade with the U.S., one excluding trade with the U.S.) only two estimates for exchange rate volatility are significant[12] and show a positive relationship between LCP and exchange rate volatility. As discussed above, high exchange rate risk only leads to LCP if the products are not highly differentiated. Even though Donnenfeld and Haug (2003) have a dataset on the industry level, they do not test for the effect of product differentiation in the industry. In the theoretical models, distance plays a role only in so far as it increases the exchange rate risk. They do, however, find some significant results for the positive relationship between distance and LCP. If, as is the case for Donnenfeld and Haug (2003), there is not sufficient support for the impact of the exchange rate risk on LCP, then the evidence of a substantial influence of distance on LCP cannot be due to the increased exchange rate risk as motivated by the theory.[13] Donnenfeld and Haug (2003) find a negative relationship between the exporter's country size and invoicing in a third currency (VCP). In this study, country size is interpreted as a sign for market power with the following reasoning: The larger the country, the larger the size of the firm, the more market power for the firm.[14] Thus, a firm from a large country is more likely to price in own currency and less likely to price in a vehicle currency.

Wilander (2004) performs a similar econometric analysis on currency invoicing in Swedish exports by industry[15] for the years 1999 to 2002. His findings on exchange rate risk are, however, contrary to the evidence of Donnenfeld of Haug (2003). In particular, he finds a

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[11] They do find, however, some significant results for the positive relationship between the exporter's country size (and therefore possibly market power) and the invoicing in PCP.

[12] One at the 5 percent, one at the 10 percent significance level.

[13] See Donnenfeld and Zilcha (1991).

[14] This argumentation is, thus, essentially different from the "herding effect" as discussed by Bacchetta and van Wincoop.

[15] Very large firms like Ikea are excluded from this analysis.

negative relationship between exchange rate volatility and local currency pricing. There are two possible reasons for this. First of all, he uses exchange rate volatility as the measure of exchange rate risk, whereas Donnenfeld and Haug (2003) use a mixture of forward and ex-post future spot rate. Second, his analysis is on Swedish *exports* while Donnenfeld and Haug's analysis is on Canadian *imports* data. Wilander (2004) finds that local currency pricing is promoted by low inflation, by the presence of a stable financial market, and the absence of capital controls and a black market. His hypothesis that less differentiated products are less likely to be invoiced in the producer currency is not explicitly tested, but the pattern in the Swedish exports, where the paper and pulp industry invoices only around 25 percent of its exports in Swedish kronas as compared to around 60 percent in the motor vehicle industry, seems to point into that direction. The amount of LCP is, however not higher in the industries with less differentiated products. On the contrary, LCP is highest in the motor vehicles industry.

In his analysis on Dutch invoicing practices, Silva (2004) finds evidence contrary to Grassman's law, which states that exports are predominantly invoiced in the currency of the exporter. He finds that for Dutch exports to industrialized countries, the currency of the trading partner, and not the Dutch guilder, was dominant. Furthermore, the strength of a currency, the depth of the financial market and the absence of high inflationary tendencies enhance the use of a country's currency. Exchange rate volatility and exchange rate expectations do not prove to be decisive in the choice of the invoicing currency. Silva (2004) does not find evidence for the use of a vehicle currency in commodity trade. He gives as a reason that his sample is predominantly composed of OECD countries, thus, not including traditional exporters of raw materials.

As described in the previous section, there are, however, convincing arguments why a vehicle currency should be used in trade with primary commodities. First and foremost, primary commodities are homogenous goods, so that the exporters of these commodities do care about the price of the competitors and are therefore likely to choose a common currency. Furthermore, in official markets there are transaction costs considerations. Especially information cost is an important factor why commodity exporters would want to price in the same vehicle currency to make prices more comparable. Goldberg and Tille (2005) highlight

the importance of organized exchange and reference pricing[16] in the role of the U.S. dollar as invoicing currency. They find that the dollar's use in these markets can explain most of the dominance of the U.S. dollar as vehicle currency. They also point out that the declining importance of organized exchanges and referenced prices could be the reason for the U.S. dollar's declining importance as a vehicle currency.

What does the literature say about the dominance of the U.S. dollar as a vehicle currency? In 1991, Black (1991) found evidence that the U.S. dollar lost attractiveness as invoicing currency while the DEM gained somewhat in importance during the 1980s. A similar result is found by Tavlas (1991) who claims that the DEM gained importance between 1980 and 1987. Wilander (2004) finds that the euro was more often used as vehicle currency from 1999 to 2002, while this was not at the cost of the U.S. dollar but rather there was less invoicing in producer's currency (the Swedish krona). Goldberg and Tille (2005) observe that the U.S. dollar is still the dominant currency with U.S. exports and imports to Latin America, China, Mexico, and most small countries being almost exclusively invoiced in U.S. dollar. While U.S. exports to other countries are exclusively invoiced in U.S. dollar, exports to Germany, the UK and Japan are to a small amount invoiced in local currency. Goldberg and Tille (2005) also find evidence for a strong role of the U.S. dollar as vehicle currency, especially in Korea, Thailand, Japan, Australia, the UK[17] and Greece. They find, however, a declining importance of the U.S. dollar as vehicle currency due to a reduction in organized trade. In her analysis on accession countries Goldberg (2005) argues that the accession countries are using the euro to a degree that is higher than optimal given their trade partners' composition of trade and the variance and covariance of macroeconomic conditions vis-à-vis the trading partners.

Altogether it has to be said that empirical evidence is still very scarce due to the lack of internationally comparable data. To get more robust results on the determinants of invoicing strategies and the possible development of the euro as an invoicing currency, I considerably expand the data base of Goldberg and Tille (2005).

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[16] Reference pricing refers to goods which are not necessarily centrally traded, but for which there are common price quotations for example in insider journals. Goldberg and Tille (2005) use an index created by Rauch (1999). For further details see next section.

[17] While UK *exports* to non-U.S. countries do not exhibit this strong bias to the use of the dollar as vehicle currency, this pattern can be observed with UK *imports* from non-U.S. countries.

4.   Empirical Findings

The main reason why there has not been more empirical research on the invoicing currency in trade is the scarcity of the data. As discussed in the previous section there are only a few econometric studies on the choice of invoicing currency and these include only evidence on Canada, the Netherlands and Sweden. While these studies are very valuable as country studies it is necessary to take in the broader picture of as many countries as possible. Goldberg and Tille (2005) give first empirical findings on a broader set of countries. My dataset is much larger[18] and I will focus on the role of the euro as invoicing currency. While I also consider U.S. dollar invoicing, I will put it into a framework where the launch of the euro plays a decisive role.

4.1   The Invoicing Database

Annual aggregated data on currency invoicing is taken from national central banks, statistical offices and from a survey by the ECB.[19] For an overview of the complete set of invoicing data see Figure 1 and Table A1 of the Appendix. The currency of invoicing is in most cases approximated by the currency of settlement.[20] In some countries data was collected by the central banks with a reporting system covering cross-border payments (e.g. the Netherlands until 2002), other countries conduct a survey (e.g. Germany). In some countries the data on invoicing is an approximation retrieved from the currency structure of foreign exchange receipts and payments (e.g. Slovakia). If a distinction is possible, data for trade in goods is chosen as compared to trade in services.[21] For the very rare case that there is no distinction between exports and imports only overall trade is reported, this is taken as an

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[18] While Goldberg and Tille (2005) use data on 25 countries for one point in time, my dataset consists of 42 countries and more than 150 observations.

[19] For details see Table A1 of the Appendix. Data from the "ECB data request" is data collected by the European Central Bank (ECB). For details see also *Review of the International Role of the Euro* published by the ECB (2005) in December 2005.

[20] For some data it is unclear whether reference is to currency of invoicing or settlement. However, the differences in the two are likely to be negligible according to Page (1977, 1981). For convenience, I will hereafter refer to invoicing data, bearing in mind the above qualifications.

[21] For most of the EU countries data on services exists. This data is not included in this paper. It is available in the *Review of the International Role of the Euro* published by the ECB (2005) in December 2005.

Figure1: Average share of currencies used in exports and imports by region

European countries (excl. euro area) - Exports

euro ▪ US dollar □ Pound sterling ▨ other ▨

European countries (excl. euro area)- Imports

euro ▪ US dollar □ Pound sterling ▨ other ▨

Euro area countries - Exports

euro ▪ US dollar □ Pound sterling ▨ other ▨

Euro area countries - Imports

euro ▪ US dollar □ Pound sterling ▨ other ▨

Asia Pacific countries - Exports

euro ▪ US dollar □ yen ▨ other ▨

Asia Pacific countries - Imports

euro ▪ US dollar □ yen ▨ other ▨

Note: Before 1999 euro stands for the euro area legacy currencies. Other (currencies) is calculated as residual.
Source: See Appendix A1, data for euro area based on extra-euro area trade, own calculations.

approximation for both export and import invoicing.[22] Before 1999 invoicing in euro is defined as invoicing in the euro area legacy currencies.[23] Altogether the database includes data on 42 countries. Some data is available already for a longer time period. I cover an estimation period from 1994 until 2004. The dataset is, however, unbalanced over time so that for some countries there are up to 10 observations and for others only 1.

As can be seen from Figure 1, the use of invoicing currencies differs considerably between regions.[24] The U.S. dollar is by far the dominant currency in the Asia Pacific region, while the euro has become the dominant invoicing currency for trade of EU-25 and candidate countries (excluding euro area countries). The share of euro invoicing has increased over time, both for EU-25 countries and for extra euro area trade of euro area countries. This seems to be at the cost of U.S. dollar invoicing. The British Pound (GBP) and the Japanese Yen (JPY) only play a minor role for currency invoicing in trade.

