Vehicle Currency Use in International Trade

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January 21, 2005

Abstract

Although currency invoicing in international trade transactions is central to the transmission of monetary policy, the forces motivating the *choice* of currency have long been debated. We introduce a model wherein agents involved in international trade can invoice in the exporter's currency, the importer's currency, or a third-country vehicle currency. The model is designed to contrast the contribution of macroeconomic variability with that of industry-specific features in the selection of an invoice currency. We show that producers in industries with high demand elasticities are more likely than producers in other industries to display herding in their choice of currency. This industry-related force is more influential than local macroeconomic performance in determining producers' choices.

Drawing on data on invoice currency use in exports and imports for twenty-four countries, we document that the dollar is the currency of choice for most transactions involving the United States. The dollar is also extensively used as a vehicle currency in international trade flows that do not directly involve the United States. Consistent with the results of our model, this last finding is largely attributable to international trade in reference-priced and organized-exchange traded goods. Although the magnitude of business-cycle volatility matters for invoicing of more differentiated products, it is less central for invoicing nondifferentiated goods.

Keywords: Currency, invoicing, vehicle currency, pass through, exchange rate, producer currency pricing, local currency pricing

JEL Classification: F3, F4

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I. Introduction

In which currency should exporters set the price of their goods? When selling to a foreign market, an exporting firm has three options. It can invoice the transaction in its own currency (producer's currency pricing, PCP), in the currency of the destination country (local currency pricing, LCP), in a third currency (vehicle currency pricing, VCP), or in a combination of these. Which of these three options is best for the firm is not straightforward from a theoretical perspective. In this paper, we contribute to this issue both theoretically and empirically. We show the interaction between macroeconomic variability and industry features in influencing invoice currency selection. We argue that the preserve of Walrasian type goods, characterized by a high price elasticity of demand, promotes herding in a single currency. In an industry where goods are close substitutes, a firm has an incentive to limit the movement of its price relative to that of its competitors, leading it to invoice in the same currency as they do. This feature leads to a currency becoming the dominant medium of invoicing in the market. Macroeconomic variability plays more of a role for differentiated products. We demonstrate these points empirically, after presenting and analyzing rich new data on the actual invoice currency choices on the exports and imports of twenty-four countries.

Our analysis builds on a rich history of thought on vehicle currency selection. Swoboda (1968, 1969) stressed the role of transaction costs in trading different currencies, and provided early arguments that currencies used as mediums of exchange would be those associated with low transaction costs. Such low costs could for instance reflect a high degree of liquidity in the foreign exchange markets for the currencies in question. More recently, Rey (2001) elegantly exposited this theme in a three-country general equilibrium model, confirming the importance of a currency's "thick market externalities" arising from a large presence in global international trade and low transaction costs of exchange. McKinnon (1979) emphasized the role of industry characteristics. He argued that industries where goods are homogeneous and traded in specialized markets likely to be invoiced in a single low transaction cost currency. Krugman (1980) pointed to the presence of inertia in vehicle currency selection. When a currency is established as the dominant one in a market, a particular firm has no incentive to invoice in an alternative currency as this would lead to higher transaction cost and

more volatile sales because of movements in its price relative to its competitors'. Once a currency has acquired a prominent role, because of low transaction costs for instance, it may keep this role even if another currency with similarly low costs emerges.

Macroeconomic variability has likewise been offered as a driver of vehicle currency choice. Giovannini (1988) was perhaps the first researcher to formalize the role such variability on both producer profit maximization and the selection of vehicle currencies. Devereux, Engel and Storegaard (2004) have a similar emphasis, but instead use a general equilibrium setup to introduce a role for monetary fluctuations in the invoicing decision. [1] The elegantly show that in a two country world, a high volatility of monetary stances in either country leads to a high volatility of the exchange rate, leading producers to set their prices in the currency of the low volatility country.[2] Engel (2003) extent use a similar setup to highlight the parallels between the choice of invoicing when prices are sticky and the optimal degree of exchange rate pass-through when prices are fully flexible.

We present a theoretical model intended to nest some of these themes. Although our analysis is partial equilibrium, we extend Devereux, Engel and Storegaard (2004) in two key dimensions. First, we consider a model with three countries in order to establish conditions for selection of non-counterparty vehicle currencies. Second, we provide an explicit role for industry-specific characteristics in influencing the invoice currency choice. This extension is essential for capturing some of the McKinnon-Krugman-Rey insights. We show that, in any country, producers with differing degrees of product homogeneity can make different invoicing choices for their international trade transactions. Producers in a industry with homogenous goods aim at keeping their price in line with their competitors', leading them to invoice in the currency that has a dominant role for the industry. By contrast, producers transacting in differentiated goods

[1] See also Bacchetta and van Wincoop (2002) and Devereux and Engel (2001).

[2] Donnenfeld and Haug (2002, 2000) look at the role of exchange rate volatility in driving the invoicing decision for Canadian trade transactions. They conclude that a higher volatility makes LCP more attractive, or VCP provided that goods are not too substitutable. These conclusions are in contrast to the ones discussed above, and may be driven by the particular nature of the (nonstandard) model used. In their model output is preset first, set prices are set, and then sales take place. The more standard models have prices set first and then output demand determined. See also Oi, Otani, and Shirota (2004) in which a general equilibrium model of invoice currency choice is presented and applied to Japanese data. Hartmann (1998) recently explores vehicle currency choice from a market microstructure perspective.

care less about limiting the movement of their price relative to their competitors, and focus more on macroeconomic volatility.

This theory provides a nice background for our novel and extensive empirical evidence on the currency invoicing of international trade for 24 countries. As broad characterizations, we confirm that the U.S. dollar is the primary, but not unique, invoice currency choice in transactions involving the United States as a counterparty. The euro has replaced the legacy currencies in euro-area transactions and has displaced the dollar mainly in some transactions of European Union accession countries (ECB 2003). The dollar remains an important invoicing currency in transactions involving Asian countries, Australia, and the United Kingdom, among others.

Our analysis of this data reveals other more nuanced patterns in the use of the dollar as a vehicle currency in international transactions. Within the few countries for which industry details on invoicing are available, we observe substantial cross-industry variation in the extent to which the dollar is a vehicle currency on trade. For the larger group of 24 countries, we explore whether a delineation of types of good traded by degree of product substitutability explains aggregate invoicing currency choices on exports and imports. Specifically, we establish this heterogeneity after applying the Rauch (1999) network indices to the trade composition of each of the countries. These indices enable us to determine the share of a country's exports and imports in homogeneous / high elasticity of substitution goods (i.e. reference-priced goods, goods traded on organized exchanges) versus in differentiated products. While out theory argues for the possibility of herding in any currency, the data show the dollar use as a vehicle currency in country trade with non-U.S. counterparties is tightly correlated with the prevalence in a country's exports or imports of transactions in the (Walrasian) organized exchange-traded and reference priced goods.[3]

These observations do not preclude a role for macroeconomic variation in invoice currency selection. However, our econometric analysis shows that the industry composition of a country's exports is much more important for invoicing than the

[3] As detailed in Rauch (1999), "Organized Exchange" traded goods cover products that have an overt market (i.e. precious metals). "Reference Price" goods are homogeneous goods that nonetheless do not have a substantial enough volume to have an "official" market (e.g. obscure chemical products), but are homogeneous enough to have "reference" prices that are published in trade magazines.

countries participating in the trade transactions. Our results do not support a strong role for standard business-cycle magnitude variation in vehicle currency selection. The industry effects are most pronounced in trade in more homogeneous products. Small degrees of macroeconomic volatility are not likely to disturb currency invoicing equilibria or the strong role of the dollar in the export and import transactions involving more homogeneous goods.

Overall, we show theoretically and empirically the herding in invoice currency choice for Walrasian goods. An implication is that, absent large macroeconomic shocks that could potentially disturb this established vehicle currency equilibrium, the prevalence of the dollar as a worldwide vehicle currency may be tied to the share of "homogeneous" goods in world trade and to the share of the U.S. as a direct counterparty in international trade transactions. While Rauch (1999) had argued that trade barriers play distinct roles in the context of differentiated products versus homogeneous products, we likewise find that macroeconomic variables have distinct roles in the determination of currency invoicing choices across these types of goods.

II. A Three-Country / Three Currency Model of Invoice Currencies

Several recent studies explore conditions under which a firm will set its export price in its own country's currency, in which case the price paid by foreign consumers moves with the exchange rate, or in the currency of its customers abroad, in which case the firm bears the exchange rate risk.[4] The existing theoretical work limits an exporter to two currencies in her decision, invoicing either in her own currency (PCP) or the currency of her customers (LCP). While these models are conceptually rich, they ignore the possibility that the exporter could choose to invoice in a third vehicle currency (VCP), that is neither her currency nor that of her customer.

We broaden the theoretical modeling of currency choice for trade invoicing, developing the interaction between industry features and macroeconomic variability in a new open-economy macro model with price rigidities that builds on Devereux, Engel and Storegaard (2004). Although we do not derive a full-blown general equilibrium version

of our model, we nonetheless extend the existing theory in several key dimensions. First, we move from a two-country / two-currency world to a world consisting of three countries and three currencies, thereby allowing for invoicing in a vehicle currency that belongs neither to the exporter or importer home markets. The use of a specific currency in invoicing international trade transactions can now be broader than the importance of that currency's home country as a direct counterparty in international trade transactions.

Second, we contrast the role of industry characteristics, such as the substitutability between competitors' goods, with macro-economic factors, such as business cycle and exchange rate volatility. We show that industry characteristics are more relevant for industries where goods are closer substitutes. Consider the situation of a firm selling to a foreign market. With prices in the market set in different currencies, exchange rate fluctuations will affect the price of the firm's goods relative to that of its competitors, leading to fluctuations in the quantities sold. If there is little differentiation between the goods produced by different firms, even small movements in relative prices generate large movements in each firm's quantity sold. The firm then has an incentive to limit the fluctuations of its relative price by choosing a trade invoicing strategy close to that of its competitors. This leads to a type of 'herding' behavior in invoice currency choice as the exporter of a relatively homogeneous product chooses to invoice in the currency that is used by the majority of other sellers.

Third, we introduce decreasing returns to scale in production. A specification with constant returns to scale limits the results of the model, a point recognized by Devereux, Engel and Storegaard (2004), since a firm's marginal cost is not affected by fluctuations in its output. Output volatility, stemming from volatile prices relative to the firm's competitors for instance, then has no direct cost implication. Devereux, Engel and Storegaard (2004) maintain the assumption of a constant returns to scale technology, but address this limitation by introducing a link through which output volatility leads to volatility in wages. While generating a channel through which output volatility affects marginal costs, their apparatus requires wages to respond to short run movements in demand, a feature that is disputable. We choose instead to model a technology with

[4] A non-exhaustive list includes Bacchetta and van Wincoop (2002), Corsetti and Pesenti (2001), Devereux, Engel and Storegaard (2004).

decreasing returns to scale, so that an increase in output leads to an increase in the marginal cost even when wages are not responsive.

Overall, the theory provided below emphasizes the roles of product substitutability and macroeconomic variability in a single theoretical framework. Although we limit ourselves to a partial equilibrium model, this provides us with more flexibility when we turn to the empirical section.[5] While we can get macroeconomic variability to play the type of role laid out in recent theoretical studies, our extensions imply that macroeconomic variability is an important consideration only when the trade transactions are in differentiated products, where the need to limit movements in relative prices is less pronounced. The degree of macroeconomic volatility needed to disturb an invoicing status quo for trade in more homogeneous products would need to be exceptionnaly large. This result supports the inertia and thick market externalities argued by Krugman and by Rey. But, importantly, our theoretical prediction is that -- even within a country where all economic agents face the same degree of macroeconomic volatility-- different producers will make different invoice currency choices.

