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Abstract

This paper estimates export and import price equations for 40 countries – including 19 emerging market economies (EMEs) – and aims to understand heterogeneity across countries in the degree of exchange rate pass-through to import and to export prices. Results indicate that (i) the elasticities of trade prices are sizeable in EMEs, and higher on average than in advanced economies for export prices; (ii) such elasticities are primarily influenced by macroeconomic factors; (iii) export and import price elasticities tend to be strongly correlated across countries; (iv) lower exchange rate pass-through in the United States, compared to other advanced economies, can be related to the geographical distribution of U.S. imports, more heavily concentrated in countries with high elasticity of export prices. Overall, these results yield an enhanced understanding of exchange rate pass-through, emphasizing the role of external factors.

Keywords: emerging market economies; exchange rate pass-through; terms of trade.

JEL: F10, F30, F41.

Résumé

Ce papier présente des équations modélisant le prix des exportations et des importations pour un groupe de 40 pays incluant 19 marchés émergents, et cherche à analyser la forte hétérogénéité qui ressort de la comparaison entre pays. Les résultats indiquent que (i) les élasticités du prix des exportations et des importations aux variations du taux de change sont élevées dans les pays émergents, et supérieures en moyenne à celles des pays avancés pour les exportations ; (ii) ces élasticités semblent influencées principalement par des facteurs macroéconomiques ; (iii) les élasticités des exportations et des importations sont corrélées entre elles ; (iv) la faible réaction du prix des importations américaines aux variations du change, comparativement à d'autres pays avancés, peut être reliée à la distribution géographique des importations US, plus fortement concentrées dans les pays dont l'élasticité du prix des exportations est plus élevée. Ces résultats apportent un éclairage complémentaire sur la question du « pass-through » du taux de change, qui souligne l'importance des facteurs externes.

Mots clés: marchés émergents; taux de change; "pass-through"; termes de l'échange.

JEL: F10, F30, F41.

1. Introduction

In contrast to the rather extensive literature on advanced economies, relatively little is known about the factors affecting trade prices in emerging market economies (EMEs). These countries, however, play an increasing role in world trade: to take an example, the share of emerging markets and developing countries in U.S. imports has roughly doubled in the past twenty years, from 28% in 1990 to 55% in 2011. More in particular, estimating the exchange rate elasticity of export and import prices in EMEs is highly relevant for at least three reasons.

First, the reaction of trade prices to exchange rate changes determines the potential role of the exchange rate in the adjustment of current account (im)balances. Indeed, the exchange rate elasticity of trade prices affects the reaction of trade volumes and, therefore, the response of the trade balance to a change in the exchange rate through the expenditure switching effect –see e.g. Engel (2002), Obstfeld (2004), or Obstfeld and Rogoff (2004). Although this mechanism has been extensively studied on the import side, the factors affecting export prices are generally less well understood, empirically. Second, the exchange rate elasticity of export prices in emerging economies is an important parameter when it comes to explaining pass-through in advanced economies, especially given the rising share of emerging markets in world trade. In particular, it has been argued that the decline in pass-through among advanced countries could stem from a rise in pricing-to-market among several emerging markets, especially in the Asian countries hit by the 1998 financial crisis (Marazzi et al. 2005, Vigfusson et al., 2007). To check this hypothesis, one needs to estimate the exchange rate elasticities of export prices for a broad set of emerging markets and relate them to the import price elasticity of selected advanced countries. Third, taking this time a domestic perspective for the emerging market economies, a precise estimate of the exchange rate elasticity of export and import prices is essential. Indeed, the net trade contribution to output growth in EMEs crucially depends on the ability of emerging market exporters to adjust prices when their exchange rate fluctuates. In addition, the degree of pass-through is also a key parameter for monetary policy in these countries, as noted for instance in Devereux, Lane and Xu (2006).

Against this background, this paper investigates the determinants of trade prices –on the export and on the import side– in emerging markets. The analysis proceeds in two steps. First, the exchange rate elasticities of import and export prices are estimated, country by country. The empirical analysis focuses on a set of 40 countries, of which 19 emerging markets (10 in Asia, 5 in Latin America, 4 in European, Middle Eastern or African countries). This analysis relies on results from a standard estimation framework that is very similar to Yang (1997), Marazzi et al. (2005), Campa and Goldberg (2005), Campa and González-Mínguez (2005), or Gopinath et al. (2010), among others. In addition, the robustness of the results is also cross-checked with alternative specifications and estimators, particularly GMM models. In the second step, the factors that may explain the cross-sectional heterogeneity in the trade price elasticities are analysed. Specifically, we investigate the role of

macroeconomic factors (such as inflation and exchange rate volatility) and microeconomic factors (such as the composition of trade flows), to potentially explain cross-country differences.[1]

The paper contributes to the existing academic literature and to the policy debate in the following way. First, this paper analyses export and import price equations for a broad range of emerging markets. While a few papers have estimated equations for import prices in EMEs (Frankel et al., 2005, Barhoumi, 2006, Ca'Zorzi et al. 2007, Choudhri and Hakura, 2006), to our knowledge, no paper has done it also for export prices with the exception of Vigfusson et al. (2007), who have estimated rolling regressions for export prices among Asian Newly Industrialised economies (taken as an aggregate) and among some developed economies. The present paper extends the analysis presented in Vigfusson et al. (2007) by considering a much broader range of emerging market economies; more importantly, the present paper also investigates the factors behind cross-country differences in the elasticity of export prices. It is indeed important to know what factors account for the degree of exchange rate pass-through to export prices across countries, which we can do thanks to a large dataset that we have assembled for this project. In addition, we show that there is value added in relating the results of the export and import price equations, which are found to be strongly correlated across countries: the countries with a high elasticity on the export side also have a high elasticity on the import side. This noticeable stylised fact has never been mentioned in the previous literature.

Moreover, the cross-sectional analysis of the factors affecting trade price elasticities contributes to the debate started by Campa and Goldberg (2005) on whether pass-through is a "macro" or a "micro" phenomenon, i.e. whether the degree of pass-through is mostly related to macroeconomic variables such as the inflationary environment (as advocated by Taylor, 2000) or to microeconomic variables such as the sectoral composition of imports (as advocated by Campa and Goldberg, 2005). It is important to distinguish between macro- and micro-economic factors as they yield different policy implications. In particular, the fact that pass-through is related to "macro" variables that are directly associated with monetary policy –such as inflation volatility– implies that a given decline in pass-through, as observed over the past decade in the U.S., may not necessarily be a permanent phenomenon: it is endogenous to monetary policy. Turning to micro variables, the role of product differentiation is actually ambiguous as two different effects may cancel out: on the one hand, more differentiated goods may be characterised by higher market power and therefore higher pass-through (which is consistent with Yang, 1997, and Bacchetta and van Wincoop, 2005); on the other hand, more differentiated products may be characterised by higher markups, hence higher scope to adjust export prices and therefore lower pass-through (consistent with the finding of Campa and Goldberg, 2005, that pass-through is higher for commodities than for manufacturing goods). To this aim, the analysis

[1] The growing importance of China in international trade has attracted a lot of attention recently. Noticeably, Bergin and Feenstra (2007) argue that the fall in exchange rate pass-through in the U.S. can be largely attributed to the increasing import penetration of China through two effects: a direct effect, which comes from the renminbi's peg to the dollar, and an indirect effect, which comes from the fact that foreign exporters (e.g. Mexico) need to compete with Chinese goods in the U.S. market. Our analysis is consistent with the Bergin-Feenstra effect.

introduces in particular newly computed proxies for the level of product differentiation, using the sectoral breakdown of trade flows for each country from CEPII's CHELEM database.