To assess the development of the invoicing practices in world trade I compare the new data on invoicing currencies with the projections of currency invoicing by Hartmann (1998). In his study Hartmann considers different scenarios implying different shares of euro invoicing. The column in Table 1 labelled "Hartmann (EU-11) 1992" gives the share of euro invoicing he projected for 1999 based on the assumption that countries have the same share of home currency invoicing as in 1992 (58%). Comparing this number to the number resulting from the new dataset for 1999 (column three), it can be seen that it is very similar to the projections made for the start of the monetary union under the assumption of no change in behaviour (1992). The column labelled "Hartmann (EU-11) like USA" gives the share of euro invoicing Hartmann projects in his most optimistic scenario based on the assumption that EMU countries increase their share of home currency invoicing to U.S. levels (92%). In this case he projects that the share of euro invoicing would rise to 25 percent.[25] The data provided in this paper shows that the share of euro invoicing in 2004 was higher than this number (27.7) even though the share of home currency invoicing remained at around 60 percent in EMU countries and thus was still much lower than in the U.S. Since the increase in the share of the euro is not

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[22] This is the case only for Slovakia, data from Latvia for the years 1994 to 2000 and for Malaysia for the years 1999 to 2003.

[23] For some countries only data on the share of some legacy currencies (mainly the DEM) is available.

[24] Unfortunately, there is no data at all for Latin America. Presumably, the U.S. dollar is by far the dominant currency of invoicing in this region.

[25] For a detailed description of this scenario see Hartmann (1998, p. 435).

due to its use as home currency it must be due to the use of the euro as vehicle currency. In particular, the use of the euro as vehicle currency in Central and Eastern European trade is much higher than Hartmann expected.[26]

Table 1: Trade Invoicing Comparison with Hartmann (1998)

	Hartmann (EU-11) 1992	Hartmann (EU-11) like USA	1999[a] (EU-12)	2004[b] (EU-12)
USD invoicing in "extra-EMU" world exports (in %)	55.7	/	55.4	49.1
Euro invoicing in "extra-EMU" world exports (in %)	18.8	25	20.8	27.7

Sources: Hartmann (1998), 1999 and 2004 author's calculations.
Note: The author's calculations of the 1999 and 2004 shares are based on real data coverage of 67 percent of "extra-EMU" world exports for euro invoicing and 58 percent for U.S. dollar invoicing. The remaining share of trade was estimated by taking the invoicing share of Portugal as approximation for the remaining EMU countries without data coverage (Austria, Finland and Ireland). As the data coverage for European countries is very high and there is no data at all for Latin America, the rest of the not covered trade was approximated using the share of currency invoicing of Thailand. This should be on the lower side of possible euro invoicing.
[a] For 1999, if data for 1999 was unavailable the data points closest to 1999 were taken.
[b] For 2004, if data for 2004 was unavailable the latest available data was taken.

When comparing the share of euro invoicing to the share of U.S. dollar invoicing in Table 1 it is evident that the dollar is still the dominant currency in world trade and that the euro is not likely to challenge the leading role of the U.S. dollar in the foreseeable future. However, there is evidence not only of the increasing importance of the euro as world currency but of the slightly diminishing role of the U.S. dollar. The following empirical analysis tries to shed some light on the role of the U.S. dollar and euro as vehicle currencies and how these are interacting. While the new dataset is a very important benchmark for the analysis of currency invoicing in international trade, the main shortcomings of the dataset are that for such a broad set of countries no bilateral data on currency invoicing is available. This is a problem insofar as the distinction between PCP, VCP and LCP becomes difficult and for most countries

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[26] Hartmann (1998) assumes a subdued scenario for interregional trade in the Central and Eastern European Countries. He already mentions, however, that a resurgence of trade in the region "may give a boost to the euro" (p. 440).

impossible.[27] In the following analysis, I control for this by including each country's share of exports to and imports from the U.S. for the U.S. dollar invoicing regressions and from the euro area for the Euro invoicing regressions. In a further step, I conduct an analysis on home currency invoicing with a reduced dataset for all those countries where data is available.

4.2 The Explanatory Variables

First of all, some explanatory variables concerning bilateral trade are created. To control for the exports and imports to and from the U.S. and the euro area I include the respective shares of exports and imports of a country's total exports and imports. The data are taken from the IMF Direction of Trade Statistics. This database is also used to create a measure of market power created as the share of a country's total exports to world exports, which should reflect the size of a country's firm. Following the approach in Goldberg and Tille (2005), to take into account the share of trade in differentiated products a variable is created according to the Rauch (1999) definitions.[28] The data on commodities is taken from the UN Comtrade database. The definition of the group of products is very precise in the sense that it does not only divide into aggregated groups of commodities and non commodities, but it is detailed up to the fourth digit code of the SITC.[29] The share of exports and imports of differentiated products in total exports and imports is calculated for the year 2004.[30]

To capture the influence of exchange rate risk, I set up a variable on exchange rate volatility. I construct a four-month moving average standard deviation of the nominal exchange rates of a country's currency vis-à-vis the U.S. dollar and vis-à-vis the euro (vis-à-vis the DEM before the introduction of the euro in 1999) respectively. As variable describing a country's monetary stability I use the inflation differential to the U.S and to the euro area (to

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[27] Most countries just provide data on invoicing in U.S. dollar and Euro. For all non-U.S and non euro area countries this leaves the possibility that the invoicing is in vehicle currency, in LCP (for exports going to the U.S and the euro area) or in PCP (for imports coming from the U.S. and the euro area).

[28] Rauch (1999) classifies all commodities by "looking them up in International Commodity Markets Handbook and The Knight-Ridder CRB Commodity Yearbook (to check for organized exchanges) and Commodity Prices (to check for reference prices, e.g., price quotations published in trade journals such as Chemical Marketing Reporter)." Products belonging to one of these categories are "organized exchange" or "reference price" goods, all others are differentiated goods.

[29] Codes are taken from http://www.macalester.edu/research/economics/PAGE/HAVEMAN/Trade.Resources /TradeData.html#Rauch and are based on the liberal classification of Rauch (1999).

[30] The share is assumed to be constant over time as the structure of trade is not likely to change from one year to another. See Table A2 of the Appendix.

Germany before 1999). Monthly data for both the inflation and the nominal exchange rates are taken from the IMF International Financial Statistics database.

I then specify a set of dummy variables. In particular, I construct a dummy that takes on the value of 1 for all countries which are either part of the European Union in 2005 (EU-25) or are formally recognized as EU candidate countries and 0 otherwise.[31] In addition, to take into account structural changes due to the introduction of the euro, I create a step dummy that takes on the value of 1 from 2002 on. This is when the euro currency was introduced and the the use of the national legacy currencies was discontinued.[32] To mirror the availability of a currency on the forward market a dummy is created that takes on the value 1 for all those countries (currencies) which had a forward market in 1999.[33] Two other dummies are created that take on the value 1 for all those years in which a country had a hard peg either to the U.S dollar or to the euro respectively.[34] For a complete list of variables see the Appendix.

4.3 Empirical Methods

As my dataset covers both a cross-sectional and a time-series dimension, I estimate a panel model. The first estimation method I use is a one-way random-effects GLS panel. The random effects model is preferred to the fixed effects model as country specific constants would result in a considerable loss of degrees of freedom. More importantly, I also want to consider time-invariant explanatory variables, which is not possible in a fixed effects model. The Breusch-Pagan Lagrange Multiplier test for a zero variance of the individual errors could be rejected for every estimation. This implies that my dataset cannot be pooled. At the same time I choose a one-way as compared to a two-way random effects model because my panel is highly unbalanced on the time dimension. To test whether the estimators are biased I perform a Hausman test comparing the coefficients of the fixed and the random effects estimation. The null hypothesis of no systematic differences cannot be rejected in almost all of the cases, so

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[31] This dummy variable is not time-variant as it tries to capture the group of countries that have been, throughout the period under consideration, part of the EU or widely seen as prospective members of the EU.

[32] I also experimented with having the dummy take on the value of 1 starting in 1999. This leads to very similar results. There are, however, only a few observations before 1999. This is why the 2002 dummy is preferred.

[33] The choice of the year 1999 is somewhat ad hoc, but it is chosen to coincide with the introduction of the forward market for the euro in 1999.

[34] In particular, this is for the euro (DEM before 1999): Estonia (from 1992), Bulgaria (from 1998) and Lithuania (from 2002). For the U.S. dollar: Lithuania (from 1994 to 2001) and Malaysia (from 1999).

that the random effects coefficient estimates should be consistent and asymptotically efficient. As a second estimation method I report the results for a fixed effects estimation to show the robustness of the results. The third estimation method I use is a Prais-Winston estimation with panel corrected standard errors. This controls for possible heteroscedasticity across the panel and panel specific autocorrelation. The last estimation method I apply is a Prais-Winston regression with importance weights. As the dataset includes data on very diverse economies, it is interesting to see whether the inclusion of the GDP of the country as importance weight makes a difference to the estimation results. While it would also be interesting to estimate a logit or probit model, the nature of the new dataset makes it a sub-optimal choice as there would be a loss of observations both over time and over countries as only a few countries report both the share of U.S. dollar and of euro invoicing and even less report the share of own currency invoicing. Likewise, the limited time dimension of the panel does not allow for a study of the dynamics of the panel. This would have been an interesting analysis especially with respect to the possible persistence of currency invoicing.

4.4   The Empirical Model for U.S. Dollar Export Invoicing

I first examine the cross-sectional and intertemporal variation in U.S. Dollar (USD) invoicing for exports of around 30 countries over a period from 1994 to 2004. The data is highly unbalanced as for some countries there is only 1 observation while for others there are up to 10 observations. The most general one-way random effects model I estimate is the following:

$$usdex_{it} = \beta_1 + \beta_2\ shexus_{it} + \beta_3\ eurinst_i + \beta_4\ euroint_{it} + \beta_5\ rauex_i + \beta_6\ usexvol_{it} + \beta_7\ usinf_{it} + \beta_8 fmdum_i + \beta_9 usdpeg_{it} + u_{it}, \tag{1}$$

where $i = 1,\ldots 30$, $t = 1, \ldots .10$ (highly unbalanced) and $u_{it} = v_i + e_{it}$, where v_i is the random error attributable to countries and e_{it} is a white noise residual. In this specification *usdex* is the share of exports invoiced in U.S. dollar in percentage terms and *shexus* stands for the share of a country's exports to the U.S. relative to a country's total exports. I expect a country to have a higher share of U.S. dollar invoicing the higher the share of trade with the U.S.[35]

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[35] In this sense the variable should capture all local currency pricing to the U.S.

