Special features

A The role of currency invoicing for the international transmission of exchange rate movements⁴⁴

Empirical studies typically find that the transmission of exchange rate movements to import prices differs sizeably depending on the currency chosen to invoice import transactions, and that it is lower the higher the share of local currency that is used to invoice imports. This finding may have implications for monetary policy in the euro area, given the large variations in the relative use of the euro as an invoicing currency for extra-euro area imports across euro area members, which ranges from around 20% in Greece to more than 70% in Estonia.

Against this background, this special feature aims to relate differences in country-specific degrees of long-run exchange rate pass-through to the relative use of the euro as an invoicing currency. In order to control for possible endogeneity of invoicing currency choice, it assumes that importing firms partly choose an invoicing currency mainly to hedge against exchange rate risk. In line with this reasoning, the special feature presents estimates of exchange rate pass-through where invoicing currency choice is instrumented by measures of aggregate costs and metrics of demand for foreign exchange hedging, which suggest the existence of a causal – and economically large – link between invoicing currency choice and exchange rate pass-through. According to the estimates, an increase in the share of the euro as an invoicing currency for extra-euro area imports by 10 percentage points lowers the degree of exchange rate pass-through by close to 7 percentage points. These findings also support the hypothesis that importing firms use invoicing currency choice as a hedge against foreign exchange rate risk.

1 Introduction

The large movements in the euro exchange rate over the past few years coupled with concerns about falling inflation in the euro area have reignited discussions on the extent of pass-through of exchange rate movements into domestic prices. Between July 2012 and May 2014 the euro exchange rate appreciated by around 15%, both in nominal effective terms against its major 38 trading partners, as well as in bilateral terms against the US dollar. This substantial and broad-based strengthening of the euro exchange rate halted in mid-2014 and reversed as expectations of diverging trends in the stance of monetary policy between the euro area and its major trading partners mounted, with the euro depreciating by more than 20% against the US dollar. It has been observed that this depreciation can be expected to contribute to the reduction of the risks of an excessively long period of excessively low inflation in the euro area.

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This expectation embodies two important assumptions. First, that the pass-through of exchange rate movements into euro area import prices is at least partial over the short run and that it rises over the long run, i.e. if and when foreign exporters adjust their markups and prices to exchange rate shocks. Second, it takes for granted that the degree of exchange rate pass-through is of broadly comparable magnitude across euro area countries.

Increasingly, however, empirical and theoretical evidence is suggesting that pass-through has been steadily declining over the past few decades, that it is far from being complete over the long run and that it can differ substantially across countries. In the case of the United States, for instance, it has been estimated that aggregate import pass-through stands at around 20% in the short run and that it remains as low as 30% over a two-year horizon (Gopinath et al., 2010). In the case of the euro area, in turn, it has been shown that pass-through rates differ substantially across member states (Campa and Mínguez, 2006).

While the finding that there is limited aggregate exchange rate pass-through to US import prices has been largely ascribed to the dominant role of the US dollar for the invoicing and settlement of US imports (90%), the role of invoicing currency choice has so far not been properly considered in explaining differences in the extent of exchange rate pass-through across several countries. This is the gap that this special feature aims to fill by relating cross-country heterogeneity in the degree of exchange rate pass-through within the euro area to cross-country differences in the share of local currency invoicing of extra-euro area imports. 45 In order to control for the possible endogeneity of currency invoicing, it is assumed here that importing firms use invoicing currency choice to hedge against exchange rate risk, in line with the observation that it is a low-cost, transparent and easy way to hedge. Specifically, the special feature builds on two key determinants of currency invoicing strategies: the cost of and demand for hedging against foreign exchange risk. The cost of hedging through financial markets is measured by financial market development. Aggregate demand for foreign exchange hedging is represented by the degree of dependence on intra-euro area exports. By using this approach, the special feature uncovers a causal - and economically large - link between currency invoicing and exchange rate pass-through. According to the estimates, an increase in the share of extra-euro area imports invoiced in euro by 10 percentage points lowers the degree of pass-through by almost 7 percentage points. Moreover, these estimates strongly support the hypothesis that importing firms aim to hedge against exchange-rate risk through their choice of invoicing currency.