As export and import prices are related through an identity,[2] modelling export prices sheds a complementary light on the issue of pass-through to import prices. Indeed, as the existing literature focuses primarily on import prices in developed economies, it tends to put greater emphasis on domestic factors in these countries. Typically, existing papers relate the elasticity of import prices to fundamental variables in the importing countries (e.g., Taylor, 2000, explains the decrease in pass-through in the U.S. by a fall in inflation in the U.S.). The present analysis offers a complementary explanation by highlighting the role of factors originating in the exporting countries, and extending the scope of the analysis to EMEs. By showing that the elasticity of export prices is related to fundamental variables in the exporting countries, we highlight the role of foreign factors.

The results indicate that (i) the elasticity of trade prices is sizeable in emerging markets, and on average higher than in advanced economies on the export side; (ii) such elasticity is primarily influenced by macroeconomic factors, such as the exchange rate regime and the inflationary environment; (iii) export and import price elasticities tend to be strongly correlated with each other across countries; (iv) low pass-through in the United States (compared to other advanced economies) can be related to the composition of U.S. imports, which is heavily concentrated in countries with high elasticity of export prices.

The rest of the paper is organised as follows. Section 2 explains the empirical approach and its theoretical underpinnings. The main results are presented in Section 3, which also provides robustness tests for alternative specifications and estimators, and some further interpretation of the results. Section 4 concludes and presents possible policy implications. Finally, the data sources and result tables are presented in the Appendix.

2. Empirical Framework and Data

2.1. Estimating the Exchange Rate Elasticity of Export and Import Prices

Model Specification

Our analysis of the effect of a change in the price of an imported good with respect to changes in the exchange rate, the pass-through elasticity, is based on the pricing behavior of an exporting firm that produces goods for sale in *n* destination markets (see, e.g. Gagnon and Knetter, 1995, Feenstra, Gagnon and Knetter, 1996). It is well-known that the first order conditions of the firm's maximization

[2] If we consider for simplicity two trading partners, import prices of country A are nothing else than export prices of country B times the bilateral exchange rate. First differencing this equality trivially yields that the elasticity of A's import prices with respect to the exchange rate is equal to one minus the elasticity of B's export prices with respect to the exchange rate. This is explained for example in Marazzi et al. (2005) and in Bussiere (2012).

problem imply that the optimal price - expressed in units of the buyers' currency - is set as a destination-specific markup over marginal cost:

$$P_i^M = E_{ij} W_j [\eta_i/(\eta_i - 1)],\ i = 1, \dots, n \quad (1)$$

where P_i^M is the import price, E_{ij} is the exchange rate measured as buyer's currency per unit of the exporter's currency, W_j denotes the marginal cost of the exporter in its own currency and η_i is the elasticity of demand in the foreign market with respect to price changes, which depends on both prices of competing varieties and demand conditions in the importing country.

A change in the exchange rate *vis-à-vis* the currency of country *i* may affect the price charged to market *i* by affecting either the marginal cost (through changes in quantity or input prices) or the elasticity of import demand. This latter effect is destination-specific. Although both the effects on marginal costs and demand's elasticity determine pass-through, the notion of pricing-to-market refers to the second effect only.

A first-order log-linear approximation of equation (1) yields the following equation for import prices:

$$ln\,(P_i^M) = \mu_i + \beta_i ln\big(E_{ij} W_j\big) + (1 - \beta_i) ln(\bar{P}_i) + \varphi_i ln(Y_i) \quad (2)$$

where μ_i is an intercept term that differs across destination markets, $\bar{P}_i$ is a price measure of competing varieties in each market and Y_i reflects demand conditions in destination markets. Differences in β_i reflect the responsiveness of markup to variations in marginal cost and competitors' prices in each market, measured in units of the importer's currency. For plausible shapes of the demand schedule, β_i is expected to be between 0 and 1. When $\beta_i > 0$ the exporter adjusts the markup to partially offset the effect of exchange rate fluctuations on the price measured in the importer's currency. In the extreme case where β_i equals one, the export price moves one for one with the exchange rate to completely offset any effect of the exchange rate on price in the importer's currency.

Note that prices expressed in terms of the exporter's currency can be obtained by simply dividing import prices by the bilateral exchange rate, $P_j^X = P_i^M / E_{ij}$. As a result, the pricing equation (2) can be expressed in the exporter's currency by trivially subtracting the logarithm of the exchange rate to both side of the equation:

$$\ln\,(P_j^X) = \mu_j + \beta_j ln\big(W_j\big) + \big(1 - \beta_j\big) ln\left(\frac{\bar{P}_i}{E_{ij}}\right) + \varphi_j ln\left(\frac{Y_i}{E_{ij}}\right) \quad (3)$$

Data and estimation

The first stage of our analysis consists in estimating short-run and long-run exchange rate elasticities of export and import prices for a sample of 40 countries over the sample period 1990Q1-2011Q2. In order to obtain comparable elasticities across countries, we first rewrite equations (2) and (3) in real terms by dividing all nominal variables by the producer price index in the importer (P_i) and in the

exporter country (P_j), respectively[3]. Let $p_i^M = \ln(P_i^M/P_i)$, $reer_{ij} = \ln(E_{ij}P_j/P_i)$, $\bar{p}_i^M = \ln(\bar{P}_i/P_i)$, $y_i = \ln(Y_i/P_i)$, $p_j^X = \ln(P_j^X/P_j)$, $reer_{ji} = \ln(P_i/E_{ij}P_j)$, $\bar{p}_j = \ln(\bar{P}_j/P_j)$ and $y_{ij} = \ln(Y_i/E_{ij}P_j)$, then after rearranging terms and differencing we obtain the two following specifications:

$$\Delta p_{it}^M = \alpha_i + \sum_{\tau=0}^{4} \beta_i \, \Delta(reer_{ij})_{t-\tau} + \gamma_i \Delta \bar{p}_{it} + \varphi_i \Delta y_{it} + u_t \quad (4)$$

$$\Delta p_{jt}^X = \mu_j + \sum_{\tau=0}^{4} \beta_j \, \Delta(reer_{ji})_{t-\tau} + \gamma_j \Delta \bar{p}_{jt} + \varphi_j \Delta y_{ijt} + v_t \quad (5)$$