Eurinst is a 0/1 dummy taking on the value 1 for all EU-25 and candidate countries while *euroint* is a 0/1 dummy taking on the value 1 for all observations from 2002 onwards mirroring the introduction of the euro currency and the discontinuation of the legacy currencies. These two dummies should reflect whether being a (prospective or actual) member of the EU, even for those who are not yet participating in the monetary union, makes a difference in their choice of invoicing currency. The second dummy tries to capture the individual effect attributable to the introduction of the common currency. I expect both variables to have a negative impact on USD invoicing. In particular, the "herding effect" brought forward by Bacchetta and van Wincoop (2002) and Goldberg and Tille (2005) implies that because a monetary union has a higher "country" share than the individual country before, invoicing in that currency is more likely and makes the use of the USD less likely.

The impact of the variable *usexvol* is ambiguous. As discussed at large in the previous section, the evidence on the impact of exchange rate risk is very ambiguous. In particular the influence depends on the level of product differentiation. While for differentiated products, an exporter would want to avoid a foreign currency to limit the fluctuations of the price he receives, for less differentiated products the exporter wants to limit his quantity uncertainty and tends to set prices in the same currency as the competitor.

As I cannot distinguish between differentiated goods at the industry level, I set up a variable capturing a country's share of differentiated trade. *Rauex* is the time invariant share of a country's differentiated products in total exports.[36] This variable is constructed to account for the possibility of different pricing strategies for differentiated and non-differentiated goods, the exporter being more likely to want to keep its relative prices stable in the case that his exports are non-differentiated.[37] The most likely assumption is that there is a natural herding in USD (also reflected in the goods traded in world markets or goods with a referenced price). Thus, *rauex* is expected to have a negative influence on USD invoicing since the higher the share of differentiated goods the more likely the exporter can set the price in the own currency.

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[36] Defined as total exports minus exports of goods priced on world markets and referenced goods. For a more detailed description see the section on data description.

[37] For a more detailed explanation see the section on the theoretical literature.

Usinf reflects the monetary stability of a country. A high inflation differential with respect to the U.S. stands for economic instability, which makes the use of that country's currency less likely. The forward market dummy *fmdum* reflects the presence of a forward market. If a forward market for their currency exists, exporters are more likely to be able to use their own currency as the importer can hedge the exchange rate risk. I take the presence of a forward market (already in 1999) as a sign that this country's currency is available easily and at low cost. The existence of a forward market implies more invoicing in that currency (PCP) and less invoicing in USD (VCP). *Usdpeg* is a 0/1 dummy that takes on the value 1 for periods where a country's currency is in a hard peg with the USD.

Table 2 summarizes the results of the regression. As discussed in the section on methodology the table reports several estimation methods as a robustness check. When discussing the regression results the main focus will be on the random effects regression while always checking for possible discrepancies to the other estimations. Since the dependent variable is expressed in percentage points, the coefficients of the dummy variables can be directly added or subtracted. The coefficients of the other variables have to be multiplied with the value of the variable to give the percentage point impact.[38]

Both in the random effects and in the fixed effects specification the share of exports going to the U.S. does not have a significant impact on USD currency invoicing. This is likely due to the fact that for most countries the use of the U.S. dollar as a vehicle currency is much more important than its use in bilateral trade with the U.S.[39] Being part of the EU, as defined above, significantly reduces the average share of exports invoiced in U.S. dollar (by around 35 percentage points). Likewise, the introduction of the euro currency in 2002 reduced export invoicing in USD by around 4 percentage points. This could point at some substitution of vehicle currency use from USD to the euro. It could, however, also be that countries of the euro area which previously relied more on USD invoicing are now able to invoice in their own currency. We will see more evidence on the role of the euro as vehicle currency in the sections on euro invoicing.

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[38] The constant need not be between 0 and 100. The economic interpretation being that it is the share of invoicing in the currency given the explanatory variables take on their average value. Thus, as is the case for euro invoicing, the constant can take on a negative value.

[39] In an alternative specification, I include the exports by Asian countries not only to the U.S. but also those going to the East Asian Dollar Block. This variable then has a significant positive impact on U.S. dollar

Table 2:

U.S. Dollar Export Invoicing
Dependent variable: share of exports invoiced in U.S. Dollar (in percentage points)

Regression	random	fixed	PW[a]	weighted[b]
Constant	94.95***	49.21***	92.29***	96.80***
	(9.39)	(18.79)	(19.38)	(18.35)
Share of exports to U.S	0.04	0.04	0.17***	0.16***
	(0.23)	(0.18)	(2.64)	(4.15)
EU-25 and candidates	-36.16***		-22.20***	-20.05***
	(-5.58)		(-5.56)	(-14.95)
Introduction of the euro (2002)	-4.56***	-4.63***	-2.71***	-2.00***
	(-6.38)	(-6.32)	(-3.24)	(-4.58)
Share of differentiated exports	-0.35*		-0.51***	-0.46***
	(-1.81)		(-5.34)	(-3.92)
Exchange rate volatility to U.S.	-23.40	-22.15	-14.37	32.61
	(-0.82)	(-0.76)	(-0.42)	(1.22)
Inflation differential to U.S.	0.32***	0.32***	0.17**	-0.02
	(5.39)	(5.27)	(2.45)	(-0.15)
Forward market	-5.63		-8.01***	-16.70***
	(-1.13)		(-3.15)	(-2.98)
Peg to USD	9.56***	9.33**	9.67***	6.38
	(2.70)	(2.61)	(2.69)	(0.34)
Number of observations	176	176	176	176
Number of countries	36	36	36	36
Wald chi2	188.7		655.0	2474.0
R squared overall	0.69	0.03	0.94	0.98

Absolute value of z statistics in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%

[a] Prais-Winston regression with heteroscedastic panel corrected standard errors and panel specific AR1.

[b] Prais-Winston regression with het. panel corrected standard errors. Importance weighted with GDP.

The share of differentiated products in exports has a significantly negative effect on the share of exports invoiced in USD for all estimations. This confirms the findings of Goldberg and Tille (2005). The product differentiation does matter as expected by the theory. The exchange rate risk, however, does not have a significant impact on the invoicing decision in any estimation and, as expected, yields ambiguous results.[40] It could be that the exchange rate

invoicing while not affecting the other results. As the trade between East Asian Dollar Block countries still has to be considered as vehicle currency invoicing this confirms the role of the U.S. dollar as vehicle currency.

[40] Goldberg (2005) suggests for example that rather than on the exchange rate volatility the invoicing decision depends on a covariance between marginal cost and exchange rates.

volatility is not significant because the effect of exchange rate uncertainty depends on the degree of product differentiation. To test for this I include an interaction variable of exchange rate volatility and the share of differentiated products. This variable is, however, also highly insignificant.[41] Countries with a hard peg to the USD should have a 9 percentage points higher share of exports invoiced in USD. All the dummy variables are straightforward in their interpretation as they take on the value of one for all data points included in that group. This means that the coefficients for dummy variables directly show the impact of belonging to this group on the dependent variable, while the size of the coefficients for the other variables does not necessarily say something about their importance as they have to be multiplied with the variable. Thus, the coefficient of the share of differentiated products seems to be very small. However, a country like Germany with around 70 percent of its exports being differentiated should ceteris paribus have around 25 percentage points less USD invoicing compared to a country like Algeria with almost no differentiated exports.

The financial stability of a country also matters for the choice of currency in trade. High inflation differentials to the U.S. significantly increase USD invoicing.[42] A country like Indonesia with an average inflation differential to the U.S. of around 6 percentage points (from 2000 to 2004) should on average invoice around 2 percentage points more of its exports in U.S. dollar than a country with the same inflation rate as the U.S. The existence of a forward market for the country's currency reduces the invoicing in USD by around 5 percentage points. This result is, however, only statistically significant in some of the equations. In other specifications not reported in the table, the measure of market power, that is a country's export share in total world exports, was also included. While this did not change the other results, neither the market power of a single country nor the market power of the whole euro area were found to be significant. The same is true if GDP is taken as a measure of a country's market power. It is not significant in any of the estimations.[43]

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[41] I also experimented with including adaptive exchange rate expectations modelled as the 4 year average of the exchange rate, but this variable was insignificant. Likewise, the spread with the U.S. dollar was also insignificant. Results are available on request.

[42] In the case of the inflation differential variable (as for exchange rate volatility), extreme data points are excluded because in relation to these extreme points, other country and time specific differences are likely to be dominated. Also, I did not want my estimations to be driven by some extreme data points. This is only the case for Indonesia in 1998.

[43] This is the case not only for the U.S. dollar estimations, but also for the estimations for euro and home currency invoicing. Likewise, I experimented with including inflation volatility and money volatility as measures

I also perform estimations on U.S dollar import invoicing. While from a theoretical point of view the currency of import invoicing reflects the choice of the exporter rather than the importer on the micro level, the macro level evidence of the importing country's characteristics still give interesting insights. In general, the results of the export invoicing estimation are confirmed. In particular, the results concerning the importance of the variables related to membership in the EU and introduction of the euro give qualitatively the same results. The exchange rate volatility is still insignificant as is the share of imports coming from the U.S., while the forward market dummy is this time inconclusive (see Table A3 of the Appendix). Highly differentiated goods are again significantly less likely to be invoiced in U.S. dollar. High inflation differentials to the U.S again increase the share of imports in USD. Of course from the theoretical point of view, it does make a difference whether the exporter or the importer exhibits high inflation differentials, but as the invoicing in USD is interpreted as vehicle currency invoicing it just shows that when either the exporting or the importing country's currency are instable, pricing in vehicle currency is more likely. While the role of the euro as vehicle currency is not easy to infer from these estimation results, I have a closer look at this in the following section.