II.1 The profit function

We assume that an exporting firm has to post a price for its goods before knowing the realization of various shocks affecting the economy. The exporter produces a brand *z*, is located in country *e,* and sells her goods to the destination country *d*. The exporter produces goods using a technology with decreasing returns to scale:

$$Y_{ed}(z) = \frac{1}{\alpha}[H_{ed}(z)]^{\alpha} \qquad (1)$$

$$0 < \alpha \leq 1$$

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

$$Y_d(z) = \left[\frac{P_{ed}(z)}{P_d}\right]^{-\lambda} C_d \qquad (2)$$

[5] By contrast Devereux, Engel and Storegaard (2004) derive the optimal invoicing in a general equilibrium model. While this allows for a complete solution, their analysis is focused on the role of macroeconomic volatility, and does not include any role for inertia stemming from the dominant role of a currency in the past.

where C_d is the total demand for brands of the relevant sector in country *d*, $P_{ed}(z)$ is the price, in country *d* currency, of the brand *z* produced in country *e*, and P_d is the price index, in country *d* currency, across all brands of the relevant sector sold in country *d*. $\lambda>1$ is the elasticity of substitution between the various brands. (2) shows that the demand for a specific brand reflects its price, relative to the prices of other brands in the sector, and the strength of overall demand.

The exporter producing brand *z* sets its price in currency *k* before the realization of the shocks affecting the economy. We denote the price by $P_{ed}^{k}(z)$. The currency of invoicing can be the currency of the country in which the exporter is located ($k=e$), the currency of the country of destination ($k=d$), a third vehicle currency ($k=v$), or a combination of these three currencies. While considering invoicing in a basket of different currencies may appear odd, it provides a simple way to generate a partial pass-through of exchange rate fluctuations to consumer prices, following Corsetti and Pesenti (2001). The presence of partial exchange rate pass-through is a desirable feature in light of the empirical evidence [Campa and Goldberg (2004, 2002), Frankel, Parsley and Wei (2004), Anderton (2003)].

The exporter sets its price in currency *k* to maximize expected profits:

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

where S_{ek} is the exchange rate between currency *e* and currency *k*, in terms of units of currency *e* per unit of currency *k* so that an increase corresponds to a depreciation of currency *e*. D_e is the state-specific discount factor at which profits are evaluated,[6] and W_e is the nominal wage. With its price set in currency *k*, the unit revenue for the exporter

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

in currency *e* is $S_{ek}P_{ed}^{k}(z)$. Similarly, the price in currency *d* paid by consumers in the destination country is $[S_{ed}]^{-1}S_{ek}P_{ed}^{k}(z)$.

Following steps detailed in the Appendix, we solve the producer problem by expressing the profit function (3) in terms of quadratic approximations around a non-stochastic steady state. Denoting log deviations from the steady state by lower case letters ($x = \ln X - \ln X_{ss}$) we obtain:

$$\pi_{ed}^{k} = \frac{\lambda}{\lambda - \alpha(\lambda-1)}\left[\frac{1}{2}E\left[s_{ek} - \lambda q_{ed}^{k}\right]^{2} + E\left[s_{ek} - \lambda q_{ed}^{k}\right]c_{d}\right] \tag{4}$$
$$+ \frac{\alpha(\lambda-1)}{\lambda - \alpha(\lambda-1)}\left[-\frac{1}{2}E\left[\frac{\lambda}{\alpha}q_{ed}^{k}\right]^{2} + \frac{\lambda}{\alpha}Eq_{ed}^{k}w_{e} + \frac{\lambda}{\alpha^{2}}Eq_{ed}^{k}c_{d}\right]$$

$$q_{ed}^{k} = s_{ek} - s_{ed} - p_{d} \tag{5}$$

where we ignore terms that are independent of the invoicing decision.

The term q_{ed}^{k} in (5) is the price of brand *z* in the destination country, relative to the price of the competing brands in that country. Following shocks, the price of brand *z* set in currency *k* does not move. The price paid by a consumer in the destination currency *d* is then driven by the exchange rate between currency *k* and currency *d*: $s_{dk} = s_{ek} - s_{ed}$, with an appreciation of currency *d* vis-à-vis currency *k* (i.e. $s_{ek} - s_{ed} < 0$) reducing the price paid by the consumer. The average price paid by the consumer for competing brands, in currency *d*, is given by the industry-wide index: p_{d}. An increase in the relative price ($q_{ed}^{k} > 0$) indicates that the firms producing brand *z* looses competitiveness, leading consumers in the destination country to shift their purchases towards other brands. The magnitude of this shift is driven by the elasticity of substitution between brands, λ.

Intuitively, the various terms of (4) reflect the co-movements of the marginal revenue and marginal cost with demand.[7] The impact of exchange rate movements on the marginal revenue is given by the term $s_{ek} - \lambda q_{ed}^{k}$, which reflects the fluctuations in the quantity sold because of movements in competitiveness, as well as the fluctuations in the exporter-currency revenue of a given sale, stemming from movements in the exchange rate between the exporter and invoicing currencies. (4) shows that profitability is increased when exchange rate fluctuations lead to a high marginal revenue in the states of

nature when demand is strong in the destination country (i.e. $E\left[s_{ek} - \lambda q_{ed}^{k}\right]c_d > 0$). Marginal costs are increasing in the wage and the strength of demand, the later aspect reflecting decreasing returns to scale. Profitability is higher when the exporter looses competitiveness in the states of nature where wages or demand are high ($Eq_{ed}^{k} w_e > 0$, or $Eq_{ed}^{k} c_d > 0$). Intuitively, the reduced competitiveness shifts demand away from the exporter, sparing her from having to produce at a high cost.

II.2 Optimal invoicing

The exporter chooses the currency *k* in which her goods are invoiced to maximize (4). Specifically, her choice is captured by the exchange rate between the currency of her country and the currency of invoicing, s_{ek}, in the profits (4) and the relative price (5). The exporter regards all the other variables in (4)-(5), such as the demand c_d, wage w_e, and aggregate price p_d and exchange rate s_{ed} as independent from her invoicing decision.

We do not restrict the exporter to invoice entirely in either currency *e*, *d* or *v*. Instead, we model the invoicing decision as a choice of weights of the three available currencies in the invoicing currency basket *k*. Specifically, the weights of currencies *d* and *v* in the invoicing of exports to country *d* are β_d^d and β_d^v respectively, with the weight of currency *e* being $1 - \beta_d^d - \beta_d^v$. The exchange rate between the exporter's currency, *e*, and the composite currency in which she invoices, *k*, is then a linear combination of the exchange rates between currency *e* and the other two currencies, *d* and *v*, with weights reflecting the composition of the invoicing basket:

$$s_{ek} = \beta_d^d s_{ed} + \beta_d^v s_{ev} \qquad (6)$$

Pricing in the producer's currency (PCP) corresponds to $\beta_d^d = \beta_d^v = 0$, while pricing in the customers' currency (LCP) corresponds to $\beta_d^d = 1, \beta_d^v = 0$, and pricing in vehicle currency (VCP) is the case where $\beta_d^d = 0, \beta_d^v = 1$.

As discussed above, the relative price between brand *z* and the competing brands (5) plays a key role in the invoicing decisions. We now turn to the sensitivity of the price

[7] A more detailed discussion can be found in the Appendix.

index of competing brands, p_d, to exchange rate movements. Some brands are invoiced in currency *d*, so the price paid by the consumers for these brands is unaffected by exchange rate movements. Other brands are invoiced in currency *e*, and the consumer price in currency *d* moves with the exchange rate between the two currencies, s_{ed}, with consumer paying a higher price when currency *e* appreciates (i.e $s_{ed} < 0$). A final set of brands are invoiced in currency *v*, so the price paid by consumers is higher when currency *v* appreciates (i.e. $s_{ed} - s_{ev} < 0$). We denote the share of competing brands invoiced in currency *d* by η_d^d, and the shares invoiced in currency *e* and *v* by η_d^e and η_d^v respectively.[8] The impact of exchange rate movements on price index of competing brands is then:

$$p_d = -\eta_d^e s_{ed} - \eta_d^v (s_{ed} - s_{ev}) = -(1 - \eta_d^d) s_{ed} + \eta_d^v s_{ev} \qquad (7)$$

Combining (6) and (7), we write the relative price (5) as:

$$q_{ed}^k = (\beta_d^d - \eta_d^d) s_{ed} + (\beta_d^v - \eta_d^v) s_{ev} \qquad (8)$$

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

The firm chooses the invoicing weights β_d^d and β_d^v to maximize the expected profits (4), under the constraint that β_d^d, β_d^v and $\beta_d^d + \beta_d^v$ do not fall outside the [0,1] interval. For a concise illustration of the determinants of the optimal weights, we focus on an interior solution where both weights are given by setting the first derivatives of (4) to zero. Following steps detailed in the Appendix we obtain:

$$\beta_d^d = \Omega \eta_d^d + (1 - \Omega) \rho(m_{ed}, s_{ed}) \qquad (9)$$

$$\beta_d^v = \Omega \eta_d^v + (1 - \Omega) \rho(m_{ed}, s_{ev}) \qquad (10)$$

$$\beta_d^e = 1 - \beta_d^d - \beta_d^v = (1 - \Omega) + \Omega \eta_d^e - (1 - \Omega)[\rho(m_{ed}, s_{ed}) + \rho(m_{ed}, s_{ev})] \qquad (11)$$

where:

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

[8] The three shares sum to one.

The term m_{ed} in (9)-(11) reflects the influence of exogenous factors on the firm's marginal cost. Movements in wages translate directly into movements in the marginal cost. Fluctuations in demand also affect the cost. Because of decreasing returns to scale, a 1 percent increase in demand requires a $1/\alpha$ percent increase in the labor input, hence a $1/\alpha$ percent increase in cost, holding the wage constant. The increase in demand also leads to a 1 percent increase in revenue, holding the price constant. The net increase in the marginal cost is then $1-1/\alpha=(1-\alpha)/1$ percent.

The terms $\rho(m_{ed},s_{ed})$ and $\rho(m_{ed},s_{ev})$ in (9)-(11) capture the sensitivity of the marginal cost, m_{ed}, to the exchange rates s_{ed} and s_{ev}. Specifically, the coefficients of a regression of the marginal cost on the exchange rate are $\rho(m_{ed},s_{ed})$ for s_{ed}, and $\rho(m_{ed},s_{ev})$ for s_{ev}.

The intuitive interpretation of the optimal invoicing (9)-(11) is that an exporter invoices in a currency other than her own for two reasons: herding and hedging. Invoicing in the exporter's currency has the advantage of fully stabilizing the exporter's marginal revenue, as she receives a given amount of her own currency for each unit sold. This full stabilization ($\beta_d^e=1$) is not necessarily an optimal choice however, for two reasons.

The first reason for deviating from a full invoicing in the exporter's currency reflects a herding motive, captured by the terms $\Omega\eta_d^d$ and $\Omega\eta_d^v$ in (9)-(10). The exporter optimally limits the movements of her relative price by choosing an invoicing strategy close to that of its competitors. For instance, the exporter puts a higher weight of invoicing in the destination currency, β_d^d, when her competitors invoice a higher share of their own sales in that currency, η_d^d. A similar motivation holds for invoicing in the vehicle currency.

The second reason captures a hedging motive, denoted by the terms $(1-\Omega)\rho(m_{ed},s_{ed})$ and $(1-\Omega)\rho(m_{ed},s_{ev})$ in (9)-(10). The exporter wants to choose an invoicing strategy that limits the impact of fluctuations in marginal costs on her profits. If she invoices in the destination currency, *d*, a depreciation of her currency vis-à-vis the destination currency ($s_{ed}>0$) increases the exporter's revenue, in her own currency, from

each unit sold. If depreciations of the exchange rate tend to be associated with increases in marginal costs, i.e. $\rho(m_{ed}, s_{ed}) > 0$, invoicing in the destination currency provides an hedge as marginal revenue and marginal costs then move in steps. A similar logic applies to the vehicle currency.