The estimation of equations (4) and (5) would require bilateral trade prices across our 40 countries. Such data is not available at a quarterly frequency and not for all countries in the sample. Due to this limitation, in this paper we estimate multilateral relationships. Thus, the dependent variables in equations (4) and (5) correspond to the aggregate import and export prices, whereas the real exchange rate on the right-hand side is a measure of a country's currency against a weighted average of its trading partners. Note that in the empirical specifications, we include various lags of the exchange rate with the aim of capturing the fact that pass-through does not happen immediately but rather takes place over more than one quarter[4]. The optimal number of lags is chosen using the AIC and BIC information criteria. Finally, equations (4) and (5) are estimated in first differences, because the underlying series are found to be at most integrated of order one I(1) and, in most cases, no co-integrating relationship can be found between the variables in the model[5].

Turning to the construction of the dataset, the variables p_{it}^M and p_{jt}^X are measured by import and export price deflators available (data sources are summarized in Table A7). The real effective exchange rate (*reer*) has been constructed by deflating the nominal effective exchange rate (a measure of the value of a currency against a weighted average of the trading partners) by the producer price index. The prices of competing goods $\bar{p}_{it}$ and $\bar{p}_{jt}$ are measured by the consumer price index obtained from national sources. The demand shifter in the import price equation is measured by the national real GDP whereas in the export price equation the demand condition in importing countries y_{ijt} is approximated by the real world GDP. As for the country sample, we considered 19 emerging economies including 10 Asian countries, 5 Latin American countries, 4 European countries, Middle Eastern or African countries. Our country list also includes a group of 21 advanced economies. The reason for including these countries was twofold: first, because we need a control group to compare our EMEs with and second, because we want to know whether the increasing share of EMEs in world trade had an impact

[3] Because p_i^M is a function that is homogenous of degree 1 in all its arguments, all variables in equation (2) can be deflated by a common price.

[4] In this case the long-run effect is computed by summing all lagged coefficients.

[5] We cannot reject the hypothesis that the logarithms of the real import and export prices together with the (log) real effective exchange rate contain a unit root. Based on the augmented Dickey-Fuller test where a deterministic time trend is included in the test equation, we can reject the hypothesis of nonstationarity of log real import and export prices only for three countries in our sample and only for two countries when we test for nonstationarity of the log real effective exchange rate. We also carried out further tests to check whether the variables in our model are cointegrated. The Johansen test for cointegration strongly accepts the null hypothesis of no cointegration and rejects the null hypothesis that there are two or fewer cointegrating equations for almost all countries in the sample.

on pass-through in advanced economies. For this reason, we included all G7 countries, given their importance in the world economy; this group of course includes the three largest euro area countries and the UK. We also included large commodity exporters (Australia, New Zealand and Norway), two non-euro area EU countries (Denmark and Sweden), as well as Switzerland. Overall, our country sample covers around 82% of world trade. The list of countries included in the analysis is presented in Table 1.

Table 1: Sample of countries

Advanced economies	Emerging economies
Australia	Argentina
Canada	Brazil
Czech Republic	Chile
Denmark	China
France	Hong Kong
Germany	India
Hungary	Indonesia
Italy	Israel
Japan	Malaysia
Netherlands	Mexico
New Zealand	Philippines
Norway	Russia
Poland	Singapore
Portugal	South Africa
Slovakia	South Korea
Slovenia	Taiwan
Spain	Thailand
Sweden	Turkey
Switzerland	Venezuela
UK	
USA	

Finally, for some emerging countries the specification also includes a dummy variable for country-specific currency crises. The dummy variable is equal to 1 when the depreciation of the nominal effective exchange rate exceeds two standard deviations quarter on quarter growth rate, and zero otherwise. Moreover, a dummy variable is created to account for the global financial crisis, such that a dummy variable equals to 1 in 2008Q2-2009Q4. Finally, we also excluded hyperinflation episodes. The main reason for excluding these observations is that we focus here on pass-through in "normal" times and are not primarily interested in what happens *during* crises and/or hyperinflation episodes. Readers interested in these specific events may refer to Ito and Sato (2008), Burstein Eichenbaum and Rebelo (2005, 2007) and to Cook and Devereux (2006) – see also Bussière (2012) for a more general discussion of non-linearities in the degree of pass-through. Finally, the error terms in equations (4) and (5), u_t and v_t can exhibit some heteroskedasticity or autocorrelation, and therefore, all models are estimated using heteroskedasticity and autocorrelation consistent (HAC) standard errors.

2.2. Understanding the Cross-Country Heterogeneity in Exchange Rate Elasticities

A natural question that arises from the previous analysis is what explains the cross-country export and import price elasticities. The existing literature relates these elasticities to structural factors, which are usually classified as either "micro" or "macro" in nature, following Campa and Goldberg (2005).[6]

Starting with the macroeconomic variables, the inflationary regime is likely to influence the degree of pass-through to trade prices. This hypothesis was put forward by Taylor (2000), and tested by Gagnon and Ihrig (2004) for consumer prices in advanced economies, and by Frankel et al. (2005) for emerging markets. Indeed, according to Taylor, the decrease in pass-through observed in the U.S. and in other developed economies was caused by lower perceived persistence of cost changes, suggesting that the decline in pass-through was directly caused by a fall in inflation (to the extent that inflation is positively correlated with inflation persistence). Moreover, as noted in Corsetti, Dedola and Leduc (2007), a more stable inflation environment reduces the incentive of producers to price discriminate across countries (implying lower pass-through). This argument is also consistent with Devereux, Engel and Storgaard (2004), who developed a model of endogenous exchange rate pass-through within an open economy macroeconomic framework and showed that countries with relatively low money growth volatility will have relatively low rates of pass-through (to the extent that these countries will also have lower inflation volatility). To empirically analyze this hypothesis, the standard deviation of domestic PPI inflation is calculated for each country and used as independent variable in the cross-sectional regression.[7] One can expect high domestic inflation volatility to be associated with higher pass-through to import prices (foreign exporters are more likely to choose producer currency pricing, implying higher pass-through). Symmetrically, we expect higher domestic inflation volatility to be associated with higher export price elasticity.[8]

A second key macroeconomic variable is the exchange rate regime. A more stable exchange rate regime in the importing country is indeed likely to induce foreign exporters to adjust prices by a greater extent to exchange rate changes, hence to decrease pass-through to import prices. We should therefore expect a positive relation between exchange rate volatility and exchange rate pass-through. Taking this time the perspective of the exporting country, more volatility at home (in the exporting country) should also be associated with higher elasticity of export prices. The standard deviation of exchange rate changes is then computed for each country as a proxy for volatility. Overall, one can

[6] These two broad sets of factors correspond to two different strands of the literature that attempted to explain the stability of import prices in local currency: the first one focusing on the pricing strategy of monopolistic firms and the second one on nominal rigidities. Corsetti, Dedola and Leduc (2007) present a model that reconciles these two approaches.