4.5   The Empirical Model for Euro Export Invoicing

The estimation is structured in the same way as the USD invoicing estimations:[44]

$$eurex_{it} = \beta_1 + \beta_2\,shexeur_{it} + \beta_3\,eurinst_i + \beta_4\,euroint_{it} + \beta_5\,rauex_i + \beta_6\,eurexvol_{it} + \beta_7\,euroinf_{it} + \beta_8\,fmdum_i + \beta_9\,eurpeg_{it} + u_{it}, \tag{3}$$

where *eurex* is the share of exports invoiced in euro and *shexeur* the share of exports going to the euro area, *eurexvol* the exchange rate volatility vis-à-vis the euro, *euroinf* the inflation differential to the euro area and *eurpeg* is a 0/1 dummy variable that takes on the value 1 for all those periods in which a country had a hard peg vis-à-vis the euro.

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of financial stability. While the qualitative results were quite similar, these variables were not significant in any specification.

[44] The euro area countries are left out in the euro invoicing estimation, of course. This data will be part of the home invoicing estimations.

Table 3 presents an overview of the estimation results. It shows that being part of or a candidate for the EU increases euro export invoicing by around 17 percentage points. When comparing this coefficient with the coefficient on *eurinst* in the USD estimations, we can see that it is smaller. The explanation for this is straightforward, as in the euro specification the share of exports going to the euro area does have a significant positive effect as expected.[45] This does already show that unlike the USD which is mainly used as vehicle currency, the use of the euro might rather be concentrated in bilateral trade. It is also interesting to see that being part of Europe does seem to have an impact on euro invoicing which is not necessarily linked to the higher trade share of these countries with Europe.[46] The introduction of the common currency increased the share of exports invoiced in euro as compared to the share of exports invoiced in legacy currencies before by around 6 percentage points. This coefficient is comparable to the reduction of U.S. dollar invoicing which comes with the introduction of the euro in the USD export invoicing equation.

How important is the role of the euro as vehicle currency? The table reveals that the share of the differentiated products (*rauex*) has a significant and *positive* impact on euro export invoicing. This is an interesting finding in the question on whether the euro is used as a vehicle currency. If the euro were substantially used as a third currency in trade, less differentiated goods would be more likely to be invoiced in euro and products with higher differentiation would be invoiced in euro to a lesser amount.[47] The contrary is the case, and the results, thus, just reflect the lower share of U.S. dollar invoicing for more differentiated products. Or to put it the other way around, it reflects the higher share of USD vehicle currency pricing in less differentiated products like primary commodities.

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[45] A country like Estonia with around 40 percent of its exports going to the euro area has an around 20 percentage points higher invoicing in euro in addition of the around 16 percentage points due belonging to the EU.

[46] I also experimented with including a geographical measure of distance. The geographical distance in combination with *shexeur* and *eurinst* is not significant. Only when either *shexeur* or *eurinst* are excluded is the measure of distance significant. The other results do not change qualitatively. This analysis was performed to control for possible collinearity between the share of exports and the dummy for being part of or a prospective member of the EU25. As both variables are significant, however, this should not be a problem but can be kept in mind when interpreting the ceteris paribus impact of the two variables.

[47] The impact should still be negative even if it reflects bilateral trade with the euro area (for which I try to control), as it should make local currency pricing (the exports to the euro area invoiced in euro) less likely.

Table 3:

Euro Export Invoicing
Dependent variable: share of exports invoiced in euro (in percentage points)

Regression	random	fixed	PW[a]	weighted[b]
Constant	-20.59*	20.78***	-28.66***	-2.44
	(-1.92)	(4.35)	(-5.73)	(-0.29)
Share of exports to euro area	0.47***	0.31**	0.67***	0.44**
	(4.66)	(2.53)	(9.24)	(2.37)
EU-25 and candidates	16.99**		15.50***	7.28
	(2.4)		(4.17)	(0.93)
Introduction of the euro (2002)	6.34***	6.27***	4.20***	1.73**
	(7.43)	(7.33)	(4.82)	(2.05)
Share of differentiated exports	0.49**		0.52***	0.17**
	(2.45)		(4.38)	(2.54)
Exchange rate volatility to euro	70.26*	80.41**	18.95	37.65
	(1.95)	(2.23)	(0.53)	(0.98)
Inflation differential to euro area	-0.30***	-0.33***	-0.18***	-0.07
	(-4.53)	(-4.91)	(-3.06)	(-0.32)
Forward market	-7.59		2.92	-8.78
	(-1.34)		(1.09)	(-1.52)
Peg to euro	12.95***	13.64***	8.54**	15.54
	(3.53)	(3.53)	(2.56)	(0.99)
Number of observations	152	152	152	152
Number of countries	29	29	29	29
Wald chi2	234.4		894.8	105.1
R squared overall	0.76	0.47	0.93	0.76

Absolute value of z statistics in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%

[a] Prais-Winston regression with heteroscedastic panel corrected standard errors and panel specific AR1.

[b] Prais-Winston regression with het. panel corrected standard errors. Importance weighted with GDP.

The possible role of the euro as vehicle currency could also be reflected as a higher share of euro invoicing for an economy which displays high exchange rate volatility and high financial instability. The impact of the exchange rate volatility is significantly positive unlike in the case for U.S. dollar invoicing, although this finding is not stable over the different estimation methodologies. This result confirms that the findings for exchange rate risk are quite ambiguous.[48] At the same time it gives some evidence for the theoretical argument that a more stable currency is preferred. There is, thus, a role for the euro as a vehicle currency in

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[48] Silva (2004) also points out this lack of evidence on the impact of exchange rate risk.

trade between countries with high exchange rate volatility. At the same time, if a country exhibits monetary instability it should be more likely to invoice in a vehicle currency, so that there should be a positive impact of inflation differentials on euro invoicing if the euro were used as a vehicle currency. The inflation differential with the euro area does have a significantly *negative* impact on euro export invoicing, however. This shows that if countries choose a vehicle currency, the choice is most likely the USD. This is then a convincing argument against a leading role of the euro as compared to the U.S. dollar. It could, however, be argued that the estimation results only reflect the choice between USD and euro invoicing, while the euro might be preferred in the choice between own currency and vehicle currency. When setting the share of export invoicing in relation to the (approximated) share of home currency invoicing leaving out USD invoicing, the inflation differential has an insignificantly *positive* impact on euro invoicing. It is also interesting to see that in this estimation the share of exports going to the euro area, being part or a candidate of the European Union, the introduction of the euro and the dummy for a hard peg to the euro still have significant positive effects. The share of differentiated products does still have a positive, albeit insignificant effect on euro invoicing. Another interesting finding is, that countries without a forward market are – in this specification significantly so – more likely to invoice in euro.[49] Thus, there does seem to be a case for the euro as vehicle currency even though in comparison with the U.S. dollar the role of the euro as vehicle currency seems to be limited.

The estimation results for euro import invoicing (see Table A4 of the appendix) confirm the finding that the euro is not extensively used as a vehicle currency as compared to the U.S. dollar, but that there are signs of a growing role of the euro as vehicle currency.[50] Altogether it can be said that the findings of the euro import invoicing estimation are compatible both with the export estimation and with the results for U.S. dollar import invoicing. They indicate that the role of the euro as vehicle currency is still rather limited, especially in comparison with the role of the U.S. dollar as a vehicle currency. There are, however, strong signs of an

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[49] The latter results have to be interpreted with the utmost care, however, as the transformation of data cannot be performed consistently due to a lack of bilateral data. Especially the variables including relative trade shares are critical, while the interpretation of the inflation differentials and the forward market dummy should be unproblematic. Results are available on request.

[50] For the import specification the forward market dummy is significantly negative in some of the estimations, implying that for a country with a forward market there is less euro invoicing. This shows that the euro is used as a vehicle currency for countries lacking a forward market. Other results are qualitatively the same as in the export estimations.

increasing importance of the euro both at the cost of the U.S. dollar as vehicle currency and at the cost of local currencies.

4.6 The Empirical Model for Home Currency Export Invoicing (PCP)

Unlike the estimations for U.S. dollar and euro invoicing, this estimation is a straightforward test of the PCP theory, as it tests the extent to which exports are denominated in a country's own currency. The observations are mainly based on the home invoicing of euro area countries in extra-euro area trade. The specification of the PCP invoicing equation is as follows:

$$homex_{it} = \beta_1 + \beta_2\, mp_{it} + \beta_3\, eurinst_i + \beta_4\, euroint_{it} + \beta_5\, rauex_i + \beta_6\, usinf_{it} + \beta_7\, fmdum_{it} + u_{it}\,, \tag{5}$$

where *homex* is the share of exports invoiced in the exporter's home currency (PCP) and *mp* is the country's export share in world exports, taken to be an indicator for market power.[51]

Table 4 shows that being part of or candidate for the European Union significantly increases the share of PCP in exports by around 15 percentage points. The market power of the exporting economy also plays a significant role. The higher the share of a country's exports in world exports, the more likely it is to invoice in its own currency. This could of course also indicate that a country pertaining to a monetary union is more likely to invoice its (extra-union) exports in home currency already due to the fact that the common market power is higher.[52] The introduction of the euro currency does have a separate significantly positive impact on home invoicing. This is because out of the 19 countries for which data is available 9 countries are part of the euro area.

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[51] For the euro area countries *mp* is the share of extra euro area exports to world exports

[52] This effect does, however, not seem to be very high, yet. In an alternative specification I tested for the influence of the individual countries' market shares. They are also found to be significant and deliver comparable results.