Equations (9)-(10) show that the extent of invoicing in the destination and vehicle currencies reflects the herding and hedging considerations. Interestingly, there is nothing 'special' about invoicing in the currency of the destination country, as it is driven by the same considerations as invoicing in any vehicle currency.

The relative weight on the herding dimension in (9)-(11) is given by the term Ω, which solely reflects the structural parameters of the model, namely the elasticity of substitution between goods, λ, and the degree of returns to scale, α. The herding dimension is more pronounced (Ω is large) in industries where goods are more substitutable (λ is large), as movements in relative prices then leads to large fluctuations in quantities sold. The effect is also stronger the more the technology exhibits decreasing returns to scale (α is small), because fluctuations in output generate large movements in marginal cost.

Our model indicates that the herding motive can dominate invoicing under reasonable parameters. Chart 1 shows the combinations of α (horizontal axis) and λ (vertical axis) leading to a small weight of the herding motives (Ω=0.2), a medium weight (Ω=0.5) and a large weight (Ω=0.8). Considering values of α=0.65 and λ=6, which are reasonable parameters,[9] leads to to a weight on the herding motive of 0.76. In the limit case of perfect competition ($\lambda \to \infty$), only the herding motive remains as the firm needs to fully stabilize its relative price:

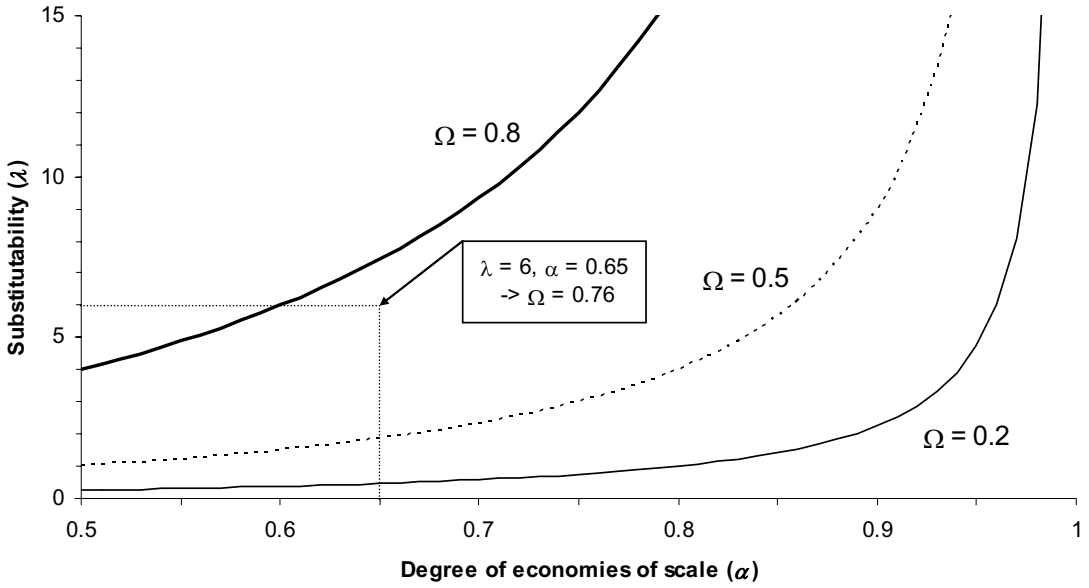
$$\lim_{\lambda\to\infty} \Omega = 1 \qquad \Rightarrow \qquad \lim_{\lambda\to\infty} \beta_d^d = \eta_d^d \qquad \lim_{\lambda\to\infty} \beta_d^v = \eta_d^v \qquad \lim_{\lambda\to\infty} \beta_d^e = \eta_d^e$$

This feature of the solution suggests important distinctions in invoicing choices across types of industries. The invoicing of exports in industries that are highly differentiated is relatively more responsive to the pattern of volatility in macro-economic

[9] In a model with a constant returns to scale technology in labor and a fixed factor, such as capital, a labor share of 65 % is a standard specification. A value of 6 for the elasticity of substitution corresponds to a 20% markup. Elasticities of this magnitude, or even higher, are a common parametrization.

variables, such as wages and demands. By contrast, in industries that produce a more homogenous good, firms will invoice in a basket of currencies close to that of their competitors.

Chart 1: Weight of the herding dimension



Another aspect also points to a moderate role for co-movements of the exchange rates with marginal cost, relative to herding. The terms $\rho(m_{ed}, s_{ed})$ and $\rho(m_{ed}, s_{ev})$ in (9)-(11) are essentially ratios between the covariance of the exchange rates with wages and demand, and the variance of the exchange rates. If the magnitude of exchange rate fluctuations is much larger than the magnitude of their co-movements with other variables, the denominators in the terms $\rho(m_{ed}, s_{ed})$ and $\rho(m_{ed}, s_{ev})$ are relatively large, hence the terms themselves relatively small. If exchange rates are considerably more volatile than demand and wage fundamentals, herding in invoicing currency selection will dominate the role of these fundamentals.

As stressed by Engel (2003), the factors driving the choice of invoicing currency when prices are sticky are the same driving the optimal degree of exchange rate pass-through under flexible prices. While he focuses on limit cases of invoicing, with prices set either in the producer or consumer currencies, we can show that the optimal invoicing weights (9)-(10) are equal to the optimal degrees of pass-through under flexible prices.

II.3 A simplified model

The optimal invoicing in (9)-(11) shows that there is no simple relation between the volatility of a particular exchange rate and the choice of invoicing. Instead, the co-movements between exchange rates and marginal costs play a central role. To put more structure in the setup, we model the exchange rate between currency *e* and currency *d* as driven by fundamental factors (such as monetary policy) in country *e* and in country *d*. We denote these factors by f_e and f_d respectively. Recognizing the sometimes difficult reconciliation between fluctuations in fundamentals and those in exchange rates, we model the exchange rate as also driven by two noise terms, denoted by ε_e and ε_d respectively.[10] The exchange rate between currency *e* and currency *v* is similar, and we write:

$$s_{ed} = f_e - f_d + \varepsilon_e - \varepsilon_d \quad , \quad s_{ev} = f_e - f_v + \varepsilon_e - \varepsilon_v \quad , \quad s_{dv} = f_d - f_v + \varepsilon_d - \varepsilon_v$$

We assume that the wage is driven by the fundamental in the exporting country, while demand in the destination market follows the fundamental in the importing country:[11]

$$w_e = \gamma_w f_e \quad , \quad c_d = \gamma_c f_d \quad , \quad \gamma_w \geq 0 \quad , \quad \gamma_c \geq 0$$

where γ_w and γ_c reflect the sensitivity of wages and demands to the relevant fundamentals. The presence of noise in the exchange rate relations allows for exchange rates to react to variables which have no effects on contemporaneous wages and demand. Following steps detailed in the Appendix, we assess how changes in the volatility of the various fundamentals impact the invoicing. The results are summarized in Table 1, where $\sigma^2(x) = E(x)^2$:

[10] Frankel and Rose (1995) show that volatility of industrialized countries' exchange rates is an order of magnitude higher than volatility in fundamentals. Engel and West (2004) provide an interesting fresh perspective on this issue by treating exchange rates as reflective of a discounted stream of expected future fundamentals.

[11] These assumptions are consistent with the effects of monetary shocks in a general equilibrium model.

Table 1: impact of fundamentals volatility

	Increase in the volatility of fundamental		
Impact on	$\sigma^2(f_e)$	$\sigma^2(f_d)$	$\sigma^2(f_v)$
β_d^e	-	+	+
β_d^d	+	-	+
β_d^v	+	+	-

Table 1 shows that an increase in the volatility of fundamentals in one country leads exporters to reduce the weight of its currency in their invoicing decision, and increase the role of the other two currencies. The detailed expressions in the Appendix also show that the shift is more pronounced towards the least volatile currency. For example, if $\sigma^2(f_d) > \sigma^2(f_v)$, an increase in $\sigma^2(f_e)$ reduces β_d^e, and increases β_d^v by more than it increases β_d^d.

While the sensitivity of the optimal invoicing to the volatility of fundamentals is unambiguous and intuitive, as shown by table 1, the sensitivity to the volatility of the noise terms is more complex. The Appendix shows that in general the effect is ambiguous. The only clear pattern is that a higher volatility of the noise term in the vehicle country, $\sigma^2(\varepsilon_v)$, has the same impact than a higher volatility of the fundamentals, $\sigma^2(f_v)$.

This model sets the stage for empirical analysis of the determinants of invoice currency choice across producers and across countries. We begin by expositing facts on the currency invoicing of international trade. We then examine industry-specific choices and the role of macroeconomic variability in invoicing outcomes.

III. The use of dollars and other currencies in international trade

III.1 Overview.

Details on the currency invoicing of international trade transactions are hard to come by. Some recent but discrete facts are given in papers motivated by individual countries or regions, as in Swedish invoicing by Friberg (1996), Canadian invoicing by

Donnenfeld and Haug (2003), and Japan by Oi, Otani, and Shirota (2004). Evidence has become available for euro-area and accession countries, in part triggered by the advent of the euro and efforts to track its adoption in goods markets and financial markets (ECB 2002, 2003).[12] No single data source compiles the information from these studies, or from the various discrete sources of information on country invoicing of international trade transactions. This section of the paper provides cross country, cross industry and some intertemporal data.

The twenty-four countries for which we have collected invoicing information are: the United States, the United Kingdom, eight euro-area countries (France, Germany, Italy, Belgium, Luxembourg, Italy, Spain, and Portugal), nine European Union accession countries (Bulgaria, Cyprus, Czech Republic, Estonia, Hungary, Latvia, Poland, Slovakia, and Slovenia), plus Japan, Korea, Malaysia, Thailand, and Australia. The data availability and sources for our study are summarized in Appendix Table 1.[13]

The availability information varies tremendously across countries in terms of details and time histories. Recently, ECB efforts have made available rich cross-country data within Europe. The United Kingdom and Australia have very detailed information on currency invoicing of trade transactions of different commodities or with different country partners. Within Asia, detailed data is available for both Japan and Korea. Data for the United States is drawn from Customs information used in constructing international price series.[14]

Chart 2 shows the extent to which each country's aggregated exports are invoiced in the exporter's currency, corresponding to the notation β_d^e aggregated across exporters from the model. The smaller countries represented in this chart typically use their own

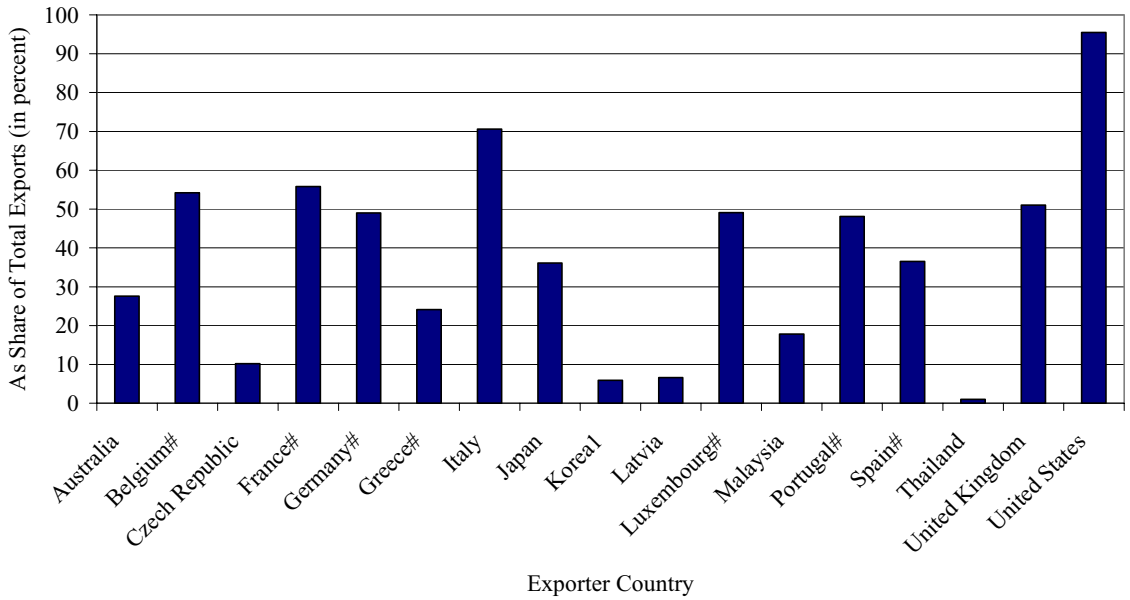
[12] Between 1999 through 2001Q3, the European Commission (Quarterly Review of the Use of the Euro) published quarterly information on the international transactions of euro area firms. This publication focused on the transition period of the euro, and measured the use of the euro compared with both national currencies (DM, Ffr, etc) and the foreign currencies.