[7] We also used the average *level* of inflation, with very similar results (countries with high inflation levels also tend to have high inflation volatility). The list of explanatory variables could be easily extended to monetary aggregates and/or interest rates. To the extent that higher inflation is likely correlated with the growth rate of monetary aggregates and loose monetary policy, similar results can be expected (see Gagnon and Ihrig, 2001, for an analysis along these lines).

[8] To take an example, the assumption is that trade between two countries, one with high inflation volatility and the other one with low volatility, will be priced in the currency of the latter.

expect higher exchange rate volatility to be associated with higher trade price elasticities, both on the export and on the import sides. [9]

Turning to the microeconomic variables, openness (measured as imports to GDP ratio) and relative size (the share of exports to world exports) directly follow from the Dornbusch (1987) model. According to this model, higher import penetration should be associated with higher pass-through to import prices. On the export side, a higher share in world exports would give more market power to the exporting firms of a given country, implying a smaller elasticity of export prices.

Similarly, the degree of product differentiation is a key variable in the microeconomic literature on pass-through (Yang, 1997). Although this variable is not directly observed, it can be proxied with the share of high-tech goods in total trade (on the export and on the import side), based on the assumption that high-tech goods are more subject to product differentiation (low-tech goods, such as primary products, usually have a single world price). The net effect of a higher share of high-tech goods in total imports on pass-through to import prices is ambiguous as two mechanisms take place at the same time. On the one hand, more differentiated goods may be characterized by higher market power, and therefore higher pass-through (which is consistent with Yang, 1997, and Bacchetta and van Wincoop, 2005). On the other hand, more differentiated products may be characterized by higher markups, hence higher scope for pricing-to-market and therefore lower pass-through (consistent with the finding of Campa and Goldberg, 2005, that pass-through is higher for commodities than for manufacturing goods). Accordingly, both effects can also be expected on the export side. To be explicit, the more exporting firms price in their own currency, the lower the exchange rate elasticity is likely to be in equation (1), on the export side, and the higher it is likely to be in equation (2), on the import side.

One important macroeconomic variable that could be added in the second stage is the degree of competition faced by the exporter in the importing country. Partly, such factors are captured by two of our variables, the market share and the degree of product differentiation, as argued in Bacchetta and van Wincoop (2005). Ideally, one would like to have one measure capturing the degree of competition in each of our 40 countries, but to our knowledge there is no such measure. Taylor (2000) refers to an interesting attempt to collect such data for the United States (Bresnahan, 1989), but reports that the data series have been discontinued.

The micro variables for the cross-sectional analysis of the trade price elasticities are obtained from the IMF World Economic Outlook database (the share of imports to GDP, and the share of exports in world's exports) and CEPII's CHELEM database (the share of high technology imports to total imports, and the share of high technology exports to total exports).[10] The average values of the independent variables over the sample period are used in the analysis. A few stylised facts can help gauge the importance of the explanatory variables. Starting with the macro variables, emerging market

[9] Devereux and Engle (2002) explore the conditions that are necessary to generate high exchange rate volatility, referring to earlier work by Krugman (1989) and Betts and Devereux (1996).
[10] This breakdown is available on CEPII's website:
http://www.cepii.fr/francgraph/ bdd/chelem/cominter/4techno.htm.

economies are characterised by higher macroeconomic volatility. They have in particular higher inflation rates (7.7% on average against 2.7% for the advanced economies), their inflation volatility is two times higher than for the advanced economies (standard deviation of 10.7% vs. 5.3%) and their exchange rate volatility nearly 2 times higher (standard deviation 18.0% vs. 9.9%). These averages hide, however, significant heterogeneity among each group. For example, average inflation is negative for Japan but nearly 3% for Italy; it is much higher for Latin American than for Asian EMEs, etc. For the micro variables, by contrast, there is no clear difference between EMEs and advanced economies: the share of high-tech goods is about the same for advanced economies (16%) and EMEs (18%). This, again, hides important differences within each group. In particular, the low high-tech content of New Zealand, Australia, Canada and Norway, which export a lot of commodities, drives down the average of the advanced economies. Conversely, the large high-tech content of South Korea, Singapore, or Malaysia drives up the EME average.

To investigate the issue empirically, the elasticities estimated earlier are regressed on the above variables, using both bivariate and multivariate estimation[11]. Specifically, the following specifications were estimated:

$$\hat{\beta}^{i}_{LR} = \varphi_1 \, ER_i + \varphi_2 \, \Pi_i + \varphi_3 \overline{\left(\frac{X_i}{X_w} \right)} + \varphi_4 \overline{\left(\frac{X_{ht}}{X_i} \right)} + u_i \tag{6}$$

$$\hat{\beta}^{\prime i}_{LR} = \varphi'_1 \, ER_i + \varphi'_2 \, \Pi_i + \varphi'_3 \overline{\left(\frac{M_i}{GDP_i} \right)} + \varphi'_4 \overline{\left(\frac{M_{ht}}{M_i} \right)} + v_i \tag{7}$$

The dependent variables in equations (6) and (7) are the estimated (long-run) elasticity of export and import prices, obtained from the first stage estimations of the models. The explanatory variables are defined as follows:

- ER_i refers to the country-specific volatility of the exchange rate. For this, we use the standard deviation of the nominal effective exchange rate by country;
- Π_i refers to the country-specific volatility of domestic PPI inflation. For this, we use both the average percent change and the standard deviation of variable PPI by country;
- $\overline{\left(\frac{X_i}{X_w} \right)}$ is the average share of country i's exports of world exports by country;
- $\overline{\left(\frac{M_i}{GDP_i} \right)}$ is the average share of imports to GDP by country;
- $\overline{\left(\frac{X_{ht}}{X_i} \right)}$ is the average share of high technology exports of total exports by country;

[11] A bivariate regression between exchange rate and inflation volatility across countries yields a coefficient of 0.35, significant at the 5% level, and an R-squared of 60%.

- $\overline{\left(\frac{M_{ht}}{M_i}\right)}$ is the share of high technology imports of total imports.