The special feature is structured as follows. Section 2 reviews the existing literature. In Section 3 country-specific estimates of exchange rate pass-through are discussed. Section 4 relates these estimates to the relative use of the euro as an invoicing currency in extra-euro area imports using instrumental variable techniques. Section 5 concludes.

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This special feature is based on Gräb and Lafarguette (2015).

2 Literature review

The literature on the pass-through of exchange rate changes to import prices can be broadly divided into two main strands. A first strand of literature has investigated the degree of exchange rate pass-through (ERPT), and typically finds that passthrough into import prices is partial, that it varies markedly across countries and that it has tended to decline over recent decades (Goldberg and Knetter, 1997; Taylor, 2000; Campa and Goldberg, 2005; 2010; Marazzi et al., 2005; Campa and Gonzalez Mínguez, 2006; Goldberg and Hellerstein, 2008; Goldberg and Campa, 2008; Burstein and Gopinath, 2013; Gagnon et al., 2014). This literature has typically focused on macro-level data and has aimed to establish a link between macroeconomic variables, such as exchange rate volatility or the stability of monetary policy and ERPT. In particular, Campa and Goldberg (2005) have been among the first to provide cross-country and time-series evidence about the level of EPRT across OECD economies, finding marked heterogeneity in long-run ERPT, with the United States having the lowest sensitivity among OECD economies. Marazzi et al. (2005) confirm the limited sensitivity of US import prices to exchange rate movements. They document a sustained decline in aggregate ERPT from above 0.5 in the 1980s to around 0.2 in the early 2000s. Campa and Mínguez (2006) investigate differences in ERPT within the euro area, finding that ERPT differs across euro area countries over the short run and the long run and they link these variations to differences in the degree of openness across individual euro area countries. In particular, countries such as Italy, France and Spain, which tend to be less open, exhibit a lower ERPT. 46

A second, more recent strand of literature has focused on the role of currency invoicing and firm characteristics for the degree of ERPT (Gopinath and Rigobon, 2008; Gopinath and Itskohki, 2010; Gopinath et al., 2010; Berman et al., 2012; Fabling and Sanderson, 2014; Devereux et al., 2014). Using micro-level data on currency and import prices, this literature finds strong evidence that import prices are sticky, in whichever currency they are priced, and that ERPT differs markedly across invoicing currency and firm performance. In the case of the United States, Gopinath and Rigobon (2008) illustrate the stickiness of border prices by showing that the median price duration in the currency of pricing is close to one year for US imports. Moreover, they show that there has been a trend decline in the probability of price adjustments for imports. By looking into the role of currency invoicing further, Gopinath et al. (2010) find evidence of large differences in ERPT, even conditional on import price changes, across US dollar and non-US dollar imports over the short run and, importantly, also the long run. Aggregate ERPT is markedly different for goods invoiced in the currency of the importer (around 25%) and goods invoiced in the currency of the producer/exporter (around 95%), both over the short run and even after two years. Devereux et al. (2014) confirm the finding that ERPT is higher for imports invoiced in foreign currency and lower for imports invoiced in local

This special feature article focuses on the impact of exchange rate movements to import prices and does not deal with the transmission of import price changes to consumer price indexes. Goldberg and Campa (2008), for instance, test the sensitivity of consumer prices, rather than import prices, to exchange rate movements. They show that the dominant channel for CPI sensitivity is through the costs arising from imported intermediate inputs for production rather than through price changes of imported costs that are directly consumed.

currency. In addition, Devereux et al. show that ERPT for imports invoiced in vehicle currencies is somewhere between the two extremes. Finally, they find evidence of a U-shaped relationship between a firm's market share and ERPT. Using French firm-level data, Berman et al. (2012) find that high-performance firms react more strongly to exchange rate movements by increasing their markups by more and their export volumes by less, suggesting that high-performance exporters pass on a smaller proportion of exchange rate fluctuations to their customers. Using firm-level data for New Zealand, Fabling and Sanderson (2014) confirm the finding of Gopinath et al. and Devereux et al. that short-run and long-run ERPT differ markedly across invoicing currencies, and that ERPT for vehicle currencies is somewhere between these two extremes.