[13] As Appendix Table 1 details, some of these data are unpublished but made available to us for this work. We are grateful to the agencies that provided this information and approved our use and dissemination. The table also shows that different methods have been used by countries in constructing the data. Looking across countries, in some cases we cannot definitely state whether the data capture the currency of transaction invoicing or currency of transaction settlement.

[14] For the United States, the BEA the International Price Program collects data on currency solely to convert prices into U.S. Dollars for the purpose of producing price indexes. The U.S. Customs Service collects the data on the value of imports and exports, but doesn't keep data on the currency in which trade

currency on less than 20 percent of their export transactions. Indeed, a number of small countries not shown in the chart (but indicated in the footnote) do not even report details of use of their own currency in international trade transactions. The euro is used as the invoice currency on 40 to 50 percent of (extra euro area) exports by euro area countries. The Korean won is seldom used, the yen is used on about a third of Japanese exports, and the pound sterling on about half of UK exports. The United States is the clear exception, invoicing more than 90 percent of exports in U.S. dollars. Broadly similar patterns in country imports, except that the importing country currency is typically less often used in the import transactions, supporting Grassman's Law.

Chart 2: Exports Invoiced in Exporter Home Currency



Extra-euro trade only. 1 For Korea, trade data for "Other currencies" (net of US$, yen, euro, UK pound sterling) used as upper bound estimate of Korean Won share. Countries for which we do not have specific data for this chart are: Bulgaria, Cyprus, Estonia, Hungary, Poland, Slovakia, Slovenia.

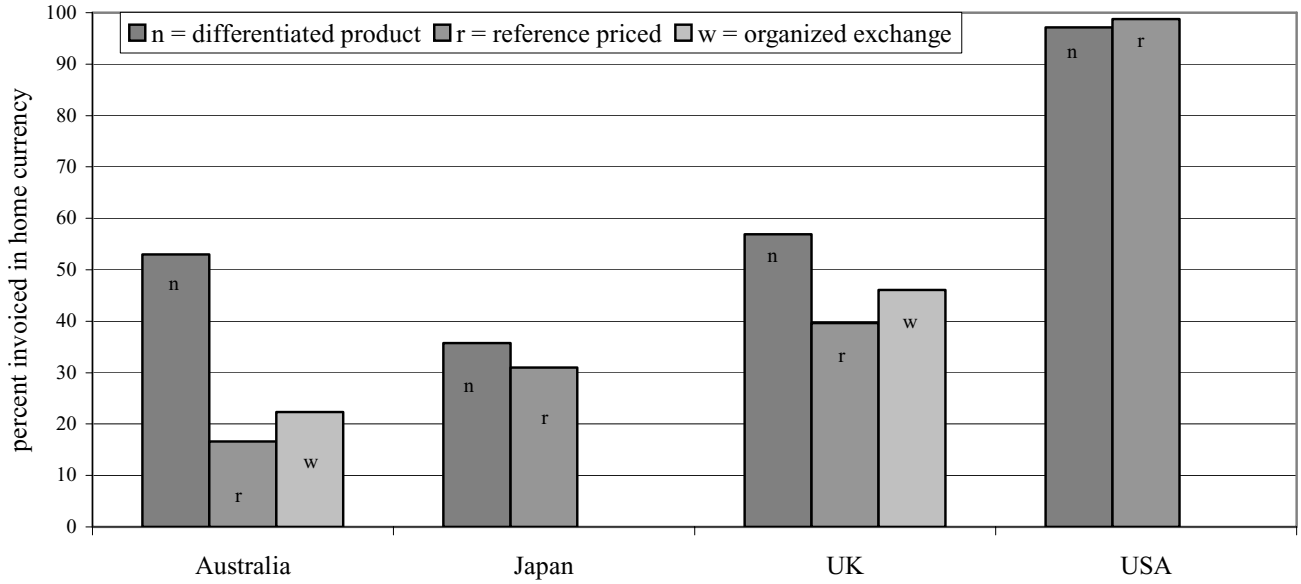
Industry details on currency invoicing are directly available for four of the countries in our database: Australia, Japan, the United Kingdom, and the United States. For each country, the industries for which invoicing data are available are compiled into one of three broad groups: differentiated products, goods traded on "organized exchanges", and "reference priced" goods. The assignment of industries to group follows the Rauch (1999) painstaking classification of commodities at the three and four-digit

is conducted. A second caveat is that the data they collect is a sample of overall trade rather than every transaction.

SITC level. In the Rauch indices, an "organized exchange" good is anything that has an overt market (i.e. precious metals). A "referenced priced" good is a homogeneous good that nonetheless does not have a substantial enough volume to have an "official" market (e.g. obscure chemical products), but that because of its homogeneity does have "reference" prices that are published in trade magazines. These three broad categories roughly correspond to classes of competitive pricing of goods, with organized exchange traded goods those that are most highly substitutable with similar categories of foreign produced goods, and the differentiated products least substitutable.

Chart 3 provides suggestive evidence that the extent of invoicing in the exporter's currency is related to the amount of transactions on reference priced or organized exchange goods. It indicates the share of exports invoiced in the exporter's currency for exports of differentiated goods (column 'n'), reference-priced goods (column 'r') and goods traded on an organized exchange (column 'w') for Australia, Japan and the United Kingdom. It shows that the extent of pricing in the exporter's currency is higher for differentiated products, the pattern being most pronounced for Australia. With the exception of the United States, we observe that the exporter's currency is more frequently used on transactions in differentiated goods than in transactions on reference priced or organized exchange goods.

Chart 3: Home Currency Use in Invoicing of Exports, by Type of Industry



Notes: Data for Australia for 2002, over 10 SITC 1-digit industry categories, covering 96.5% of DOTS-reported total imports. Data for Japan for 1999, over 6 SITC 1-digit industry categores, covering 95.1% of DOTS-reported total imports. Data for UK for 2002, over 10 SITC 1-digit industry categories, covering 101.4% of DOTS-reported total imports. Data for USA for 2002, over 5 end-use categories, covering 95.2% of DOTS-reported total imports.

III.2. Explaining the U.S. Dollar as a Vehicle Currency

Table 2 reports the use of the U.S. dollar in the invoicing of exports and imports in our sample. More than 95 percent of U.S. exports and 85 percent of U.S. imports were invoiced in dollars in early 2003. The use of the dollar in U.S. export and import transactions depends on the trading partner.[15] U.S. exports to and imports from Latin America, China, Mexico, and most small countries, are almost exclusively invoiced in U.S. dollars. By contrast, foreign currencies appear more prominently in the invoicing of U.S. imports from the European Union, the United Kingdom, and Japan. While the specific shares assigned to foreign currencies is not always consistent across reporting partner countries, from the perspective of U.S. data about 25 percent of U.S. imports from Germany (in value terms) are euro invoiced; 14 percent of U.S. imports from the UK are invoiced in pound sterling, while 12 percent of U.S. imports from Japan are in Japanese yen. U.S. imports from the rest of the world are overwhelmingly invoiced in U.S. dollars.

Turning to other countries, approximately one third of the exports of most euro area countries (to countries outside of the euro area) are invoiced in dollars. Close to 40 percent of comparable euro area imports are invoiced in dollars. Looking across countries, the U.S. dollar is used intensively in U.K. trade transactions, on 26 percent of U.K. total exports and 37 percent of U.K. imports. The EU accession countries are mixed in the extent to which dollars are used in invoicing their international trade transactions. Currently, dollar use on invoicing is often lower than incidence of use by euro-area countries. As we will detail later, these patterns are starkly different than in the recent past for these accession countries.

[15] The extent to which the dollar is used in bilateral trade transactions is often not identical across the two parties reporting currency use in trade transactions. Given the sampling limitations in the U.S.-sourced data, we defer to foreign source data for currency shares when that foreign data is available.

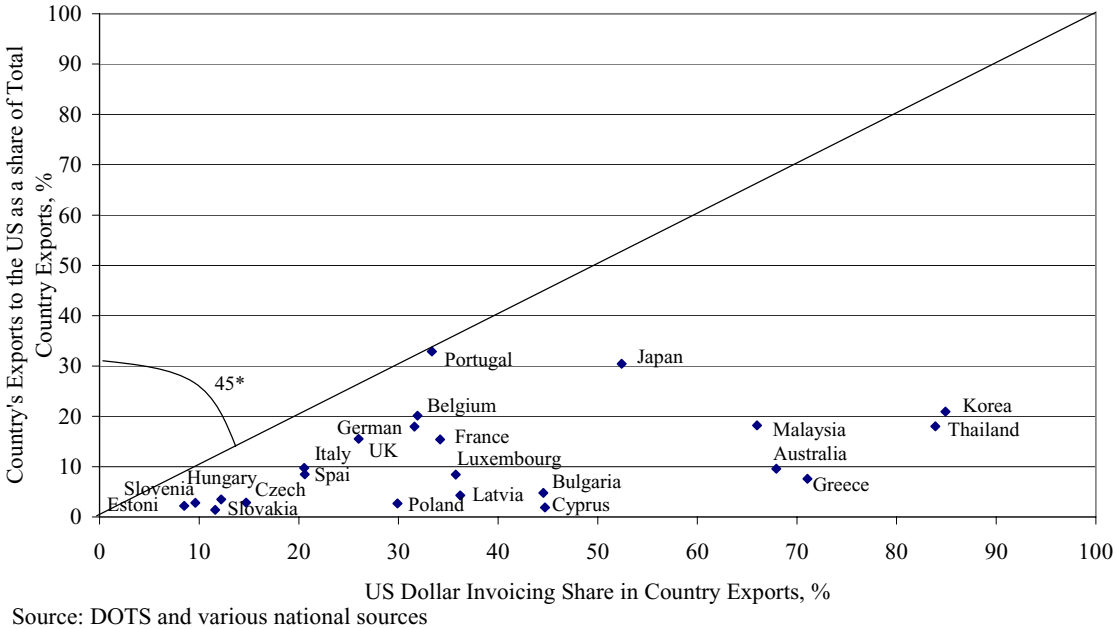
Table 2: U.S. Dollar Use in the Export and Import Invoicing of 24 Countries

	Invoicing Observation*	US $ Share in Export Invoicing	US $ Share in Import Invoicing
United States	2003	95.0	85.0
Asia			
Japan	2001	52.4	70.7
Korea	2001	84.9	82.2
Malaysia	1996	66.0	66.0
Thailand	1996	83.9	83.9
Australia	2002	67.9	50.1
European Union			
Belgium#	2002	31.9	33.5
France#	2002	34.2	43.2
Germany#	2002	32.3	37.9
Greece#	2002	71.0	62.0
Italy#	2002	20.5	30.8
Luxembourg#	2002	35.7	38.0
Portugal#	2002	33.4	34.5
Spain#	2002	32.8	39.5
United	2002	26.0	37.0
EU-Accession			
Bulgaria	2002	44.5	37.1
Cyprus	2002	44.7	34.9
Czech	2002	14.7	19.5
Estonia	2003	8.5	22.0
Hungary	2002	12.2	18.5
Latvia	2002	36.2	29.8
Poland	2002	29.9	28.6
Slovakia	2002	11.6	21.2
Slovenia	2002	9.6	13.3

* Latest Observations are annual except for: Japan – January 2001, Germany & Germany# – 2002Q3, Estonia – Jan-Aug 2003. United States data are for 2003Q1. Malaysia and Thailand figures are for overall trade and are not broken down by exports or imports. # Invoicing data refer only to the invoicing of "extra euro-area" trade. For the U.K. this figure refers to "extra EU-14 trade".