3. Estimation Results

3.1 Exchange Rate Elasticities by Country

This section summarizes the main results of the estimation of the exchange rate elasticities for import and export prices. The estimated long-run exchange rate elasticities are presented in Figures 1 and 2 below, and the corresponding tables with the full results in the Appendix (Tables A1-A3). Overall, the estimation results show that the coefficients of the key variables are statistically significant, with expected signs and magnitudes for most countries.

Starting with import prices, significant heterogeneity can be noted across countries regarding the magnitude of the exchange rate impact –coefficient β_0 in equation (4). While there is no space to review all countries individually here, some results seem particularly noteworthy (see Figure 1 below and Table A1 in the Appendix).

Figure 1: Estimated exchange rate elasticity of import prices

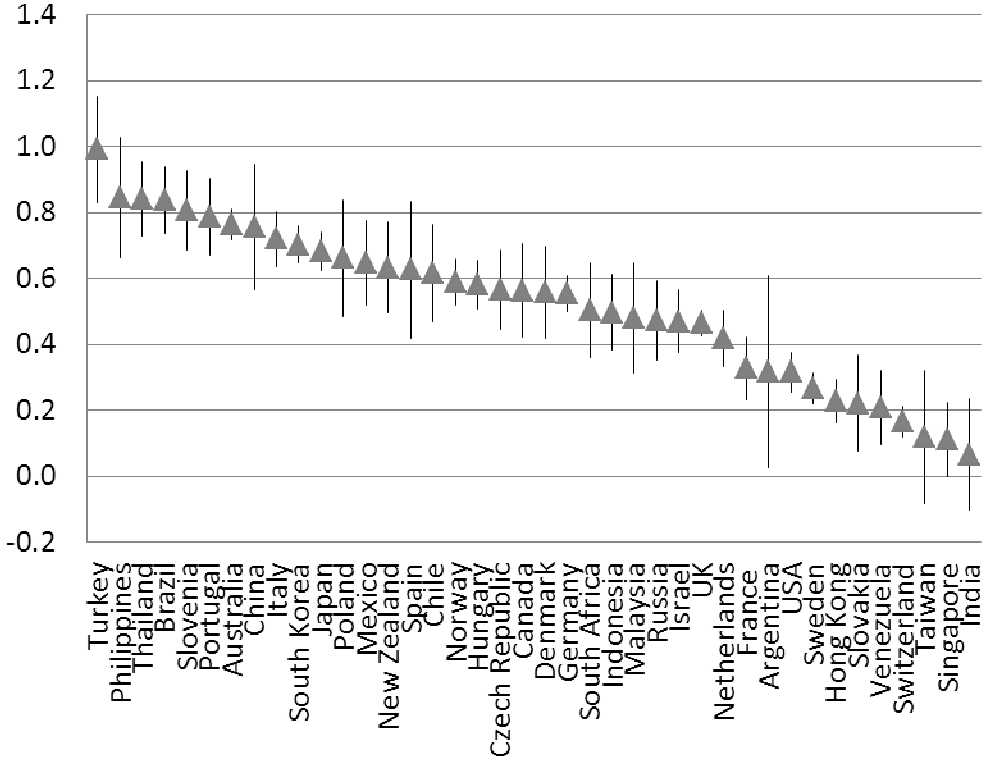
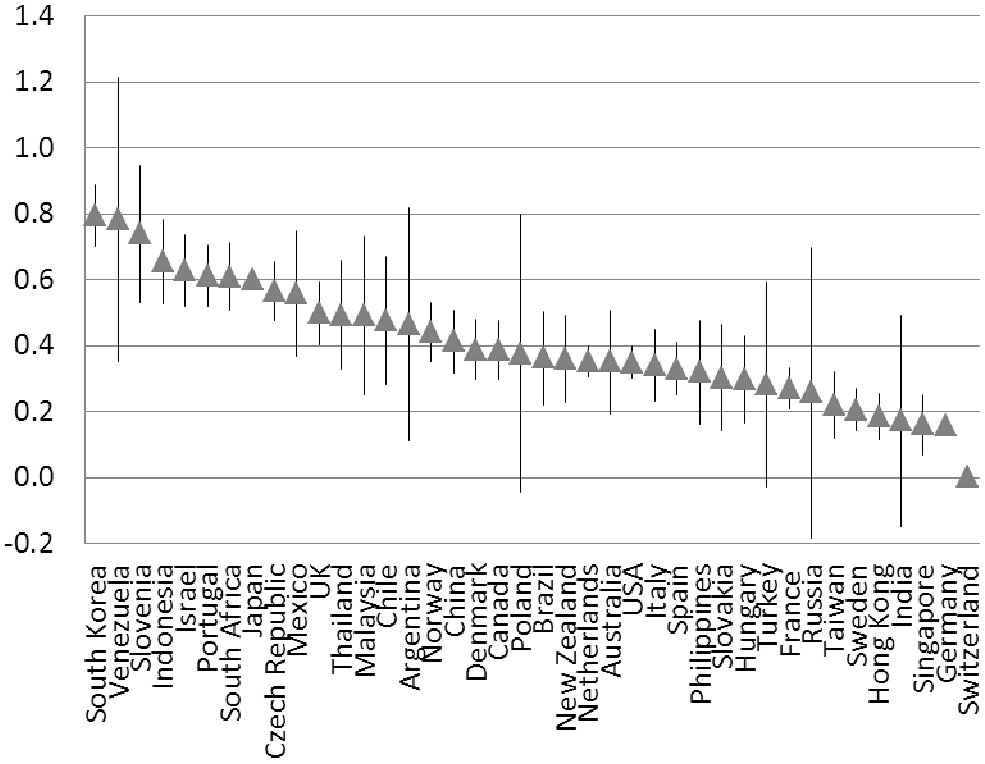


Figure 2: Estimated exchange rate elasticity of export prices



Notes to Figures 1 and 2: import and export prices are denominated in local currencies; long-run point estimates and 95% confidence intervals correspond to the absolute values of β_i and β_j in equations (4) and (5), respectively (see full results in the Table Appendix).

The long-run exchange rate elasticity is estimated to be high for several EMEs such as Turkey, Philippines, Thailand, Brazil and China (around 80-100%), or low for instance for India, Singapore, Taiwan and Venezuela (below 20%). However, pass-through is also estimated to be high for several advanced economies. This is particularly the case for Slovenia, Portugal, Australia, Italy, Japan, Poland, New Zealand, and Spain, where our estimate indicates a pass-through coefficient above 60%. In contrast, we estimate a low pass-through (around 30% or lower) for Switzerland, Slovakia, Sweden and the U.S.