In the following, this special feature seeks to link the two strands of the literature by relating cross-country differences in ERPT to the relative use of local currency for invoicing extra-euro area imports.

3 ERPT to import prices: evidence for the euro area

In order to estimate country-specific degrees of long-run ERPT for euro area countries, we follow the literature and use a standard log-linear regression model (see, for instance, Campa and Goldberg, 2005, Gopinath et al. 2010):

$$\Delta p_{it} = \alpha + \sum_{j=0}^{4} \beta_{ij} \Delta e_{t-j} + \sum_{j=0}^{4} \gamma_{ij} \Delta Cost_{t-j} + \delta_{ij} \Delta IP_{it} + \epsilon_{it}, \qquad (1)$$

Table 4Estimated elasticities of long-run ERPT to import prices

	Long-run elasticity
Austria	-0.29
Belgium	-0.50
Cyprus	-0.64
Germany	-0.48
Spain	-0.52
Estonia	-0.40
Finland	-0.61
France	-0.45
Greece	-0.59
Ireland	-0.75
Italia	-0.60
Luxembourg	-0.57
Malta	-0.57
Netherlands	-0.68
Portugal	-0.37
Slovakia	-0.38
Slovania	-0.29
Euro area	-0.51

Note: Cumulated ERPT over four quarters.

where Δp_{it} is the quarterly log change in import price unit values of euro area economy i, Δe is the quarterly change of the broad measure of the euro nominal effective exchange rate (NEER-38), $\Delta Cost$ is a quarterly effective measure of inflation in production costs of the euro area's major trading partners⁴⁷ and ΔIP is the quarterly log change in industrial production (excluding construction) of euro area economy i. The estimation sample has a quarterly frequency, spans the time period Q1 2000 to Q4 2014 and covers 17 euro area countries.⁴⁸

The results for the estimated degrees of long-run ERPT are reported in Table 4. For the euro area aggregate we find that a one per cent nominal effective appreciation of the euro has on average resulted in a 0.51% decline in aggregate import prices over the estimation period. However, this finding

This measure is derived by taking a trade-weighted average of the export unit value cost indices of 38 of the euro area's major trading partners.

Latvia is excluded from the sample on account of data restrictions. For euro area member states that joined the euro area at a later stage (after Q1 2000) the regression starts at the time of accession.

masks substantial heterogeneity in ERPT across euro area economies, ranging from 0.29% in Austria to 0.75% in Ireland.49

4 Understanding differences in ERPT across euro area economies

What explains the marked variation in estimated ERPT across euro area economies? As stressed by Devereux and Engel (2001) this is of particular relevance in the euro area since firms choose currencies with low exchange rate variability and stable monetary policies for international transactions, factors that are common across countries in a monetary union.

4.1 Standard determinants of ERPT

The existing literature that aims to explain cross-country differences in ERPT has so far focused on a combination of macroeconomic and microeconomic structural determinants (see, for instance, Devereux and Engel, 2001; Campa and Goldberg, 2005; Campa and Mínguez, 2006; Bussière et al, 2014). We follow this literature and relate our estimated ERPT to a set of macro and micro variables:

$$\beta_i = \alpha + \gamma_1 Openness_{it} + \gamma_2 HICP_{it} + \gamma_3 LowTech_{it} + \varepsilon_{it},$$
 (2)

Table 5 Determinants of long-run ERPT

	(1) OLS	(2) OLS	(3) OLS	(4) (IV-2SLS)
Openness	0.06***	0.04***	0.07***	0.07***
	(6.98)	(3.17)	(10.80)	(10.32)
Inflation	-0.02***	-0.01	0.01	0.00
	(-3.16)	(-1.41)	(1.29)	(1.17)
Agricultural Imports (percentage of Imports)		-9.35***	-2.68***	-2.92***
		(-12.22)	(-5.62)	(-5.91)
Local currency share			-0.71***	-0.68***
			(-29.07)	(-18.56)
Constant	0.49***	0.65***	0.85***	0.84***
	(55.48)	(51.27)	(77.61)	(58.43)
Observations	777	777	777	777
R-squared	0.03	0.27	0.68	0.68
Hansen-J (p-value)				0.11
K-P-Test (p-value)				0.00
First-stage- F-Stat				308.55

Source: Gräb and Lafarquette (2015).