By contrast, the dollar remains a dominant currency in the invoicing of both exports and imports by countries outside of Europe. Both Korea and Thailand use the dollar in invoicing more than 80 percent of their export and import transactions. For Japan, Australia, and Malaysia, the dollar is used in more than 50 percent of trade transactions.

Chart 4: Vehicle Currency Use of the U.S. Dollar in International Export Transactions



Source: DOTS and various national sources
Euro-area country data, with the exception of Italy data, refer to extra-euro area trade and invoicing

To gain perspective on what portion of these dollar invoicing results might be directly attributable to country transactions with the United States and what portion is a pure vehicle currency role, in Chart 4 we contrast the dollar invoicing share in export transactions of each country (horizontal axis) with the share of the United States as a direct recipient of a country's exports (vertical axis).[16] Under an extreme assumption of complete dollar invoicing of trade with the United States and no vehicle currency role for the dollar, the indicated points would lie along the diagonal of this chart. All data points are to the right of the 45 degree line, presenting strong (and understated) indicative evidence of dollar use as a vehicle currency. This vehicle currency role appears particularly strong for trade transactions by Korea, Thailand, Australia, the United Kingdom, and Greece, among others. Overall the prevalence of dollar invoicing of a country's export and import bundles is far greater than what would be expected purely on the basis of the direct importance of the U.S. as a direct trade counterparty for any of these countries.

[16] We have done a similar analysis for country imports from the United States, with broadly similar findings.

Another very compelling empirical finding arises from our application of the Rauch indices to export data in order to explain the portion of each country's exports that is invoiced in dollars, without the United States as a counterparty, and in organized exchange traded or reference priced goods. [17] For each country, we construct measures of the share of total exports of that country (in trade that excludes the United States) that are in organized exchange traded products, or referenced priced products. The share of these transactions in country export transactions are shown in Table 3. Among the countries in our table, Australia has the highest share of exchange traded and reference priced goods in its exports, weighing at 66 percent of the exports to countries other than the United States. Greece, Bulgaria, and Cyprus all have this type of export share at about 40 percent. Japan and Germany have low shares of these types of goods, on the order of 15 percent of their non-U.S. exports.

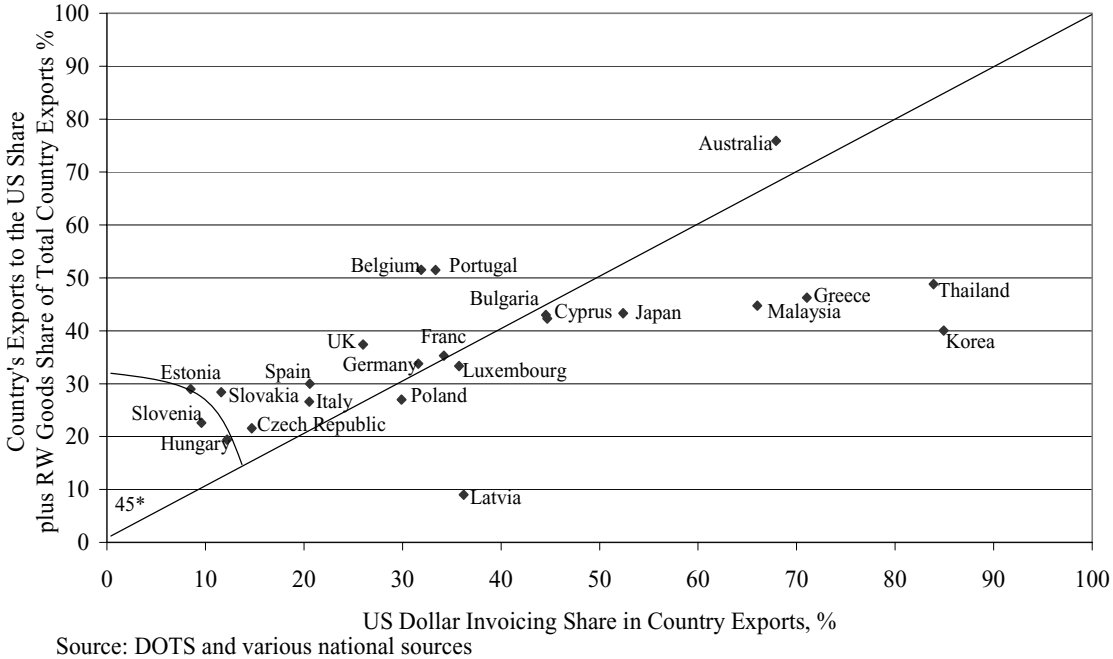
Visually, Chart 5 builds on Chart 4. The horizontal axis shows the share of exports invoiced in dollars, while the vertical axis shows the *total* share of exports that are either going to the United States, or consist of reference priced goods going to destinations other that the U.S. While the role of the dollar exceeds the role of the U.S. as a destination market, as shown in Chart 4, the pattern shown in chart 5 aligns more closely with the 45 degree line. Specifically, the role of the dollar in invoicing is in line with the role of the U.S. as a market and the role of exports of reference priced goods to countries other than the United States. Consistent with the detailed data available from Australia, the United Kingdom, and Japan, across countries these commodity-type transactions appear to "explain" the widespread vehicle currency use of the dollar in most of the countries (outside of the U.S.) for which we have compiled trade invoicing data.

While Chart 5 brings us closer to a complete understanding of the role of the dollar in international trade, two country groups stand out. First, the role of the dollar for Eastern European countries is smaller than what their patter of exports suggests. This likely reflects the prominent role of the euro area as a destination market. An exporter from Eastern Europe selling a non-differentiated goods, such as chemicals, in the euro area puts a high weight on keeping his price in line with that of his competitors. If a substantial share of the competitors price in euro, because for instance they are firms

[17] We do an analogous exercise also on the import side for each country, with qualitatively similar findings.

located in the euro area, then the exporter will also invoice in euro. The second outlier group is made of countries in South-East Asia for which the exports to the U.S. and in reference-priced goods still fall short of accounting for the role of the dollar as an invoicing currency. This possibly reflects a downward bias in the measured role of the U.S. as a trading partner, because of trade flows to the U.S. that go through other countries. Consider the case of a Thai exporter selling components to a producer in Malaysia for assembly for final goods destined to the U.S. While the trade flow from Thailand is not going directly to the U.S., it is part of an export from the region to the U.S.

Chart 5 Vehicle currency use of the dollar and "commodity " type exports



Source: DOTS and various national sources
Euro-area country data, with the exception of Italy data, refer to extra-euro area trade and invoicing

Table 3: Organized Exchange and Reference Priced Goods in Exports and Imports

	Date	Share in Export Transactions		Share in Import Transactions	
		All exports	Net - U.S.	All imports	Net-U.S.
United States	2002	22.7	22.7	24.3	22.7
Asia					
Japan	2001	15.2	12.9	46.0	39.7
Korea	2001	21.1	19.1	49.8	44.9
Malaysia	1996	27.7	26.5	27.5	25.0
Thailand	1996	34.7	30.8	35.5	32.5
Australia	2002	70.8	66.3	22.8	20.5
Euro-Area Countries					
Belgium#	2002	39.5	31.4	47.1	40.2
France#	2002	23.4	19.9	39.7	36.9
Germany#	2002	18.0	15.8	29.8	27.9
Italy					
Greece#	2002	41.9	38.7	43.8	42.8
Luxembourg#	2002	28.7	24.9	19.4	16.4
Portugal#	2002	22.5	18.6	53.2	50.6
Spain#	2002	24.1	21.5	46.7	44.0
United Kingdom	2002	25.6	21.9	25.0	23.4
EU-Accession					
Bulgaria	2001	39.7	38.2	26.8	26.1
Cyprus	2002	41.2	40.4	26.8	24.3
Czech	2002	20.2	18.7	32.1	31.5
Estonia	2003	27.6	26.8	29.9	29.5
Hungary	2002	16.4	15.9	23.1	22.7
Latvia	2002	37.3	34.7	31.5	31.2
Poland	2002	24.9	24.3	32.0	31.5
Slovakia	2002	27.2	27.0	32.9	32.7
Slovenia	2002	20.3	19.8	31.4	30.8

III.3 Econometrics of Herding versus Macroeconomic Variability

Our model emphasizes that β_d^e, β_d^d, and β_d^v are endogenous to both industry structure and macro-economic volatility. The herding motive in invoicing is a more important consideration for walrasian goods. The macroeconomic volatility underlying the hedging motive matters more for trade in differentiated products, with the likelihood of a country's currency being chosen for invoicing international trade transactions

inversely related to the volatility of the country's fundamentals. In this section, we provide an econometric analogue of the previous sections graphics. We also relate the invoicing unexplained by trade with the U.S. or walrasian exports to the volatility of aggregate demand in the exporting country versus, for example, the United States market.[18]

The regressions take a panel format using all countries for which we have invoicing data, except the United States. Two dependent variables are used in the regressions, 1) the share of a country's exports that are invoiced in dollars, or 2) the share of a country's exports that are invoiced in the home country currency.[19] The explanatory variables are the share of the U.S. as a destination market for exports, the share of a country's exports (excluding those to the U.S.) that are in Rauch-type walrasian goods (exchange traded plus organized exchange traded), and home country aggregate demand volatility. The regressions for invoicing in home currencies also add a variable to reflect the share of a country's trade with the euro area. The results of these regressions are presented below in Table 4. In some specifications, we test whether euro-area countries have different invoicing sensitivities than countries that have not yet adopted the euro.

[18] We have derived an explicit mapping from the theoretical specification to a regression specification under the assumption that there are two types of goods in the world, walrasian versus differentiated. This explicit formulation also assumed that, for a particular industry, the average share of invoicing in the exporter's currency is a weighted average across the choices with respect to each trade partner destination, with the weights corresponding to the importance of each partner as an export market. We have experimented with specifications of trade-partner weighted volatilities as explanatory variables, but have not gotten additional insights from those specifications.

[19] A few countries do not report shares of exports that are invoiced in their home currency (Bulgaria, Cyprus, Estonia, Hungary, Poland, Slovakia and Slovenia, see Appendix Table 1 for more details). These countires are not included in the regression for the home currency invoicing share of exports, but are included in the regression for the dollar invoicing share.