Our results are broadly in line with existing studies for the advanced economies. For the U.S., our long-run elasticity is estimated to be around 32%. This result is consistent with the moderate response of U.S. import prices following the dollar depreciation between 2002 and the end of 2007. It is also broadly in line with Ihrig et al. (2006), who find an estimate of 32%, and Corsetti, Dedola and Leduc (2007) at 27% under the main assumption (when prices are kept unchanged on average for 4.3 months), while Marazzi et al. (2005)'s estimate is even lower, at 20%. For Japan, we estimate the long-run coefficient at nearly 70%, slightly above Bussière (2012) who reports a coefficient at 63% in the linear specification. It is actually common to find a high coefficient for Japan – for instance, Wickremasinghe and Silvapulle (2004) find a pass-through coefficient close to unity. Meanwhile, for Italy our long-run coefficient reaches 72%, exactly equal to Bussière (2012), and somewhat above

Warmedinger (2004). For the U.K., we find a long-term effect of nearly 47%, in line with that of Campa and Goldberg (2005), equal to 46%, and Bussière (2012), at 48%. Our results are significantly below those of Warmedinger (2004) for France (33% against 73%) but close enough for Germany (55% against 48%). Thus, similarly with existing studies, we estimate the import price pass-through in the U.S. to be lower than in most other G7 economies.

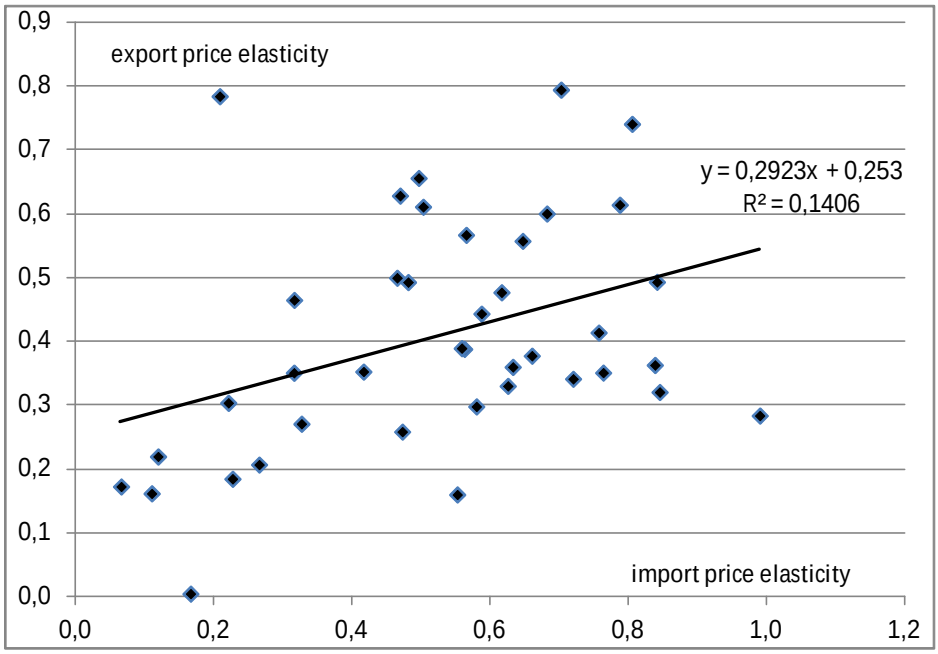
Regarding the export prices, the long-run elasticity is estimated to be high for EMEs, particularly South Korea, Venezuela, Indonesia, and South Africa (60-80%). In contrast, the exchange rate elasticity is estimated to be relatively low for Singapore, India, Hong Kong and Taiwan (below 20%). For the advanced economies, we estimate high exchange rate elasticities for Slovenia, Israel, Portugal and Japan (60-74%). The group of advanced countries with the lowest estimated exchange rate elasticity for export prices are Switzerland, Germany, and Sweden (less than 20%), while the elasticity is also estimated to be rather low in France, Hungary and Slovakia (20-30%). Comparing our findings with the existing literature, we note that our long-run estimates are slightly higher than those of Marazzi et al. (2005). For instance, for the United States, we estimate an elasticity of 35% vs. 12%, for Germany (16% vs. 3%), the U.K. (50% vs. 33%), and for Japan (60% vs. 47%).

Beyond the estimates for individual countries, two key observations can be made. The first observation relates to the comparison between the group of advanced countries and the group of emerging market economies. Based on panel estimation method using these two groups of countries separately (Table A4 in the Appendix), one finds indeed that the elasticity of trade prices is higher for EMEs than for advanced countries, both on the export and on the import side. Regression results estimated over the two different samples reveal indeed that the long run coefficient in the export price equation is 58% for the emerging markets against 47% for the advanced economies. On the import side, the contemporaneous coefficients are somewhat closer but the difference is still noticeable (64% for the emerging markets and 59% for the advanced economies). However, while the lagged coefficient for the exchange rate variable is not statistically significant for the EMEs, it is significant for the advanced countries. This implies that the estimated long-run elasticity for advanced countries is slightly higher (around 67%) than for the EMEs. The result that pass-through is not significantly higher in EMEs than in advanced economies is noticeable given that pass-through is generally found to be higher in EMEs (see for instance Obstfeld, 2004 and Gaulier et al., 2008). However, this is in line with other empirical research: Ca'Zorzi et al. (2007) also conclude, based on a different sample and estimation technique, that pass-through is not higher in emerging markets. In the present paper, one needs to underline that this result is also partly due to the fact that the impacts of currency crises, hyperinflation periods, and the global financial crisis are controlled for in the regressions by means of dummy variables.

The second observation to draw from the results is that there is a close relation between the estimated elasticities for export and import prices, within countries. Figure 3 presents results from a simple regression of the long-run coefficients of the export price equation on those of the import price

equation: the coefficient reaches 0.29 and is significantly different from zero at the 1% confidence level. The correlation coefficient between the two estimated elasticities is 37%.

Figure 3: Estimated export and import price elasticities for each country.



Without Venezuela, Turkey and Philippines, which are clearly outliers in this regression, the correlation coefficient reaches 60% and the coefficient of the regression is 49%. A direct implication of this is that terms-of-trade changes may not be as high as commonly assumed for EMEs, as the export and import price elasticities tend to be in the same ballpark. The results presented in this paper provide a natural explanation for this finding, given that similar factors affect both export and import prices (the impact of variables like exchange rate volatility goes in the same direction for export and import prices). This is further examined in Section 3.2.

3.2 Which Factors Potentially Explain the Cross-Country Differences in Exchange Rate Elasticities?

The next question that arises from the results presented in Section 3.1 is what explains the cross-country differences in the response of export and import prices to exchange rate changes. As outlined in section 2.2, this issue can be investigated by estimating regressions as in equations (6) and (7). The estimates are presented in Table A5 in the Appendix. In the table, the first columns present the estimation results when both macro and micro covariates are included in the regressions jointly, while the subsequent columns include the macro variables one at the time. Finally, the last two columns include potential microeconomic determinants of cross-country heterogeneity in the long-run exchange rate elasticity.