Table 4:
Home Currency Export Invoicing
Dependent variable: share of exports invoiced in producer currency (in percentage points)

Regression	random	fixed	PW[a]	weighted[b]
Constant	-22.79** (-2.00)	26.77*** (12.64)	-50.10*** (-6.32)	-34.34*** (-4.80)
Share of exports in world exports	0.49*** (2.60)	0.41** (2.12)	0.22 (1.45)	0.36*** (5.66)
EU-25 and candidates	14.58** (2.42)		14.53*** (2.99)	14.63*** (18.98)
Introduction of the euro (2002)	4.66*** (4.57)	4.75*** (4.71)	4.76*** (3.61)	2.41*** (5.65)
Share of differentiated exports	0.25 (1.22)		0.50*** (4.66)	0.28*** (3.16)
Exchange rate volatility to U.S.	17.67 (0.44)	21.44 (0.54)	10.73 (0.28)	-31.12 (-1.44)
Inflation differential to U.S.	-0.11 (-0.94)	-0.06 (-0.49)	-0.11 (-1.05)	0.00 (0.04)
Forward market	30.66*** (4.00)		48.56*** (12.25)	47.85*** (21.18)
Number of observations	92	92	92	92
Number of countries	19	19	19	19
Wald chi2	98.2		1251.1	49591.3
R squared overall	0.76	0.54	0.95	0.97

Absolute value of z statistics in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%

[a] Prais-Winston regression with heteroscedastic panel corrected standard errors and panel specific AR1.

[b] Prais-Winston regression with het. panel corrected standard errors. Importance weighted with GDP.

The share of differentiated products has a positive sign as expected and is significant in most of the specifications. The inflation differential on the other hand is always insignificant, albeit mostly with the expected sign. The reason why the results are not so significant can partly be attributed to the fact that for the home specification there are much fewer observations and the cross section is much smaller. Another reason could be that the euro area countries don't exhibit strong divergence in terms of inflation differentials with the U.S. If a country has a developed financial system as modelled with the forward market dummy it is

more likely to invoice its exports in the own currency.[53] The volatility of the exchange rate towards the U.S. dollar does not have any significant impact.

4.7   The Empirical Model for Home Currency Import Invoicing (LCP)

In the most general specification I expect the market power of the importing country, i.e. the share of a country's exports in total world exports, the share of differentiated products imported and the monetary stability of the importing country to be significant.[54] The most general specification has the following structure:

$$homeim_{it} = \beta_1 + \beta_2\ mp_{it} + \beta_3\ eurinst_i + \beta_4\ euroint_{it} + \beta_5\ rauim_i + \beta_6\ usinf_{it} + \beta_7\ fmdum_{it} + u_{it}\ ,$$

$$(6)$$

where *homeim* stands for imports invoiced in the importer's home currency (LCP).

As can be seen from Table 5, the market power of the importer has a significantly positive influence on home currency invoicing in all regressions. Thus, the higher the market power of an economy, the more likely it is that this country's imports are invoiced in the home currency.[55] In the alternative specification, where only the market share of the individual country is included, this variable is not always significant. There is, therefore, a weak indication that the monetary union does increase the likelihood of imports being invoiced in the union's currency as herding in euro becomes more likely.

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[53] I also experimented with including the private credit to GDP ratio as a measure of financial development. For the home export invoicing estimations this variable is insignificant as was the case for vehicle currency invoicing in U.S. dollar and euro. Only for the home import invoicing estimation does the coefficient become significantly positive (as expected) when the forward market dummy is excluded due to possible collinearity. This does not change the other results.

[54] Ideally, the characteristics of the exporting country would also be included. Due to the lack of bilateral invoicing data, this is difficult to determine. Alternatively one could include a trade weighted average of the exporting countries' market power (to one importing country) and monetary stability. Goldberg and Tille (2005) experiment with this and do not get satisfactory results.

[55] Alternatively, the size of the country could also be included. I chose the share of exports in relation to world exports as a proxy, however, as Rey (2001) states that the use of vehicle currencies cannot be explained by a large GDP but by high trade flows.

Home Currency Import Invoicing
Dependent variable: share of imports invoiced in local currency (in percentage points)

Regression	random	fixed	PW[a]	weighted[b]
Constant	-31.52***	18.47***	-47.85***	-33.02***
	(-2.68)	(11.76)	(-10.43)	(-5.44)
Share of exports in world exports	0.83***	0.62***	0.98***	0.75***
	(5.37)	(3.81)	(4.74)	(7.36)
EU-25 and candidates	7.8		9.02***	9.71***
	(1.46)		(2.73)	(6.14)
Introduction of the euro (2002)	3.84***	4.00***	2.03**	3.72***
	(4.73)	(5.15)	(2.00)	(6.94)
Share of differentiated imports	0.51*		0.80***	0.53***
	(1.94)		(8.64)	(10.32)
Exchange rate volatility to U.S.	16.6	21.14	12.53	98.45***
	(0.52)	(0.69)	(0.63)	(4.32)
Inflation differential to U.S.	-0.01	0.01	-0.06	-0.39**
	(-0.15)	(0.13)	(-1.32)	(-2.34)
Forward market	19.72***		20.05***	20.74***
	(3.26)		(5.39)	(3.18)
Number of observations	103	103	103	103
Number of countries	19	19	19	19
Wald chi2	136.1		1290.1	2654.4
R squared overall	0.83	0.69	0.96	0.96

Absolute value of z statistics in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%

[a] Prais-Winston regression with heteroscedastic panel corrected standard errors and panel specific AR1.

[b] Prais-Winston regression with het. panel corrected standard errors. Importance weighted with GDP.

Being part of or a candidate of the EU again increases the share of home currency invoicing. This result is, however, not significant for all specifications. The results for the introduction of the euro are significantly positive. Around 4 percentage points more imports have been invoiced in home currency since 2002. The inflation differential variable is inconclusive and the effects of the exchange rate volatility are again insignificant. Although the coefficients are positive, there is, thus, no evidence that high exchange rate volatility increases local currency pricing.

The share of differentiated products is significant for the home import invoicing estimation. From a theoretical perspective we expect that if a product is highly differentiated the exporter is more likely to choose PCP as he does not care so much about relative prices. I would therefore expect *rauim* to have a negative impact on LCP. It has a significantly positive

impact, however. How can this phenomenon be explained? The share of differentiated goods was found to significantly reduce invoicing in U.S. dollar as vehicle currency. Apparently, this reflects only the choice of a vehicle currency, though, whereas the theory also makes a strong argument for its role in the choice between PCP and LCP. In the estimation of the share of imports invoiced in the importer's home currency (LCP), I find that the more differentiated the products the more likely it is that they are invoiced in the local – i.e., importer's – currency, while we would have expected them to be invoiced in the exporter's currency instead. As the dataset mainly refers to euro area countries, this unexpected result may simply reflect that the lower the share of organized traded and referenced goods, the lower the invoicing in U.S. dollar. Thus, the higher the share of differentiated products, the more likely the product is invoiced in euro – which in this specification is the home currency for half the countries. While the home export invoicing estimations suggest a positive impact of the degree of product differentiation on the use of the own currency, there is, thus, no clear support for the theory of the importance of differentiated products with respect to PCP and LCP. The only conclusion that can be drawn is that the level of product differentiation plays a role for the decision on vehicle currency invoicing and that apparently the role of the euro in this respect is still fairly limited.

4.8   Robustness and Goodness-of-Fit of the Model

In addition to the inclusion of a wide range of specifications to show that the significance level and the coefficients are quite stable over different specifications, I also perform Hausman tests to compare the coefficients of the random effects and the fixed effects model and find that they are not systematically different.[56] As the time invariant variables drop out for the fixed effects estimations the Hausman test may not be proof enough for the validity of the random effects estimations. I therefore also report the fixed effects specifications. They deliver the same qualitative results for the time varying variables. To control for heteroscedasticity across the cross section and for autocorrelation I also present estimation

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[56] Only for euro import invoicing can the null hypothesis of no systematic difference be rejected. This does not change the qualitative results of the estimation, however.

results for a Prais-Winston regression with panel corrected standard errors.[57] Almost all variables which are found to be significant in the random effects model are also significant for this specification and insignificant results stay insignificant. Only for the exchange rate volatility variables and the forward market dummy is there some change in the significance pattern as compared to the reference estimations. The estimation method for which results diverge the most is the importance weighted Prais-Winston regression. In this case it is not surprising that the results vary a bit as the GDP weights of the countries do differ considerably. On the contrary, it is very reassuring to see that this regression also confirms the general findings of the other regressions.

As another test for robustness I ran regressions including a dummy for every year to control for omitted variable bias. This does not change the results significantly, either. Furthermore, I experimented with including different sets of variables as mentioned in the above analysis. Not all variables which were found to be insignificant are reported as they did not change the main results. As an indicator of the explanatory power of my model I include the pseudo R squared adjusted for the overall estimation as reported by stata. Although one has to interpret this R squared with caution, it indicates, that the model does have quite good explanatory power. The main contribution of the explanatory power stems from the variables reflecting the prospective future adoption of the euro. In particular, whether a country belongs to or is a candidate for the EU, the introduction of the common currency and the share of trade with the euro area (for the euro invoicing estimations). However, even when leaving out these variables, the remaining parameters still have a significant and quite high overall explanatory power.

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[57] I also estimated an alternative feasible GLS estimation with heteroscedasticity robust errors. Likewise, I estimate a random effects model with serial correlation robust standard errors especially constructed for unbalanced data by Baltagi and Wu (1999). Again, this does not qualitatively change the estimation results. The results for these estimations are not included in the paper as they are both qualitatively and quantitatively almost identical.

5. Conclusion

This paper provides empirical evidence on the determinants of currency invoicing in international trade, a topic which has received little attention so far due to data limitations. This study presents a newly constructed dataset on currency invoicing in trade for 42 countries. The paper contributes to the literature by exploring the use of the euro in invoicing of international trade. It provides a comparison of the role of the euro and the role of the U.S. dollar as world vehicle currencies.