Table 4 Determinants of the Currency Used in Invoicing Country Export Transactions

Determinants of U.S. Dollar Share in Invoicing

Regression#	***1***	***2***	***3***	**4**
constant	**23.35*****	-7.76	-1.14	-9.82
	(6.72)	(9.63	(12.35)	(10.95)
Export share to the United States	**1.96*****	**2.17*****	**1.65*****	**2.23*****
	(0.54)	(0.43)	(0.58)	(0.48)
Euro area dummy * Export share to the	**-1.57****	-0.14		-0.38
United States	(0.57)	(0.85)		(1.02)
Walrasian share of exports to countries		**0.95*****	**0.60****	**0.97*****
other than the US		(0.25)	(0.27)	(0.28)
Euro area dummy *Walrasian share of		**-0.81***		**-0.94***
exports to countries other than US		(0.39)		(0.49)
Home country volatility of real			0.05	0.01
aggregate demand			(0.06)	(0.05)
Euro area dummy * Home country				8.12
volatility of real aggregate demand				(16.23)
# observations	23	23	23	23
adj.R2	0.37	0.62	0.30	0.58

Determinants of Home Currency Share in Invoicing Exports

Regression#	***1***	***2***	***3***	**4**
	9.57	-0.77	**49.92****	8.15
constant	(11.27)	(22.19)	(21.15)	(28.19)
Export share to the United States	0.52	0.69	-0.07	0.49
	(0.56)	(0.69)	(0.82)	(0.80)
Euro area dummy * Export share to the	**2.13*****	**2.65****		**2.17***
United States	(0.52)	(1.10)		(1.11)
Export share to Euro Area	0.18	0.26	-0.27	0.25
	(0.24)	(0.29)	(0.28)	(0.32)
Walrasian share of exports to countries		0.20	-0.15	0.20
other than the US		(0.34)	(0.30)	(0.39)
Euro area dummy * Walrasian share of		-0.23		-0.32
exports to countries other than the US		(0.45)		(0.59)
Home country volatility of real			**-0.95****	-0.54
aggregate demand			(0.40)	(0.35)
Euro area dummy * Home country				5.51
volatility of real aggregate demand				(18.66)
# observations	16	16	16	16
adj.R2	0.56	0.49	0.25	0.52

Note: all regressions include constant terms. ***, **, * statistical significance at 10, 5, 1 percent levels. Standard errors in parentheses.

The regression results support the arguments of our theoretical section, and reconfirm the empirical observations from Charts 4 and 5. The results for the dollar use in invoicing as reported in the top panel of Table 4 are most interesting. Regression 1 includes only the share of the U.S. in total exports, allowing for a different effect for euro-area exporters. This factor alone explains one third of the cross country variation in dollar use, with a higher dollar use in invoicing by countries that are not in the euro-area. Regression 2 introduces also consider the role of exports of walrasian goods to countries other than the U.S. These walrasian good terms explain an additional 25 percent of the cross-country variation in dollar use in trade invoicing. Once we account for the trade role of the United States and the composition of trade, we have a good indication of the extent to which a country will be using dollars to invoice exports.

The results of regressions 3 and 4 show that the volatility of aggregate demand in the exporting country is not a statistically significant contributor. It is important to note that this finding is not necessarily a refutation of the potential role for macroeconomic volatility terms in the invoicing decisions of producers. As the U.S. aggregate demand volatility is low relative to the volatility observed in most countries in our sample, a choice of invoicing in dollar based on volatility considerations would to a large extent be captured by the constant term. Nevertheless, the constant is not statistically significant, and the absence of a role for volatility persists even when we distinguish between countries in the euro-area, with a similar volatility than the U.S., and others. This points to a limited role of volatility as a driver of invoicing.

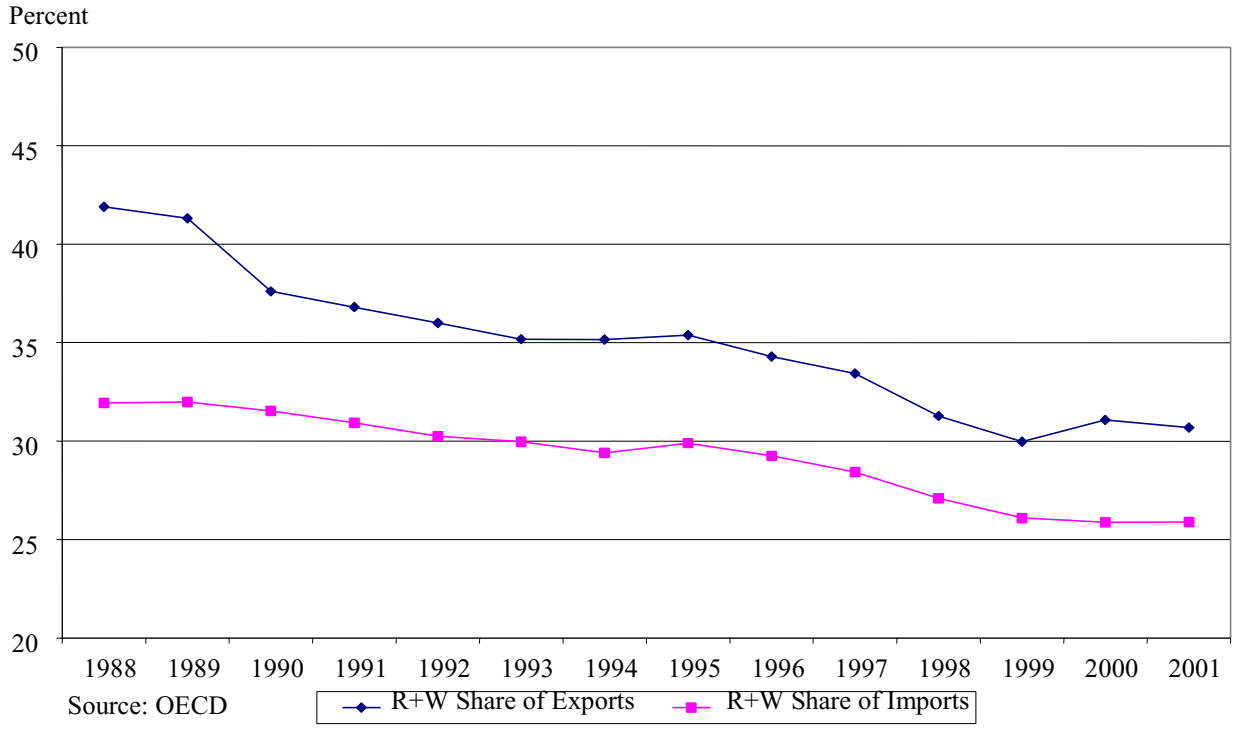
The regression for the use of the home currency is presented in the bottom panel of Table 4.[20] The only statistically significant results are that the countries in the euro-area are more likely to invoice their exports in the euro. Also, higher domestic volatility reduces the use of the home currency.

[20] The results exclude the countries that do not report shares of exports invoiced in their home currency (Bulgaria, Cyprus, Estonia, Hungary, Poland, Slovakia and Slovenia).

III.4 Perspectives for the international role of the dollar.

Our analysis suggests that the perspectives for the future role of the dollar as an invoicing currency are driven both by the role of the U.S. in international trade, and by the importance of world trade in goods that transact via organized exchanges or via reference pricing. Based on annual data 1980 through 2002, the U.S. share in total world imports fluctuates between approximately 15 and 20 percent, in relation to the U.S. business cycle. Also centrally important is the composition of world trade, and particularly the share of goods are in industries with high degrees of product substitutability. As one rough measure of this, Chart 6 shows the share of world trade in goods traded on organized exchanges or goods that are reference priced (which we construct using the Rauch measures). This type of trade has been declining steadily as a share of world trade over recent decades, consistent with the rapid growth of trade in manufactured goods both as intermediate components and as final products. These stark declines point to a steady decline in dollar invoicing of trade via this channel.

Chart 6 Share of Organized Exchanges and referenced priced goods in World Trade



IV. Concluding Remarks

Our analysis shows that the dollar is strongly used on all trade transactions with the United States, and on other transactions that are primarily in goods that are traded on organized exchanges or that are reference priced. We have shown that this use of the dollar does not primarily depend on the exchange rate between the dollar and other partner currencies. Instead, the role of the dollar as a transaction currency in international trade has elements of industry herding and hysteresis, often with a less central role in invoicing for hedging as associated with variances and covariances among macroeconomic fundamentals.

Our theoretical and empirical results support the type of conclusion reached in a recent European Central Bank report

> "While the existence of international pricing standards does not preclude, by itself, the use of another currency for settlement, the euro area's trade in energy and raw materials will probably continue to be both invoiced and settled in U.S. dollars, as long as international prices continue to be expressed in that currency."
>
> ECB 2002 pp.41-42.

We argue that industries with highly substitutable goods have a strong incentive to herd in their choice of invoicing currency. This type of conclusion is consistent with the intuitions of McKinnon (1979), Krugman (1980) and Rey (2001). The U.S. dollar appears to be important in the invoicing of world trade both because the U.S. is an important consumer and producer in world markets, and because of its use in invoicing the many products that are traded via organized exchanges or using reference pricing.

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Appendix

A.1 Expansion of the profit function

Maximizing the expected profits (3) leads to the following relation for the optimal price $P_{ed}^{k}(z)$:

$$\begin{aligned}&\left(P_{ed}^{k}\right)^{1-\lambda} ED_{e}\left(S_{ek}\right)^{1-\lambda}\left(S_{ed}\right)^{\lambda}\left(P_{d}\right)^{\lambda} C_{d} \\ &=\frac{\lambda\alpha^{(1-\alpha)/\alpha}}{\lambda-1}\left(P_{ed}^{k}\right)^{-\frac{\lambda}{\alpha}} ED_{e}W_{e}\left(S_{ek}\right)^{-\frac{\lambda}{\alpha}}\left(S_{ed}\right)^{\frac{\lambda}{\alpha}}\left(P_{d}\right)^{\frac{\lambda}{\alpha}}\left(C_{d}\right)^{\frac{1}{\alpha}}\end{aligned} \qquad \text{(A1)}$$

where we dropped the *z* index on $P_{ed}^{k}(z)$ as all firms face the same problem and hence choose the same price.

We express the profits functions (3) in terms of a quadratic expansion around a deterministic steady state. Following Tille (2002) the expansion is based on the following relation:

$$X^{a}Y^{b} = X_{ss}^{a}Y_{ss}^{b}\left[1+ax+by+\frac{1}{2}(ax+by)^{2}\right]$$

where San Serif letters denotes log deviations from the steady state: $x=\ln X-\ln X_{ss}$. Using (A1), the profit function (3) is expanded as follows:

$$\begin{aligned}\pi_{ed}^{k} =& \frac{\lambda}{\lambda-\alpha(\lambda-1)}\left[\begin{array}{l}(1-\lambda)p_{ed}^{k}+Ed_{e}+(1-\lambda)Es_{ek}+\lambda Es_{ed}+\lambda Ep_{d}+Ec_{d} \\ +\frac{1}{2}E\left[d_{e}+(1-\lambda)s_{ek}+\lambda s_{ed}+\lambda p_{d}+c_{d}\right]^{2}\end{array}\right] \\ &-\frac{\alpha(\lambda-1)}{\lambda-\alpha(\lambda-1)}\left[\begin{array}{l}-\frac{\lambda}{\alpha}p_{ed}^{k}+Ed_{e}+Ew_{e}-\frac{\lambda}{\alpha}Es_{ek}+\frac{\lambda}{\alpha}Es_{ed}+\frac{\lambda}{\alpha}Ep_{d}+\frac{1}{\alpha}Ec_{d} \\ +\frac{1}{2}E\left[d_{e}+w_{e}-\frac{\lambda}{\alpha}s_{ek}+\frac{\lambda}{\alpha}s_{ed}+\frac{\lambda}{\alpha}p_{d}+\frac{1}{\alpha}c_{d}\right]^{2}\end{array}\right]\end{aligned}$$

where $\pi_{ed}^{k}=\left(\Pi_{ed}^{k}-\Pi_{ss}\right)/\Pi_{ss}$ we used the fact that p_{ed}^{k} is of order 2 and therefore does not enter the squared terms. After some algebra this expression becomes:

$$\begin{aligned}\pi_{ed}^{k} =& X_{ed}+\frac{\lambda}{\lambda-\alpha(\lambda-1)}\left[\frac{1}{2}E\left[s_{ek}-\lambda q_{ed}^{k}\right]^{2}+E\left[s_{ek}-\lambda q_{ed}^{k}\right]c_{d}\right] \\ &+\frac{\alpha(\lambda-1)}{\lambda-\alpha(\lambda-1)}\left[-\frac{1}{2}E\left[\frac{\lambda}{\alpha}q_{ed}^{k}\right]^{2}+\frac{\lambda}{\alpha}Eq_{ed}^{k}w_{e}+\frac{\lambda}{\alpha^{2}}Eq_{ed}^{k}c_{d}\right]\end{aligned} \qquad \text{(A2)}$$

where q_{ed}^k is the relative price of brand *z*: $q_{ed}^k = s_{ek} - s_{ed} - p_d$ (recalling that p_{ed}^k is preset hence does not enter the squared terms). X_{ed} is a term independent of the invoicing choice:

$$X_{ed} = Ed_e - \frac{\alpha(\lambda-1)}{\lambda-\alpha(\lambda-1)}Ew_e + \frac{1}{\lambda-\alpha(\lambda-1)}\left[\lambda(Es_{ed} + Ep_d) + Ec_d\right]$$
$$+ \frac{\lambda}{\lambda-\alpha(\lambda-1)}\frac{1}{2}E\left[d_e + c_d\right]^2 - \frac{\alpha(\lambda-1)}{\lambda-\alpha(\lambda-1)}\frac{1}{2}E\left[d_e + w_e + \frac{1}{\alpha}c_d\right]^2$$
$$+ \frac{\lambda}{\lambda-\alpha(\lambda-1)}E(s_{ed} + p_d)d_e$$