Starting with the regressions where all potential covariates are jointly included, only the volatility of the exchange rate is found to be statistically significant in the export price elasticity regression. This

result can be due to the fact that there is potentially multicollinearity[12] across variables and that the number of observations is rather small.

Turning to bivariate regression results for the macroeconomic variables, we find that higher exchange rate volatility is associated with a higher elasticity of both import and export prices, and that the coefficient of the inflation level is significant at the 10% level. These findings are consistent with those of Gagnon and Ihrig (2004) and with the predictions of the model by Devereux and Engel (2001), as summarized by Campa and Goldberg (2005): "*in equilibrium, countries with low relative exchange rate variability or stable monetary policies would have their currencies chosen for transaction invoicing. The low-exchange-rate-variability countries would also be those with lower exchange rate pass-through*" (p. 679). These results also indirectly confirm Taylor's (2000) hypothesis that higher domestic inflation is associated with higher pass-through.

Regarding the microeconomic variables, the evidence is less clear than with the macroeconomic variables. As noted above, none of the microeconomic variables are statistically significant in the multivariate regression models. Moreover, in the bivariate regressions, the coefficient for the share of imports of the GDP is not statistically significant from zero. This result is at odds with the Dornbusch (1987) model. According to this model, higher import penetration should be associated with higher pass-through to import prices. Our result seems to be driven by several outliers: we estimate very high import pass-through to countries such as Turkey (99%), which openness measured using imports-to-GDP ratio is on the low side (18.3%), Brazil (elasticity 84%, openness 8%), Australia (elasticity 76%, openness 15%) and China (elasticity 76%, openness 17%). On the export side, a higher share in world exports would give more market power to the exporting firms of a given country, implying a smaller elasticity of export prices. We estimate a negative coefficient, but it is not statistically significant. One potential reason behind this is that there are noticeable outliers (in particular, Japan is a large economy with high estimated export price elasticity).

Turning now to the coefficients of the variables we use as proxies for the level of product differentiation, we estimate both coefficients for the share of high-tech exports to be negative, but do not appear to be significantly different from zero. This could reflect the fact that available proxies for product differentiation are imperfect, as they rely on relatively broad product classifications. Yet, this may also reflect the fact that two effects may offset each other in the aggregate, as explained in Section 2.2. On the one hand, goods that are characterized by higher product differentiation may be associated with higher market power and hence higher (import price) pass-through, as noted in Yang (1997). On the other hand, such goods may also be associated with higher mark ups, and hence higher opportunities to price-to-market (higher export price elasticities) and lower (import price) pass-through.

[12] The unconditional correlation of the standard deviation of NEER and of PPI is 0.58, while the unconditional correlation of the average of NEER and of PPI is -0.92.

3.3 Robustness Analysis and Interpretation

The aim of this section is to subject the main results of the paper to a set of additional tests of robustness and also interpret some results further. One potential concern with the results presented in Section 3.1 is that the estimated equation gives rise to a potential endogeneity problem. To account for this, we have re-estimated the two main equations (4) and (5) using a GMM estimator with lagged observations both in levels and first differences used as instruments. The specification of the GMM models is similar to the benchmark OLS models, where the optimal lag length for the exchange rate variables is chosen using the AIC and BIC information criteria. Qualitatively, the results obtained using the GMM models are close to those of the OLS models. [13] Thus, despite the fact that the OLS estimates tend to be biased in the presence of potential endogeneity and misspecification of the model, this suggests that the endogeneity problem may not be of first order importance in the data. The estimation results are not presented in the paper for brevity reasons, but are available from the authors upon request.

A further refinement of the analysis is to test the stability of the estimated models, focusing on the exchange rate coefficients. The results from the Elliott-Müller (2006) test of stability of estimated coefficients is presented in Table A6 in the Appendix. As can be seen from the table, overall, the models seem to be well-specified, as the null hypothesis of stable exchange rate elasticity cannot be rejected at conventional levels of statistical significance. In the case of import price elasticity, the null hypothesis is marginally rejected for Japan and Thailand, while it is rejected at the 5% level for Singapore. In the case of export price elasticity, the null hypothesis is rejected at the 1% level for the Chile, Germany and the U.S., and at the 5% for Singapore and at the 10% for Brazil and Thailand.

As noted above, the stability of the parameters is not only an issue for the emerging markets (which went through a substantial number of structural changes in the past decades) but also for the advanced economies. In particular, it has been argued that the U.S. and other advanced countries have experienced a structural fall in the degree of pass-through. Besides the domestic factors highlighted by Taylor (2000) and Campa and Goldberg (2005), one explanation for the observed fall in pass-through for advanced economies (in particular the U.S.) may be therefore related to the increasing role of EMEs in the world economy. Specifically, two effects might be at play. First, the elasticity of export prices seems to have risen in several emerging markets, which, by definition, implies a fall in pass-through in the importing countries. This is the mechanism defended by Vigfusson et al. (2007), which therefore finds some support also in our dataset. Second, there has been a rise in the market share of some emerging markets over time: for example, the U.S. now imports 10% of its total imports from Mexico, against less than 5% twenty years ago. As Mexico is characterized by a relatively high elasticity of export prices (56%), this effect also plays a role in the reduction in U.S. pass-through. This may also explain differences between the U.S. (which recorded a fall in pass-through) and the U.K. (which did not): indeed, the 10 countries with the highest estimated export price elasticities

[13] The coefficients we got for export prices (β_0)according to the two methods are positively correlated (the correlation coefficient is equal to 0.76); for import prices also, the correlation coefficient is very high, at 0.72.

account for 25% of U.S. imports but only 10% of U.K. imports. This second effect is different from the first one: it does not necessarily imply a rise in the export price elasticity of the trading partners, but rather a change in the market share of these trading partners, whereby the share of the countries with a high export price elasticity rises over time. In the context of pass-through to U.S. import prices, the case of imports from China deserves to be specifically mentioned: the market share of China in U.S. imports has doubled in the past decade (reaching nearly 20% in the late 2000s), which contributed to lower pass-through in the U.S. given the renminbi's *de facto* peg to the U.S. dollar (a larger share of U.S. imports is not exposed to exchange rate fluctuations given the peg). This mechanism is analyzed in Bergin and Feenstra (2007), who also suggest that another effect takes place, this time through third competitors (e.g. Mexican exporters), who need to compete with China in the U.S.[14]

While systematically checking for this relation for all countries in the sample is clearly beyond the scope of the paper, we illustrate this by focusing on the example of the United States, compared with other advanced economies. For the subset of our advanced countries, we can indeed compare the degree of "import price pass-through" as estimated in the paper with the weighted average of "export price pass-through" among all 39 trading partners, using as weight the bilateral shares of each of these 39 countries in the imports of each of these advanced countries. The results indicate that the weighted average of "export price pass-through" for the United States is high, at 0.44 (to be fully explicit, 0.44 is the weighted average of the long-un exchange rate elasticity of export prices reported in Table A1 using as weights the share of each country in US imports). This is higher than the average number for the group of advanced economies, which is equal to 0.35, and this is consistent with the fact that pass-through to import prices in the US is lower (0.32) than for the group of advanced countries we considered (0.53). To take another example, this number is only 0.33 for the UK, which is consistent with the fact that pass-through to UK import prices is higher, at 0.47. To conclude this discussion, low pass-through in the United States, compared to other advanced economies, can be understood more comprehensively by considering that the United States imports more from emerging market economies with high export price elasticity.