The main findings of this analysis are that the membership or prospective membership of a country in the EU plays a decisive role in the choice of the euro as invoicing currency in its trade. At the same time, the introduction of the common currency in the euro area increased the invoicing in euro at the expense of the U.S. dollar. This effect goes hand in hand with the finding that higher market power defined as a country's total exports in relation to world exports leads to increased invoicing in home currency for the countries of the euro area. The paper finds ambiguous evidence for the importance of exchange rate risk as a determinant of currency invoicing. Neither for the estimations of home currency invoicing nor for U.S. dollar invoicing is there increased invoicing in the vehicle currency and less home currency invoicing with higher exchange rate risk. Only for the euro invoicing estimations, there is a higher incidence of euro vehicle currency invoicing when a country's currency is volatile. There is, thus, some evidence for an increased role of the euro as a vehicle currency. The role of the euro as vehicle currency in trade seems to be limited, however, when compared to the U.S. dollar. The estimation results support the hypothesis that monetary instability reflected in high inflation differentials increases the invoicing in vehicle currency. But this relationship is only found for vehicle currency invoicing in U.S. dollar in the case when monetary unstable countries are involved. At the same time, while a low level of product differentiation increases vehicle currency pricing in U.S. dollar, this mainly seems to reflect the trade in organized and referenced priced goods. The data only provides partial support for the theoretical hypothesis that producer currency invoicing is likely if exports are highly differentiated, however. Summing up, it can be said that the U.S. dollar is still the dominant vehicle currency as compared to the euro. There are, however, some indications that the role of the euro as invoicing currency increased as the euro replaced the legacy currencies.

The use of this new and extensive dataset made a thorough econometric analysis of the determinants of currency invoicing possible. Data limitations, nevertheless, have to be borne in mind when interpreting the results. Industry specific country data and data on bilateral trade, if available for each of the countries in the data set, would help to refine the analysis. Also, once the time horizon of available data will be longer, research could focus on the dynamics of the invoicing process, including the question of inertia of invoicing strategies.

Appendix

List of Variables

Invoicing (Database see Appendix Table A1)

eurex	share of exports invoiced in euro (in %)
eurim	share of imports invoiced in euro (in %)
homex	share of exports invoiced in home currency (in %)
homeim	share of imports invoiced in home currency (in %)
usdex	share of exports invoiced in U.S. dollar (in %)
usdim	share of imports invoiced in U.S. dollar (in %)

Trade Share (IMF Direction of Trade Statistics)

mp	market power, measured as country's export share in total world exports
shexeur	country's share of exports to the euro area as share of total country exports (in %)
shexus	country's share of exports to the U.S. as share of total country exports (in %)
shimeur	country's share of imports from the euro area as share of total country imports (in %)
shimus	country's share of imports from the U.S. as share of total country imports (in %)
shimdum	0/1 dummy, taking on the value of 1 if share of imports from the euro area is higher than 50 percent

Rauch Index (UN Comtrade Statistics)

rauex	share of country's differentiated exports in country's total exports (measured with SITC rev. 2 four digits codes)
rauim	share of country's differentiated imports in country's total imports (measured with SITC rev. 2 four digits codes)

Membership of the EU and euro currency introduction

eurinst	0/1 dummy, taking on the value of 1 when a country is a member of the EU-25 or an official candidate country (Bulgaria, Croatia, Romania).
euroint	0/1 dummy, taking on the value of 1 for the year 2002 and thereafter. Introduction of the euro currency and discontinuation of the legacy currencies.

Financial Stability (IMF International Financial Statistics)

credit	private credit to GDP ratio
eurexvol	volatility of country's exchange rate vis-à-vis the euro (four month moving average of standard deviation)
eurinf	country's inflation differential with the euro area (before 1999 with Germany)
eurpeg	0/1 dummy, taking on the value of 1 when a country has a hard peg vis-à-vis the euro
fmdum	dummy taking on the value of 1 all those countries with a forward market for their exchange rate in 1999 (Bloomberg statistics)
usdpeg	0/1 dummy, taking on the value of 1 when a country has a hard peg vis-à-vis the U.S. dollar
usexvol	volatility of country's exchange rate vis-à-vis the euro (four month moving average of standard deviation)
usinf	country's inflation differential with the U.S.

Table A1:
U.S. Dollar, Euro and Home Currency Invoicing in the Exports and Imports of 42 Countries

		Exports in Goods			Imports in Goods		
		EUR	USD	home	EUR	USD	home
EUROPE *Euro Area*							
Belgium[a]	2000	42		42	43.6		43.6
	2001	46.7		46.7	47.2		47.2
	2002	53.5	32.5	53.5	53.6	34.6	53.6
	2003	56.6	30.8	56.6	57.7	32.9	57.7
	2004	57.7	29.6	57.7	55.5	35.1	55.5
France	1999	52.2	35.5	52.2	40.6	48.4	40.6
	2000	44.6	42.6	44.6	32.9	57.2	32.9
	2001	47.1	41.0	47.1	44.4	45.7	44.4
	2002	51.0	37.0	51.0	46.9	45.2	46.8
	2003	52.7	33.6	52.7	45.3	46.9	45.3
Germany[b]	2002	49.0	31.6	49.0	48.0	34.5	48.0
	2003	63.0	24.1	63.0	55.2	33.9	55.2
	2004	61.1	24.1	61.1	52.8	35.9	52.8
Greece	2001	23.5	67.7	23.5	29.3	61.5	29.3
	2002	39.3	52.6	39.3	35.8	57.1	35.8
	2003	47.3	45.9	47.3	39.6	54.7	39.6
	2004	44.3	51.2	44.3	40.6	55.3	40.6
Italy	2001	52.7		52.7	40.8		40.8
	2002	54.1		54.1	44.2		44.2
	2003	58.2		58.5	44.5		44.5
	2004	59.7		59.7	44.5		44.5
Luxembourg[a]	2000	42.0		42	43.6		43.6
	2001	46.7		46.7	47.2		47.2
	2002	46.0	38.3	46.0	31.6	47.5	31.6
	2003	51.2	26.6	51.2	41.6	36.9	41.6
	2004	62.7	22.1	62.7	49.4	36.3	49.4
Netherlands	1998	51.5	32	51.5	41.9	44.3	41.9
	1999	51.8	32	51.8	41.5	45.6	41.5
	2000	44.7	41.3	44.7	37	52.8	37
	2001	47.8	39.2	47.8	41.1	48.5	41.1
	2002	52.0	35.2	52.0	48.0	43.8	48.0
Portugal	2000	40.1		40.1	47		47
	2001	43.5		43.5	53.6		53.6
	2002	48.4	33.0	48.4	57.5	35.2	57.5
	2003	53.6	27.6	53.6	59.2	31.1	59.2
	2004	57.6	27.4	57.6	58.8	32.6	58.8
Spain	1998	48.9	40.1	48.9	42.1	46.4	42.1
	1999	50.2	39.1	50.2	45.3	44.4	45.3
	2000	49.0	40.9	49.0	44.0	48.2	44.0
	2001	52.0	38.4	52.0	49.7	43.7	49.7
	2002	57.5	32.4	57.5	55.9	38.9	55.9
	2003	61.7	29.3	61.7	61.1	34.9	61.1
	2004	62.6	29.1	62.6	61.1	35.5	61.1

Table 1 continued

		Exports in Goods			Imports in Goods		
		EUR	USD	home	EUR	USD	home
Other EU 25							
Cyprus	2003	30.2	34.1		44.9	33.4	
	2004	32.0	28.6		52.9	30.2	
Czech Rep.[c]	1999	71.2	13.1		67.3	18.8	
	2000	69.2	14.4		66.9	20.5	
	2001	68.7	14.1	10.3	66.6	19.7	7.7
	2002	68.2	14.7	10.2	66.7	19.5	8.7
	2003	70.3	13.5	9.6	67.6	18.3	9.3
	2004	72.4	12.0		68.8	18.5	
Denmark	1999	30.0	19.7		32.6	20.6	
	2000	29.3	25.4		32.6	24.1	
	2001	32.6	25.6		35.3	24.3	
	2002	35.9	22.0		37.4	19.3	
	2003	35.2	19.5		32.4	17.4	
	2004	34.3	19.5		33.1	17.0	
Estonia[d]	2002	65.1			59.0		
	2003	70.3	9.0		61.5	22.0	
	2004	72.2	9.4		62.5	21.9	
Hungary[e]	1992	52.4	37.5		53.3	33.8	
	1993	50.6	40.3		48.3	40.1	
	1994	55.2	34.3		53.5	34.3	
	1995	59.6	31		55.2	33.1	
	1996	62.6	27.4		55.8	32.9	
	1997	60.5	28.7		57	29.4	
	1998	65.1	28.5		61.6	27	
	1999	74.4	21.2	0.4	70.6	22.5	2.1
	2000	78.6	17.5	0.3	69.8	23.2	2.6
	2001	79.4	15.7	1.0	70.5	21.7	3.4
	2002	83.2	12.2	1.4	73.3	18.5	4.0
	2003	85.0	10.1	1.8	72.4	17.7	5.4
	2004	84.8	9.6	2.3	70.8	18.8	6.3
Latvia	2000	28.5	46.9		40.2	42.4	
	2001	34.1	41.4		44.5	37.3	
	2002	40.4	36.2		51.9	29.7	
	2003	41.6	38.3		49.6	34.0	
	2004	47.9	35.2		52.7	34.9	
Lithuania	1996				25	62.2	2.0
	1997				28	60.3	1.3
	1998				33	55.9	0.7
	1999	28.5	62.5	1.4	34.3	58.8	1.4
	2000	32.3	60.7	1.2	38.3	57.5	1.5
	2001	40.1	54.3	1.3	42.9	52.9	1.2
	2002	48.2	46.3	1.4	46.0	49.2	1.3
	2003	51.7	43.6	1.4	53.0	42.0	1.5
	2004	53.0	42.0	1.6	54.7	39.3	2.4
	2005	54.8	40.8	1.4	61.0	34.2	1.3