Notes: Robust standard errors, t-statistics reported in parentheses. Significance levels: *p<0.1 ** p<0.05 *** p<0.01.

where Openness of euro area economy i is measured as the share of imports to GDP, HICP is the logarithm of annualised HICP inflation, and LowTech is the share of agricultural and raw material imports in total imports, a proxy for the degree of product differentiation (assuming that low-technology imports are subject to less product differentiation; see, for instance, Berman et al., 2012). The estimation sample has an annual frequency, spans the time period 2000-2013, and covers the 15 euro area countries for which data on currency invoicing is available.

We start with a regression specification that is restricted to the standard macroeconomic determinants of ERPT: the level of inflation and the degree of openness. The results are reported in column (1) of Table 5. The R-squared is 3%, which suggests that these standard macroeconomic determinants explain only a small share of the cross-country heterogeneity in ERPT. Countries with a higher degree of openness are found

A possible limitation of single equation ERPT regressions conducted in this section is that these may not cover the endogeneity among the different regressors, such as the exchange rate and the proxy for foreign inflation. Some studies have hence included a measure of domestic costs as an extra determinant in single equation models of ERPT to account for domestic substitutes that act as an additional determinant in the equation.

to be those with higher ERPT, which is consistent with previous findings in the literature, such as those of Campa and Mínguez (2006).⁵⁰

Next, we add the share of agricultural and raw material imports to total imports to equation (2). The results are reported in column (2) of Table 5 and suggest that economies which import more low-technology products tend to have lower pass-through. This may reflect the fact that exporters of less differentiated products tend to have lower market power and hence react to depreciation by increasing their markup rather than their export volume, which translates into a lower ERPT.⁵¹ Moreover, the R-squared increases from 3% to 27%, suggesting that the import structure of an economy is an important determinant of cross-country differences in ERPT.

4.2 The role of invoicing currency choice

A determinant that has not been considered in existing studies that analyse cross-country differences in ERPT is the role of local currency invoicing. Evidence for one country, namely the United States, suggests that the fraction of imports invoiced in local currency (i.e. the US dollar) may have significant predictive power for measures of aggregate ERPT to import prices, even at long horizons (see Gopinath et al, 2010 and Fabling and Sanderson, 2014). To what extent do these conclusions extend to other economies?

To address this question, we draw on a unique country-level dataset on the share of local currency import invoicing collected for this year's International Role of the Euro report. Table 6 reports the share of the euro as an invoicing currency (or settlement

Table 6The euro's share as an invoicing or settlement currency in extra-euro area imports

	Austria	1													
		Belgium	France	Germany	Italy	Luxembourg	Netherlands	Greece	Ireland	Portugal	Spain	Cyprus	Slovakia	Estonia	Slovenia
2000		44	43			44	37			44	44				77
2001		47	43		41	47	41	26		51	50				79
2002		54	41	48	44	32	48	35		55	56				83
2003		58	44	55	45	42	45	39		58	61				82
2004		56	46	55	41	50	41	40		58	61	12			79
2005	63	51	46	55	39	44	37	33	43	54	56	12	82		77
2006	63	58	45	56	43	39	37	32	43	53	55	12	82		64
2007	63	56	45	57	44	38	37	34	43	52	57	2	82		73
2008	63	56	44	41	48	39	37	37	36	54	59	10	82		75
2009	56	58	44	35	50	55	41	38	35	57	62	13	78	47	70
2010	55	53	44	49	47	55	33	31	23	51	60	12	77	45	62
2011	56	56	47	49	44	49	35	33	21	46	52		69	61	64
2012	55	57	44	57	46	44	37	24	33	40	52		68	66	54
2013			54					23		36	48		67	72	59

Notes: Data taken from this report (see Table A11). Missing values replaced based on imputation methods. Finland and Malta do not report data.