The first bracket on the right hand side of (A.2) captures the movements in the revenue, $S_{ek}\left[QP_{ed}^k\right]^{-\lambda}C_d$. The marginal revenue term $s_{ek} - \lambda q_{ed}^k$ captures the impact of exchange rate movements, including through movements in competitiveness. Exchange rate movements affect the relative price of brand *z* vis-à-vis the competing brands, q_{ed}^k, leading consumers to shift the allocation of their purchases across brands. In addition, with the price fixed in currency *k*, a depreciation of currency *e* (i.e. $s_{ek} > 0$) increases the amount of currency *e* received by the exporter for each unit sold abroad. Expected revenue for the exporter is higher when exchange rate fluctuations lead to a high marginal revenue in the states of nature when demand is strong (i.e. $E\left[s_{ek} - \lambda q_{ed}^k\right]c_d > 0$).

The second bracket in (A.2) reflects marginal cost considerations, $W_e\left[Q_{ed}^k\right]^{-\frac{\lambda}{\alpha}}(C_d)^{\frac{1}{\alpha}}$. The expected cost is reduced when the firm in country *e* is not competitive (i.e. its relative price Q_{ed}^k is high) precisely in the states where wages are high ($Eq_{ed}^k w_e > 0$), as the reduced competitiveness spares the firm from having to produce a lot at a high cost. The expected cost is also lower when the firm is not competitive in the states where demand is high ($Eq_{ed}^k c_d > 0$).Because of the decreasing returns to scale, fluctuations in output are costly. When $Eq_{ed}^k c_d > 0$, a strong demand is offset by a low competitiveness, a pattern that stabilizes the exporters' marginal cost.

A.2 Optimal invoicing

We take the derivative of (4) with respect to the weights β_d^d and β_d^v:

$$\frac{\partial \pi_{ed}^k}{\partial \beta_d^{i=d,v}} = \frac{\lambda}{\lambda-\alpha(\lambda-1)}\left[E\left[s_{ek}-\lambda q_{ed}^k\right]\left[\frac{\partial s_{ek}}{\partial \beta_d^i}-\lambda\frac{\partial q_{ed}^k}{\partial \beta_d^i}\right]+E\left[\frac{\partial s_{ek}}{\partial \beta_d^i}-\lambda\frac{\partial q_{ed}^k}{\partial \beta_d^i}\right]c_d\right]$$
$$+\frac{\alpha(\lambda-1)}{\lambda-\alpha(\lambda-1)}\left[-\left(\frac{\lambda}{\alpha}\right)^2 E q_{ed}^k\frac{\partial q_{ed}^k}{\partial \beta_d^i}+\frac{\lambda}{\alpha}E\frac{\partial q_{ed}^k}{\partial \beta_d^i}w_e+\frac{\lambda}{\alpha^2}E\frac{\partial q_{ed}^k}{\partial \beta_d^i}c_d\right]$$

Using equation (5) the derivatives of the exchange rate and relative prices are:

$$\frac{\partial s_{ek}}{\partial \beta_d^d}=\frac{\partial q_{ed}^k}{\partial \beta_d^d}=s_{ed} \qquad \frac{\partial s_{ek}}{\partial \beta_d^v}=\frac{\partial q_{ed}^k}{\partial \beta_d^v}=s_{ev}$$

The derivatives of the profit function are then:

$$\frac{\partial \pi_{ed}^k}{\partial \beta_d^{i=d,v}} = \frac{-\lambda(\lambda-1)}{\lambda-\alpha(\lambda-1)}E\left[s_{ek}+\lambda\frac{1-\alpha}{\alpha}q_{ed}^k-m_{ed}\right]s_{ei}$$

where m_{ed} summarizes the impact of movements in wages and demand in the destination market:

$$m_{ed}=w_e+\frac{1-\alpha}{\alpha}c_d$$

Substituting for s_{ek} and $q_{ed}^k=\left(\beta_d^d-\eta_d^d\right)s_{ed}+\left(\beta_d^v-\eta_d^v\right)s_{ev}$ using (5) we obtain:

$$\frac{\partial \pi_{ed}^k}{\partial \beta_d^d}\propto -\left[\beta_d^d+\lambda\frac{1-\alpha}{\alpha}\left(\beta_d^d-\eta_d^d\right)\right]E\left(s_{ed}\right)^2-\left[\beta_d^v+\lambda\frac{1-\alpha}{\alpha}\left(\beta_d^v-\eta_d^v\right)\right]E\left(s_{ed}s_{ev}\right)+E\left(s_{ed}m_{ed}\right)$$
$$\frac{\partial \pi_{ed}^k}{\partial \beta_d^v}\propto -\left[\beta_d^d+\lambda\frac{1-\alpha}{\alpha}\left(\beta_d^d-\eta_d^d\right)\right]E\left(s_{ed}s_{ev}\right)-\left[\beta_d^v+\lambda\frac{1-\alpha}{\alpha}\left(\beta_d^v-\eta_d^v\right)\right]E\left(s_{ev}\right)^2+E\left(s_{ev}m_{ed}\right)$$

where $\propto$ denotes a relation of proportionality. Note that setting the first derivatives to zero ensures a maximum (provided of course that β_d^d, β_d^v, and $\beta_d^d+\beta_d^v$ do not fall outside the [0,1] interval), as the direct second derivatives are negative and the determinant of the matrix of second derivatives is positive.

Setting the first derivatives to zero and solving the resulting system of two equations leads to the following weights on the various currencies:

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

where:

$$\Omega = \frac{\lambda(1-\alpha)}{\alpha + \lambda(1-\alpha)}$$

and $\rho(m_{ed}, s_{ed})$ and $\rho(m_{ed}, s_{ev})$ are the coefficients obtained in a regression of m_{ed} on the exchange rates s_{ed} and s_{ev}.

A.3 A simpler model

A.3.1 Driving factors

We consider that each country experiences shocks in a fundamental variable *f*, such as the monetary stance. Wages in the exporter's country and demand in the destination market are driven solely by the fundamental in the exporting and destination country, respectively. The exchange rate between two countries follows the difference between the fundamentals. We also let the exchange rate be driven by a noise variable, ε, in order to capture the fact that exchange rates are more volatile than wages and demand. The wage in the exporting country, the demand in the destination country, and the exchange rates are given by:

$$w_e = \gamma_w f_e \;,\; c_d = \gamma_c f_d \;,\; m_{ed} = \gamma_w f_e + \frac{1-\alpha}{\alpha}\gamma_c f_d \qquad \gamma_w \geq 0 \qquad \gamma_c \geq 0$$

$$s_{ed} = f_e - f_d + \varepsilon_e - \varepsilon_d \;,\; s_{ev} = f_e - f_v + \varepsilon_e - \varepsilon_v \;,\; s_{dv} = f_d - f_v + \varepsilon_d - \varepsilon_v$$

where γ_w and γ_c capture the sensitivity of the wage and demand to the fundamentals. We consider that the various fundamentals and noises are all independent from each other, and denote the variances of fundamentals and noise in country *i* by $\sigma^2(f_i + \varepsilon_i) = \sigma^2(f_i) + \sigma^2(\varepsilon_i)$. The components of (9)-(11) are then given in table A.1:

Table A.1: components of invoicing

$\rho(m_{ed}, s_{ed}) = \Delta^{-1}\left[\gamma_w \sigma^2(f_v + \varepsilon_v)\sigma^2(f_e) - \frac{1-\alpha}{\alpha}\gamma_c\left[\begin{matrix}\sigma^2(f_e + \varepsilon_e) \\ +\sigma^2(f_v + \varepsilon_v)\end{matrix}\right]\sigma^2(f_d)\right]$
$\rho(m_{ed}, s_{ev}) = \Delta^{-1}\left[\gamma_w \sigma^2(f_d + \varepsilon_d)\sigma^2(f_e) + \frac{1-\alpha}{\alpha}\gamma_c \sigma^2(f_e + \varepsilon_e)\sigma^2(f_d)\right]$
$\rho(m_{ed}, s_{ed}) + \rho(m_{ed}, s_{ev}) = \Delta^{-1}\left[\gamma_w\left[\begin{matrix}\sigma^2(f_v + \varepsilon_v) \\ +\sigma^2(f_d + \varepsilon_d)\end{matrix}\right]\sigma^2(f_e) - \frac{1-\alpha}{\alpha}\gamma_c \sigma^2(f_v + \varepsilon_v)\sigma^2(f_d)\right]$
$\Delta = \sigma^2(f_e + \varepsilon_e)\sigma^2(f_d + \varepsilon_d) + \sigma^2(f_e + \varepsilon_e)\sigma^2(f_v + \varepsilon_v) + \sigma^2(f_d + \varepsilon_d)\sigma^2(f_v + \varepsilon_v)$

A.3.2 Impact of fundamentals' volatility

Computing the derivatives of the various components of table A.1 with respect to the volatility of fundamentals in the exporting country, we obtain:

$$\frac{\partial\rho(m_{ed},s_{ed})}{\partial\sigma^2(f_e)}>0 \qquad \frac{\partial\rho(m_{ed},s_{ev})}{\partial\sigma^2(f_e)}>0 \qquad \frac{\partial[-\rho(m_{ed},s_{ed})-\rho(m_{ed},s_{ev})]}{\partial\sigma^2(f_e)}<0$$

Turning to the derivatives with respect to the volatility of fundamentals in the destination country we get:

$$\frac{\partial\rho(m_{ed},s_{ed})}{\partial\sigma^2(f_d)}<0 \qquad \frac{\partial\rho(m_{ed},s_{ev})}{\partial\sigma^2(f_d)}>0 \qquad \frac{\partial[-\rho(m_{ed},s_{ed})-\rho(m_{ed},s_{ev})]}{\partial\sigma^2(f_d)}>0$$

The derivatives with respect to the volatility of fundamentals in the vehicle country are:

$$\frac{\partial\rho(m_{ed},s_{ed})}{\partial\sigma^2(f_v)}>0 \qquad \frac{\partial\rho(m_{ed},s_{ev})}{\partial\sigma^2(f_v)}<0 \qquad \frac{\partial[-\rho(m_{ed},s_{ed})-\rho(m_{ed},s_{ev})]}{\partial\sigma^2(f_v)}>0$$

A.3.3 Impact of noise volatility

The derivatives of the various components of table A.1 with respect to the volatility of the noise term in the exporting country are:

$$\frac{\partial\rho(m_{ed},s_{ed})}{\partial\sigma^2(\varepsilon_e)}<>0 \qquad \frac{\partial\rho(m_{ed},s_{ev})}{\partial\sigma^2(\varepsilon_e)}<>0 \qquad \frac{\partial[-\rho(m_{ed},s_{ed})-\rho(m_{ed},s_{ev})]}{\partial\sigma^2(\varepsilon_e)}<>0$$