Table 1 continued

		Exports in Goods			Imports in Goods		
		EUR	USD	home	EUR	USD	home
Poland	1994	48.1	41.2		48.1	41.2	
	1995	44.2	49.1		49.3	41.0	
	1996	43.6	49.4		51.5	39.5	
	1997	44.0	48.5		53.3	38.0	
	1998	51.2	40.0	2.7	58.3	32.3	1.5
	1999	53.7	36.3	4.1	57.2	32.1	3.4
	2000	54.8	36.2	3.5	54.9	34.8	3.9
	2001	57.2	33.8	4.1	57.7	32.9	4.6
	2002	60.1	29.9	4.9	59.6	28.6	6.5
	2003	64.9	25.2	5.1	60.2	27.2	8.3
	2004	69.3	21.4	5.1	61.7	26.1	8.5
Slovakia	1999	58.3	28.4				
	2000	58.5	30.0				
	2001	61.3	26.4				
	2002	63.7	23.2				
	2003	69.8	19.0				
Slovenia	2000	85.0	10.4		77.0	17.9	
	2001	85.0	10.3		79.0	15.7	
	2002	87.0			83.0		
	2003	87.2	9.5		82.4	14.2	
	2004	88.1	8.1		83.3	13.2	
UK	1999	19	27	53	23	30	40
	2000	21	29	46	19	34	42
	2001	23	29	46	19	38	40
	2002	21	26	51	27	37	33
EU candidates							
Bulgaria	1998	31.5	65.9		42.1	53.5	
	1999	36.7	60.4		46.8	48.9	
	2000	37.5	60		46.9	50.1	
	2001	48.1	49		55.5	41.8	
	2002	52.4	44.4		60.1	37.1	
	2003	60.7	36.4		62.7	34.7	
	2004	62.2	35.2		63.6	34.1	
Croatia	1998	61	36		72	24	
	1999	62	33		72	24	
	2000	60	36		70	26	
	2001	63.0	32.9		72.7	24.4	
	2002	69.4	27.6		77.1	20.2	
	2003	72.0	24.2		78.0	18.6	
	2004	68.5	27.7		78.0	18.3	
Romania	1999	50.5	45.2		57.1	37.7	
	2000	51	42.8		60.4	33.7	
	2001	55.7	39.5		60.6	35.1	
	2002	58.6	36.4		65.6	30.3	
	2003	63.8	30.6		67.9	28.3	
	2004	66.3	28.5		70.8	25.6	
	2005	64.3	31.5		71.1	25.7	
Turkey	2002	46.7	44.9	0.9	37.0	56.7	0.3
	2003	49.3	42.6	1.1	39.7	55.1	0.2
	2004	49.3	42.9	1.0	40.3	55.0	0.2

Table 1 continued

		Exports in Goods			Imports in Goods		
		EUR	USD	home	EUR	USD	home
Other European Countries							
The former Yugoslav Republic of Macedonia	1998	54.7	43.8		58.4	39.9	
	1999	59.4	39.1		62.0	36.3	
	2000	54.7	43.8		54.6	43.7	
	2001	61.0	37.6		63.7	34.6	
	2002	66.4	32.2		67.6	30.4	
	2003	67.4	31.2		70.6	27.9	
	2004	75.5	22.9		75.3	23.2	
Serbia and Montenegro	2002		20.0			30.0	
	2003		15.0			27.0	
Ukraine	2001	2.6	76.0				
	2002	4.7	75.7		10.8	73.3	
	2003	5.7	75.4	0.4	14.6	74.1	0.4
	2004	7.6	78.0	0.4	14.1	76.9	0.4
AFRICA							
Algeria	2003	0.48	99.0		50.8		
	2004	0.58	99.0		48.0		
Morocco	2003				55.0		
South Africa	2003	17.0	52.0	25.0			
Tunisia	1995	45.4			46.6		
	1996	45.5			49.1		
	1997	49.1			45.9		
	1998	56.9			48.5		
	1999	47.7			65.6		
	2000	46.2			50.4		
	2001	52.3			55.6		
ASIA PAZIFIC							
Australia	1997	0.8	63.0	33.8	7.8	51.7	24.9
	1998	0.9	66	30.8	7.8	52.5	24.3
	1999	0.7	64.2	32.1	8.3	49.7	28.6
	2000	0.5	68.4	28.6	7.1	51.4	28.3
	2001	0.7	68.8	27.7	9.2	49.5	30.7
	2002	1.4	67.9	27.6	8.7	50.1	30.6
	2003	1.4	67.5	27.8	9.4	47.9	32.6
India	1998	7.1			8.1		
Indonesia	1991	4.5	89.7	0.0	10.8	70.6	0.0
	1992				11.1	72.1	0.0
	1993				9.0	73.3	0.0
	1994	0.7	95.7	0.1	8.9	74.7	0.1
	1995	0.5	83.5	0.0	6.6	77.7	0.2
	1996	0.5	90.4		6.6	81.5	0.2
	1997	1.2	91.9	1.7	6.6	78.7	0.5

Table 1 continued

		Exports in Goods			Imports in Goods		
		EUR	USD	home	EUR	USD	home
Indonesia	1998	0.8	93.7	0.2	8.4	77.4	0.3
	1999	1.2	92.9	0.0	4.1	83.3	0.6
	2000	1.5	92.7	0.0	4.5	79.9	1.0
	2001	2.2	91.0	0.0	5.8	80.0	0.6
	2002	2.1	91.4	0.1	5.8	79.6	0.4
	2003	1.5	92.8	0.0	5.8	80.3	0.4
	2004	1.2	93.6	0.0	5.7	82.5	0.4
Israel	2000	24.6	62.6				
	2004	23.9	64.7				
Japan	1992		46.6	40.1		74.5	17
	1993		48.4	39.9		72.4	20.9
	1994		48.3	39.7		73.9	19.2
	1995		52.0	36.8		69.6	23.5
	1996		53.2	35.6		72.3	20.6
	1997		52.5	35.8		72.4	20.8
	1998		51.2	36.0		71.5	21.8
	2000	7.6	52.4	36.1	2.3	70.7	23.5
	2001	8	52.8	34.9	3	70	23.4
	2002	8.6	51.7	35.8	4.4	68.3	24.9
	2003	9.6	48.0	38.4	4.5	68.7	24.6
South Korea[f]	1990	2.1	88		4.1	79.1	
	1995	2.4	88.1		3.8	79.4	
	1996	2.2	89.1		3.6	81.0	
	2000	1.8	84.8		1.9	80.4	
	2001	4.5	87.4		4.0	82.2	
	2002	5.8	86.8		5.4	80.6	
	2003	7.6	84.6		6.1	78.3	
Malaysia	1995	3.2	61.7	18.7	8.2	1.2	
	1996	2.8	66	17.8	6.8	1	
	2000		90				
Pakistan	2001	1.6	92.6		3.5	84.2	
	2002	3.5	92.3		7.0	84.6	
	2003	6.9	89.4		9.0	82.8	
Thailand	1993	1	91.8	0.9	5.1	74.3	0.6
	1994	0.8	90.5	1.6	4.6	77.1	0.7
	1995	0.5	91.0	2.4	3.6	80.7	0.5
	1996	0.5	91.7	1.3	3.5	80.1	0.8
	1997	0.4	92.0	2.1	3.5	80.4	1.7
	1998	0.7	90.6	2.6	2.9	80.7	1.7
	1999	1.7	87.6	3.7	3.0	79.2	2.2
	2000	1.8	87.0	3.9	3.0	79.0	2.4
	2001	2.8	85.7	4.0	5.1	77.9	3.5
	2002	3.2	84.7	4.3	5.3	77.2	4.4
	2003	2.7	84.4	5.0	4.3	76.0	5.6
NORTH AMERICA							
Canada	2001		70	23			
US	2003				2.0	90.3	90.3

See below for sources and notes.

Table 1 continued: Sources and Notes

Country	Type of Data	Source and Notes
EUROPE		
Euro Area		
Belgium	Exports and imports, goods and services	ECB data request to National Central Banks. [a] Data before 2002 refers to Belgo-Luxembourg economic union.
France	Exports and imports, goods and services	ECB data request to National Central Banks.
Germany	Exports and imports, only goods	ECB data request to National Central Banks. [b] Data for Germany reflect the average value of data collected in surveys carried out in the first and third quarters of 2002, 2003 and 2004 on behalf of the Deutsche Bundesbank.
Greece	Exports and imports, goods and services	ECB data request to National Central Banks.
Italy	Exports and imports, goods and services	ECB data request to National Central Banks.
Luxembourg	Exports and imports, goods and services	ECB data request to National Central Banks. [a] Data before 2002 refers to Belgo-Luxembourg economic union.
Netherlands	Exports and imports, goods and services	Dutch National Bank, Data Request. Currency practices in Dutch exports and imports (1975-2002), DNB Quarterly March 2004.
Portugal	Exports and imports, goods and services	ECB data request to National Central Banks.
Spain	Exports and imports, goods and services	ECB data request to National Central Banks.
Other EU-25		
Cyprus	Exports and imports, only goods	ECB data request to National Central Banks.
Czech Republic	Exports and imports, only goods	ECB data request to National Central Banks. [c] Goods data for 2004 refer to the first quarter of 2004 as a result in changes in the way data are collected from May 2004 onwards.
Denmark	Exports and imports, goods and services	ECB data request to National Central Banks