The results reported in column (1) also suggest that members which tend to have higher domestic HICP inflation, show lower rates of pass-through. This result is different from what the earlier literature has typically found, namely a significant positive relation between rates (and volatility) of inflation and rates of pass-through; see, for instance, Campa and Goldberg (2005) and Bussière et al. (2014). However, the sign of the coefficient turns into positive (and statistically significant) territory when controlling for product differentiation and currency invoicing, see columns (3) and (4).

Note, that based on French firm-level data, Berman et al., (2012) find the opposite, namely that high-productivity firms react to depreciation by increasing their markup significantly more and their export volume less, which translates into lower pass-through.

currency when this is unavailable) for extra-euro area imports. Cross-country variation in the use of the euro is substantial. Invoicing shares range from just over 20% in Greece to more than 70% in Estonia.⁵²

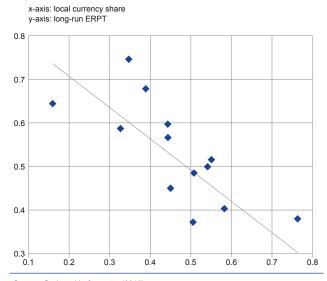
Plotting the relative use of the euro as an invoicing currency for extra-euro area imports against the estimated degree of pass-through, Chart 21 shows that the correlation coefficient is strikingly large. Member states with a higher share of extraeuro area imports invoiced in euro typically have a substantially lower degree of ERPT. In order to control for other factors that affect the choice of invoicing currency we now modify equation (2) to:

$$\beta_i = \alpha + \gamma_1 Openness_{it} + \gamma_2 HICP_{it} + \gamma_3 LowTech_{it} + \gamma_4 LCI_{it} + \varepsilon_{it}$$
 (3),

where LCI is the share of local currency invoicing of extra-euro area imports in euro area economy i. The estimation results are reported in column (3) of Table 5. The share of local currency invoicing is highly correlated with long-run ERPT and highly statistically significant when controlling for standard determinants of ERPT heterogeneity. Moreover, the R-squared increases markedly, by more than 30 percentage points.

This result is intuitive and not necessarily surprising from a theoretical perspective since there is evidence that invoicing currency choice is an endogenous decision. In other words, the invoicing strategies of exporters may well reflect different preferences for ERPT. Exporters are more likely to choose local currency pricing if they stand ready – or are able – to absorb more exchange rate movements through

Chart 21Relation between estimates long-run ERPT and share of local currency invoicing



Source: Gräb and Lafarguette (2015).

Notes: The figure depicts a simple OLS regression of the estimated long-run ERPT on the share of local currency invoicing. The local currency share is averaged over time.

adjustments to their markups, which translates into lower ERPT (see, for instance Berman et al., 2013 and Gopinath et al., 2010). From a macroeconomic perspective, this suggests that aggregate invoicing shares are the simple reflection of cross-country differences in ERPT preferences.

In order to address possible concerns about endogeneity and identify the causal impact of currency invoicing on ERPT we adopt an instrumental variable approach. Instruments should be relevant and valid, i.e. the variation in the instruments must have sufficient power to explain the variation in ERPT and the instruments must be exogenous, i.e. uncorrelated with the error term.

To find appropriate instruments we assume that importing firms partly use invoicing currency strategies to hedge against exchange rate risk. According to Levi (2005), firms have six main options for hedging against risk, which include using the forward, futures, options and money markets, as well as choosing adequate supply sources or invoicing currencies. The first four of

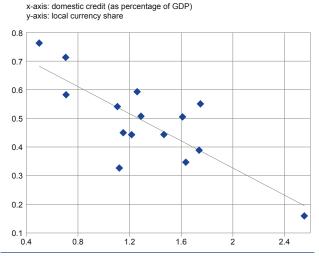
Estonia's high local-currency share in the invoicing of imports in 2013 is largely explained by Estonia's high share of imports from Latvia and Lithuania. Both countries were at the time expected to join the euro area and thus predominantly used the euro as invoicing currency for trades with Estonia.