The derivatives with respect to the volatility of noise in the destination country are:

$$\frac{\partial\rho(m_{ed},s_{ed})}{\partial\sigma^2(\varepsilon_d)}<>0 \qquad \frac{\partial\rho(m_{ed},s_{ev})}{\partial\sigma^2(\varepsilon_d)}<>0 \qquad \frac{\partial[-\rho(m_{ed},s_{ed})-\rho(m_{ed},s_{ev})]}{\partial\sigma^2(\varepsilon_d)}<>0$$

The derivatives with respect to the volatility of noise in the vehicle country are:

$$\frac{\partial\rho(m_{ed},s_{ed})}{\partial\sigma^2(\varepsilon_v)}>0 \qquad \frac{\partial\rho(m_{ed},s_{ev})}{\partial\sigma^2(\varepsilon_v)}<0 \qquad \frac{\partial[-\rho(m_{ed},s_{ed})-\rho(m_{ed},s_{ev})]}{\partial\sigma^2(\varepsilon_v)}>0$$

Appendix Table 1 Currency of Invoice in International Trade Transactions: Data Sources and Notes

Country	Data Availability	Type of Data Disaggregation Available	Data Source and Notes.
United States	2002,2003	Bilateral, by trading partner, by industry. Both export and import invoicing.	Confidential. Made available by special request. BEA the International Price Program collects data on currency solely to convert prices into U.S. Dollars for the purpose of producing price indexes. The U.S. Customs Service collects the data on the value of imports and exports, but do not keep any data on the currency in which trade is conducted. The data collected is a sample of overall trade rather than every transaction.
United Kingdom	1999-2002	France, Germany, Italy, Canada, USA, Japan. World, Eurozone, EU14, OECD, Oil Exporting Countries --- By $, Euro, Pound, Local Partner Currency, Other. Various specific SITC (Rev3) codes and commodities. Both export and import invoicing.	This is publicly available data. Original source found in "United Kingdom: HM Customs and Excise United Kingdom Imports and Exports Currency of Invoicing", February 23, 2001. http://www.hmce.gov.uk/business/importing/tradestatistics/pr09-2001.pdf 2002 data found at http://www.uktradeinfo.com/downloads/COIResults02.pdf These data are not covered by the UK National Statistics quality kitemark, so should be viewed as indicative rather than as an exact measure. Specifically, the coverage in this survey is limited for all exports and for imports from the rest of the European Union, consequently caution should be exercised in interpreting the results for a single year.
Japan	1992-2001	Breakdown by World, U.S. SouthEast Asia, and EU. Breakdown by $ Yen, Other. Both export and import invoicing. Data reported in percent of total trade *invoiced* in each currency. Each year is only represented by data from only one or two months: January (2001), March (1995-1998), and/or September (1992-1997)	This is publicly available data. Original source is: "Japanese MOF Study Group for the Promotion of the Internationalization of the Yen Report", June 2001. http://www.mof.go.jp/english/if/if043a.htm#con Japanese Ministry of International Trade and Industry, downloaded from the Ministry of Finance web site http://www.mof.go.jp/english/if/if043f.htm
Korea	1976-2001 1984m01-2002m04	Breakdown by $,yen, DM, pound, other. Overall Trade Only	This is publicly available data. It can be found in the *Monthly Statistical Bulletin*, 2003 vol 57 no. 6, Bank of Korea, Table 52 **Source**: Korea National Statistics Office, Downloaded from http://www.nso.go.kr/eng/index.shtml Data is for currency *invoicing* and is provided in 4 categories: Receipts-Visible Trade, Receipts-Invisible Trade, Payments-Visible Trade, Payments-Invisible Trade.
Australia	1997Q1-2003Q1	Overall Trade Only $, yen, pound, New Zealand $, Australian $, Various	This is publicly available data. The source is the Australian Bureau of Statistics Australia Now "International Merchandise Trade, Australia 2003, feature article

		Other Asian Currencies, Other. Both exports and imports. Currency invoicing data.	Export and Import Currencies, March 2003. http://www.abs.gov.au/Ausstats/abs%40.nsf/46d1bc47ac9d0c7bca256c470025ff87/5e55d2aa9e595ebeca256d2e0083c571!OpenDocument. Other data also purchased from ABS.
Bulgaria	1998Q1- 2003Q1 1998-2002	Overall Trade Only $,euro, DM, pound, various other now defunct European currencies Reported in percent share of imports and exports for each currency.	Customs clearing data from the "Information Services" Company, processed by the BNB and supplemented with NSI data. Preliminary data as of 24-Mar-2003. See NSI BNB web sites http://www.bnb.bg select English version, then click statistics -> foreign trade -> Currency Structure (all 4 files))
Belgium and Luxembourg	1999 2002Q1-2002Q4, 2002	Euro, Other for overall trade Extra-euro area trade in Goods and Services. $,euro, yen, pound, Other.	Confidential. This data was received through a special request via ECB. (1) Separate data for Belgium and Luxembourg were not available in 2000 and 2001. All data is for trade *settled* in the relevant currencies. Euro data for 2001 and 2002 includes trade settled in both Euros and in the Euro Zone legacy currencies. Data was received in the form of total values settled in Euros, US dollars, Yen, etc. recorded separately for *goods and service (including travel)*.
Greece	2001-2002 2001Q1-2002Q4	Extra euro area exports and imports of goods and services Euro, other	Confidential. This data was received through a special request via ECB. (1)
Portugal	2000-2002 2001Q1-2002Q4	Extra euro area exports and imports of goods and services $, Euro, yen, pound,other	Confidential. This data was received through a special request via ECB. (1) In the case of exports and imports of goods and services the currency breakdown refers to the currency of settlement, which may differ from the actual currency of invoicing.
Spain	1998-2002 1998Q1-2002Q4	Extra euro area exports and imports of goods and services $, Euro, yen, pound,other i) The Spanish data refer to the use of the euro as a settlement currency instead of invoicing currency; ii) Data on services excluded travel.	Confidential. This data was received through a special request via ECB. (1) The currency breakdown of Spain's trade in goods and services with non-euro countries (called the extra euro area) are based on settlement currency instead of invoicing currency. There is no way to assess when the settlement currency is also the invoicing currency. As these data have not been published yet, a proper checking and cleaning process has not been carried out, so the cleaning and the quality of Spanish data cannot be guaranteed sufficiently.
Italy	2001-2002	Extra euro area exports and imports of goods and services. Euro, other	Confidential. This data was received through a special request via ECB. (1)
France	1988-1999 2000,2001qtrs 2000Q1-02Q4 2000-2002	Overall Trade $,yen, pound, France, Austrialian $, DM, Other now defunct European Currencies Total Euro, US$, Other Extra-euro area exports and imports of goods and services. Euro, US$, Other	Confidential. This data was received through a special request via ECB. (1) Special request via to Banque de France

Germany	2002Q1-Q3 2002Q1-02Q3 2000-2002	Overall Trade $,euro, pound, other Euro, US$, pound, Other. Extra-euro area exports and imports of goods . Euro, US$, pound, yen, Other	Confidential. This data was received through a special request via ECB. (1) In general, the data are derived from a survey conducted twice a year. This survey was implemented in 1989 to cover overall trade exports for DM and some other European invoicing currencies, USD and Yen. From 2002 onwards, data on currencies for trade imports were included; above that, the survey was expanded to implement the extra euro area trade breakdown. Since then, the respective invoicing currencies are broken down by EUR, USD, Pound Sterling and others.
Cyprus,Estonia, Hungary, Latvia, Poland, Sovakia, Slovenia	2002 or 2003	Breakdowns provided for use of euros, dollars, pounds, yen, rubles, and other currencies, including those of the accession countries.	Confidential European Parliament briefing document The Latvian central bank (Latvijas Banka) provides data on their web site: http://www.bank.lv/eng/main/pubrun/lbgadaparsk
Czech Republic	2001-2003 first 9 months	Overall Trade. Euro, US$, pound, local currency, Other.	Confidential. This data was received through a special request via ECB. (1) Czech Statistical Office, extracted from the web site (http://www.czso.cz/eng/edicniplan.nsf/p/6001-04)
Malaysia/ Thailand	1995-1996 (A)	Exports and imports combined. Data was received as the percent share of total invoicing for each currency.	Senivongs, Chirathep, "Currency Internationalisation in Selected ASEAN Countries", Unpublished Monograph, International Monetary Fund, 1997. **Source**: Senivongs, Chirathep, "Currency Internationalisation in Selected ASEAN Countries", Unpublished Monograph, International Monetary Fund, 1997. Table from "FINANCIAL AND MONETARY COOPERATION IN EAST ASIA: THE SINGAPORE PERSPECTIVE" Ngiam Kee Jin, Senior Fellow, Institute of Southeast Asian Studies, paper presented at *PECC Finance Forum Conference Issues and Prospects for Regional Cooperation for Financial Stability and Development, Honolulu August 11-13, 2002*

Note: Industry specific details are available for the USA, United Kingdom, Japan, and Australia.
(1) Data for 2000 and 2001 include trade settled in euro and in legacy currencies. Data refer to the use of the euro as a settlement currency, except for Germany. For Germany, data on trade in goods reflect the average value of data collected in surveys carried out in the first and third quarters of 2002 on behalf of the Deutsche Bundesbank. Data on services for Greece, Portugal, and Spain exclude travel.

Appendix Table 2 Alternative Currencies in Trade Invoicing

		Currency Share in X			Currency Share in M		
H	Latest Year	US $	Euro	Yen	US$	Euro	Yen
HUnited States	2003	95			85		
HAsia							
H Japan	2001	52.4	*	36.1	70.7	*	23.5
H Korea	2001	84.9	*	7.1	82.2	*	9.8
H Malaysia	1996	66.0	*	6.8	66.0	*	6.8
H Thailand	1996	83.9	*	8.2	83.9	*	8.2
HAustralia	2002	67.9	1.4	1.0	50.1	8.7	4.0
HCanada							
HEuro Union							
H Belgium	2002	31.9#	54.2#	0.5#	33.5#	54.2#	1.5#
H France	2002	34.2#/21.2	55.8#/71.6	*	43.2#/25.0	48.6#/70.0	*
H Germany	2002	32.3#/18.1	45.9#/70.5	0.0	37.9#/21.2	45.5#/73.0	0.0#/*
H Greece	2002	71.0#	24.1#	0.2#	62.0#	30.7#	1.0#
H Luxembourg	2002	35.7#	49.1#	1.7#	38.0#	37.4#	4.0#
H Portugal	2002	33.4#	48.1#	0.4#	34.5#	57.8#	0.9#
H Spain	2002	32.8#	58.1#	0.6#	39.5#	54.7#	0.8#
H U.K.	2001	40.0#/29.0	5.0#/15.0	*	61.0#/38.0	1.0#/10.0	*
HEU-Accession							
H Bulgaria	2002	44.5	60.1	*	37.1	52.3	*
H Cyprus	2002	44.7	21.8	*	34.9	45.5	*
H Czech	2002	14.7	68.0	*	19.5	66.2	*
H Estonia	2003	8.5	70.4	*	22.0	61.7	*
H Hungary	2002	12.2	83.1	*	18.5	73.1	*
H Latvia	2002	36.2	40.1	*	29.8	51.5	*
H Poland	2002	29.9	60.2	*	28.6	59.6	*
H Slovakia	2002	11.6	73.9	*	21.2	60.1	*
H Slovenia	2002	9.6	86.9	*	13.3	82.8	*

H*- Data Not Available for this particular currency. See Notes on Table 4.3 for more information about the data sources and dates used. #Extra-euro area trade.