Country	Trade	Source
Estonia	Exports and imports, goods and services	ECB data request to National Central Banks. d Goods data for 2004 refer to the first quarter of 2004 as a result in changes in the way data are collected from May 2004 onwards.
Hungary	Exports and imports, goods and services	ECB data request to National Central Banks. e Please note break in the series, data for 1992 to 1999: Ibolya Mile: Exchange rate policy of Hungary on the way to European Union membership.
Latvia	Exports and imports, goods and services	ECB data request to National Central Banks.
Lithuania	Exports and imports, goods and services	ECB data request to National Central Banks. Before 2000: Data only available for imports of goods from Igor Vetlov: The Monetary Transmission Mechanism in Lithuania, Eesti Pank publication (approximation for euro share as he quotes EU currencies): http://www.bankofestonia.info/pub/en/dokumendid/publikatsioonid/seeriad/muud_uuringud/_2004/_3.pdf
Poland	Exports and imports, only goods	ECB data request to National Central Banks. Data before 2002: Only data on goods. Bank of Poland, various issues of Annual Reports. http://www.nbp.pl/en/publikacje/r_roczny/rocznik2001_en.pdf
Slovakia	Overall Trade	Bank of Slovakia, Report on Monetary Developments in the SR in 2003. Currency structure of foreign exchange receipts and payments.
Slovenia	Exports and imports, goods and services	ECB data request to National Central Banks. Data before 2002: Banka Slovenije, Annual Report 2001.
UK	Exports and imports, only goods	HM Revenue & Customs [formerly H M Customs and Excise]. Bilateral trade data available. Warning issued that data may not be reliable.
EU candidates		
Bulgaria	Exports and imports, only goods	ECB special data request. Bulgarian National Bank, Customs declarations data, supplemented with NSI data and processed by the BNB. Data are coordinated with the National Statistical Institute of Bulgaria.
Croatia	Exports and imports, only goods	Bank of Croatia, various issues of Annual Reports. Data before 2001 refers to overall trade only.
Romania	Exports and imports, goods; services (only starting with 2005 data)	National Authority for Customs, National Bank of Romania.
Turkey	Exports and imports	Turkish undersecretariat of the Prime Ministry for Foreign Trade
Other European Countries		
F.Y.R.of Macedonia	Exports and imports	State Statistical Office of the Republic of Macedonia

Country	Trade	Source
Serbia & Montenegro	Exports and imports	Bank of Serbia and Montenegro, Annual Report 2003 and 2002. Data only for USD invoicing.
Ukraine	Exports and imports	Bank of Ukraine. Balance of Payments Report. Data for 2002 on bilateral basis.
AFRICA		
Algeria	Exports and imports	ECB special data request. Bank of Algeria. Only euro no USD invoicing for imports.
Morocco	Only imports	Article in "Al Bayane": Les scénarii d'impact du renchérissement de l'euro sur l'économie marocaine. http://www.albayane.ma/Detail.asp?article_id=41798. Article from 3/28/2004.
South Africa	Only exports	Budget Review. http://www.treasury.gov.za/documents/budget/2004/review/Chapter%202.pdf
Tunisia	Exports and imports	ECB special data request. Banque Centrale de Tunisie. Data on services available for imports.
ASIA PACIFIC		
Australia	Exports and Imports	Bank of Australia. Data available on industry level. Australian Bureau of Statistics. Australia Now. International Merchandise Trade, Australia 1998 and 2003.
India	Exports and imports	Bank of India. Annual Report 1998/99. Bank of India Story. Box VI.4: Euro and India. Only euro data.
Indonesia	Exports and imports	Bank of Indonesia, Balance of Payments Statistics; data transformed to represent overall trade (not only non-oil trade). http://www.bi.go.id/web/en/Data+Statistik/
Israel	Overall trade	Bank of Israel, Press Release April 23 2000.
Japan	Exports and imports	Japan Customs, http://www.mof.go.jp/english/if/if043f.htm, and McKinnon and Schnabl (2004).
South Korea	Exports and imports	Monthly Statistics of Korea and McKinnon and Schnabl (2004) and Yun (2005). [f] Data for 2001 approximation.
Malaysia	Exports and imports	Ngiam Kee Jin: Financial and Monetary Cooperation in East Asia: The Singapore Perspective. Data for 2000: Treasury Malaysia: The Performance of the Malaysian Economy.
Pakistan	Exports and imports	Bank of Pakistan, Annual report 2003. http://www.sbp.org.pk/reports/annual/index.htm
Thailand	Exports and imports	Bank of Thailand, bilateral data. http://www.bot.or.th/BOThomepage/databank/EconData/EconData_e.htm
NORTH AMERICA		
Canada	Only exports	Murray and Powell (2002), Dollarization in Canada. Bank of Canada Technical Report No. 90.
United States	Only imports	Bureau of Labor Statistics. Special data request.

Table A2:
Share of Differentiated Goods in Exports and Imports

		Year	Exports	Imports
EUROPE				
Euro Area				
	Belgium	2004	55.0	64.9
	Germany	2004	72.9	69.5
	Spain	2003	67.0	64.0
	France	2004	66.1	67.5
	Greece	2004	49.6	61.9
	Italy	2004	73.9	62.7
	Luxemburg	2004	56.7	62.3
	Netherlands	2004	51.3	62.6
	Portugal	2004	66.2	65.3
Other EU 25				
	Cyprus	2004	64.4	69.8
	Czech Republic	2004	72.6	70.8
	Denmark	2004	64.9	71.4
	Estonia	2004	70.6	67.0
	Hungary	2003	73.6	76.3
	Latvia	2004	63.6	66.0
	Lithuania	2003	46.2	63.2
	Poland	2004	66.9	67.5
	Slovenia	2004	69.4	65.8
	Slovakia	2004	63.0	66.5
	United Kingdom	2004	66.7	76.5
EU candidates				
	Bulgaria	2004	49.9	75.9
	Croatia	2004	59.8	66.7
	Romania	2004	64.1	66.6
	Turkey	2004	68.0	46.8
Other European Countries				
	Macedonia	2004	52.6	53.8
	Serbia Montenegro	2004	47.8	55.2
	Ukraine	2003	31.0	40.5
AFRICA				
	Algeria	2004	0.3	58.8
	Morocco	2004	44.8	28.7
	Tunisia	2004	59.1	64.6
	South Africa	2004	30.4	68.4
ASIA PAZIFIC				
	Australia	2004	38.1	75.9
	Indonesia	2004	37.6	39.8
	India	2003	47.0	39.5
	Israel	2004	47.0	72.0
	Japan	2004	72.8	56.2
	Korea	2004	62.8	52.2
	Malaysia	2004	46.0	74.4
	Pakistan	2004	69.5	35.6
	Thailand	2003	55.0	62.3
NORTH AMERICA				
	Canada	2004	54.9	77.5
	United States	2004	64.1	75.3

Source: UN Comtrade database; own calculations based on Rauch (1999) index.

Table A3:

U.S. Dollar Import Invoicing

Dependent variable: share of imports invoiced in U.S. Dollar (in percentage points)

Regression	random	fixed	PW[a]	weighted[b]
Constant	108.21*** (8.82)	48.27*** (25.82)	99.99*** (15.66)	106.78*** (40.34)
Share of imports from U.S	0.08 (0.40)	-0.01 (-0.06)	0.21 (1.21)	0.05 (0.53)
EU-25 and candidates	-16.31*** (-2.68)		-14.62*** (-2.72)	-16.48*** (-13.43)
Introduction of the euro (2002)	-3.63*** (-5.01)	-3.91*** (-5.29)	-2.04*** (-2.59)	-2.41*** (-3.72)
Share of differentiated imports	-0.97*** (-3.66)		-0.73*** (-4.07)	-0.80*** (-19.08)
Exchange rate volatility to U.S.	0.96 (0.04)	2.36 (0.11)	8.70 (0.45)	3.52 (0.18)
Inflation differential to U.S.	0.22*** (4.76)	0.21*** (4.67)	0.16*** (3.58)	0.17** (2.45)
Forward market	4.18 (1.03)		-4.11* (-1.76)	-0.3 (-0.27)
Peg to USD	12.19*** (5.59)	11.86*** (5.40)	10.58*** (4.33)	10.16 (1.49)
Number of observations	160	160	160	160
Number of countries	31	31	31	31
Wald chi2	232.7		531.9	2860.8
R squared overall	0.77	0.02	0.97	0.99

Absolute value of z statistics in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%

[a] Prais-Winston regression with heteroscedastic panel corrected standard errors and panel specific AR1.

[b] Prais-Winston regression with het. panel corrected standard errors. Importance weighted with GDP.

Table A4:

Euro Import Invoicing

Dependent variable: share of imports invoiced in euro (in percentage points)

Regression	random	fixed	PW[a]	weighted[b]
Constant	-1.16 (-0.10)	25.53*** (4.84)	-1.00 (-0.26)	5.37 (1.32)
Share of imports from euro area	0.60*** (5.44)	0.27* (1.96)	0.95*** (11.98)	0.92*** (4.91)
EU-25 and candidates	13.99** (2.45)		12.84*** (3.40)	0.21 (0.03)
Introduction of the euro (2002)	5.24*** (6.19)	5.28*** (6.40)	2.17** (2.37)	2.56*** (4.12)
Share of differentiated imports	0.20 (0.80)		-0.09 (-1.21)	-0.29*** (-9.67)
Exchange rate volatility to euro	42.42 (1.21)	50.46 (1.48)	-26.69 (-0.89)	44.71 (1.50)
Inflation differential to euro area	-0.28*** (-4.67)	-0.28*** (-4.87)	-0.16*** (-3.28)	-0.18 (-1.49)
Forward market	-12.95*** (-2.78)		-1.09 (-0.48)	-1.32 (-0.34)
Peg to euro	12.83*** (4.52)	13.95*** (4.83)	8.43*** (3.05)	26.09** (2.23)
Number of observations	154	154	154	154
Number of countries	30	30	30	30
Wald chi2	254.7		918.7	630.0
R squared overall	0.77	0.48	0.87	0.90

Absolute value of z statistics in parentheses

* significant at 10%; ** significant at 5%; *** significant at 1%

[a] Prais-Winston regression with heteroscedastic panel corrected standard errors and panel specific AR1.

[b] Prais-Winston regression with het. panel corrected standard errors. Importance weighted with GDP.

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