these options are based on using financial instruments, which may be costly or even simply inexistent for some illiquid currency pairs. Supply sourcing might not be possible for some firms in some sectors which rely on highly differentiated goods. The choice of invoicing currency is, conversely, a low-cost, transparent and easy way to hedge for firms. A firm can reduce its overall exposure to foreign exchange risk by matching the currency of its cost structure with that of its revenue sources. Using invoicing currency choice as a hedge depends on firm-level micro factors, such as bargaining power with suppliers/customers, the degree of product differentiation and exposure to international trade, as well as on macro factors, in particular relative hedging costs through financial instruments, exchange rate volatility and invoicing practices in the industry at large.

At the aggregate level, it is possible to use proxies for these factors in the form of different macro indicators. We hence rely on two measures. First, we use the ratio of domestic credit provided by the financial sector to GDP (a standard measure of an economy's financial market development), as a proxy for hedging costs through financial instruments. This variable captures the extent to which invoicing currency choice may be used as a hedge against foreign exchange risk if adequate financial instruments are either too costly or simply inexistent. Second, we make use of the degree of intra-euro area export linkages, measured as the share of intra-euro area exports in total exports, as an indicator of firms' need for foreign exchange hedging. Since balancing costs and revenues in the same currency is a cost-efficient way to hedge against exchange rate risk, euro area economies which predominantly rely on intra-euro area exports, and whose revenues are hence mainly denominated in euro, can be expected to be more likely to invoice extra-euro area imports in euro.

Chart 22 and Chart 23 show the strong correlation between cross-country differences in long-run ERPT and domestic credit to GDP, as well as intra-euro area export

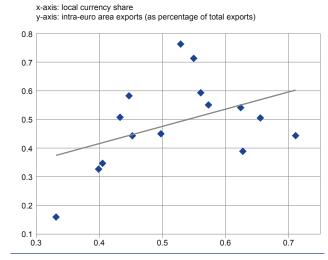
Chart 22Share of local currency invoicing vs domestic credit to GDP



Source: Gräb and Lafarguette (2015).

Notes: The figure shows a simple OLS regression of the estimated share of local currency invoicing on the ratio of domestic credit to GDP (share of intra-euro area exports in total exports). All variables are averaged over time.

Chart 23Share of local currency invoicing vs degree of intra-euro area export linkages



Source: Gräb and Lafarguette (2015). Notes: The figure shows a simple OLS regression of the estimated share of local currency invoicing on the ratio of domestic credit to GDP (share of intra-euro area exports in total exports). All variables are averaged over time. linkages, respectively. Countries with less developed capital markets tend to invoice a larger share of their extra-euro area imports in euro. Similarly, euro area economies invoice a larger share of their extra euro area imports in euro if they export mainly to other euro area countries.

Two-stage least square regression estimates are reported in column (4) of Table 2. The specification test statistics (the J-test for over-identifying restrictions and the Kleibergen-Paap test for under-identifying restrictions) suggest that the instruments are both valid and relevant. Comparing the first-stage F statistics with the Stock-Yogo statistics suggests that the hypothesis suggesting that the endogenous regressor is weakly identified can be rejected. The estimates suggest a causal – and economically significant – link between invoicing currency choice and ERPT. Specifically, the IV estimates in column (4) point to an elasticity of around 0.7, suggesting that an increase in the share of the euro as an invoicing currency (as a percentage of total imports) by 10 percentage points would lead to a decline in ERPT to import prices of some 7 percentage points.

5 Conclusion

This special feature has related the use of the euro as an invoicing currency for extra-euro area imports to differences in long-run ERPT across euro area member countries. It has uncovered strong evidence that euro area countries which predominantly rely on intra-euro area exports and which have limited access to alternative and lower-cost financial instruments are more likely to invoice extra-euro area imports in euro. This pattern, in turn, tends to reduce the degree of exchange rate pass-through. Overall, these findings suggest that importing firms partly choose invoicing currencies as hedges against foreign exchange rate risk.

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