4. Conclusion

This paper has analyzed the issue of exchange rate pass-through in the global economy, focusing on the role of emerging market economies. It reported the exchange rate elasticities of export and import prices that we estimated for 19 emerging markets and compared them with those of a group of 21 advanced economies. Results indicate that the degree of exchange rate pass-through to export and import prices are broadly comparable between these two groups of countries, once currency (and global) crisis episodes are controlled for, but that they tend to be higher among EMEs on the export

[14] The effect of China on pass-through in the U.S. may also operate through another channel, as the price *level* of Chinese exports is significantly below that of other countries. For an analysis along these lines see Kamin et al. (2006), who conclude however that the overall effect of China's trade integration on prices is modest.

side. The paper provides, for the first time, a set of export price elasticities for a large number of EMEs. In addition, the results point to a strong correlation between export and import price elasticities across countries. Finally, the paper relates the estimated exchange rate elasticities to a set of structural factors and finds support for the *de facto* exchange rate regime as measured by volatility of nominal effective exchange rate and the volatility of domestic inflation. So-called "micro" variables, related to the sectoral composition of exports and imports, appear to play a more modest role; this may reflect the difficulty to find suitable measures of product differentiation, but it may also result from a theoretical ambiguity concerning the relation between pass-through and product differentiation.

The elasticities estimated in this paper represent essential parameters for the monitoring and forecasting of emerging market economies. The elasticity of export prices is an important element in the competitiveness of a given country, as the offsetting effect of changes in the profit margins directly impacts the response of trade quantities to exchange rate changes. Moreover, given the relation between the export prices of exporting countries and the import prices of advanced economies, the results presented here provide an alternative interpretation of exchange rate pass-through. In particular, low pass-through to import prices in some countries, like the U.S., may simply come from the fact that they import a lot of goods from EMEs, where the export price elasticity is estimated to be higher than in advanced economies. This explanation could complement other interpretations in the literature, such as those related to the influence of U.S. monetary policy (Taylor, 2000) and to the sectoral composition of U.S. imports (Campa and Goldberg, 2005). Turning to possible policy implications, the paper suggests that trade price elasticities may be endogenously determined by policy measures at home, but also abroad.

Finally, the high correlation, across countries, of export and import prices elasticities is another noticeable finding. This result may be explained by common factors. For example, a country that has high exchange rate volatility is likely to price its exports in foreign currency; similarly, foreign exporters to this country are more likely to price their exports in their currency, resulting in higher pass-through to import prices. When the elasticity of import prices is high, so is the elasticity of export prices. One consequence is that, *ceteris paribus*, emerging markets may be more insulated from terms-of-trade shocks than commonly assumed: either the import price elasticity is low, and the country is not much affected by exchange rate changes in domestic currency terms, or it is high, and it will be compensated by high export price elasticity (having said that, other effects may still take place: a terms-of-trade shock can still have a large effect on the profitability of an economy's exporters and thus on its trade balance and national income, for instance).

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TABLE APPENDIX

Table A1: Estimates of long-run exchange rate elasticities, sample period 1990Q1-2011Q2 (OLS)

	Import price		Export price	
Country	Long-run exchange rate elasticity	Standard Error	Long-run exchange rate elasticity	Standard Error
Argentina	0.317	0.292	0.464	0.353
Australia	0.764	0.046	0.350	0.156
Brazil	0.839	0.101	0.362	0.143
Canada	0.563	0.143	0.387	0.089
Chile	0.617	0.147	0.476	0.195
China	0.758	0.190	0.413	0.096
Czech Republic	0.566	0.121	0.566	0.090
Denmark	0.559	0.139	0.389	0.090
France	0.327	0.094	0.270	0.062
Germany	0.553	0.054	0.159	0.027
Hong Kong	0.228	0.068	0.184	0.069
Hungary	0.581	0.075	0.297	0.131
India	0.066	0.168	0.172	0.321
Indonesia	0.497	0.115	0.655	0.130
Israel	0.470	0.096	0.627	0.110
Italy	0.721	0.084	0.341	0.108
Japan	0.683	0.057	0.599	0.026
Malaysia	0.482	0.167	0.492	0.240
Mexico	0.648	0.127	0.557	0.190
Netherlands	0.417	0.085	0.352	0.048
New Zealand	0.633	0.138	0.359	0.132
Norway	0.588	0.069	0.443	0.089
Philippines	0.846	0.182	0.320	0.158
Poland	0.661	0.175	0.377	0.422
Portugal	0.788	0.117	0.613	0.094
Russia	0.473	0.120	0.258	0.440
Singapore	0.110	0.113	0.161	0.092
Slovakia	0.221	0.146	0.303	0.160
Slovenia	0.806	0.120	0.740	0.208
South Africa	0.503	0.144	0.610	0.104
South Korea	0.703	0.055	0.793	0.093
Spain	0.626	0.206	0.329	0.079
Sweden	0.266	0.047	0.206	0.063
Switzerland	0.167	0.047	0.004	0.028
Taiwan	0.120	0.202	0.219	0.102
Thailand	0.842	0.113	0.492	0.165
Turkey	0.991	0.161	0.283	0.309
UK	0.466	0.039	0.499	0.096
USA	0.316	0.060	0.350	0.049
Venezuela	0.209	0.112	0.783	0.432

Table A2: Cross-country estimates of import price equation, sample period 1990Q1-2011Q2 (OLS)

Country	α		β0		β1		β2		β3		β4		β5		β6		γ^i		φ^i		crisis		global crisis		N
Argentina	-0.0306	(-1.01)	0.317	(1.09)													-0.365	(-0.87)	1.045	(0.81)			0.0199	(1.00)	27
Australia	-0.00244	(-1.50)	0.626***	(18.99)	0.138***	(4.14)											-0.0750	(-0.74)	0.0237	(0.15)	0.00560	(0.62)	0.00524	(1.18)	84
Brazil	0.000254	(0.09)	1.032***	(22.88)	-0.0647	(-1.67)	-0.0712	(-1.60)	-0.0567	(-1.64)							-0.228*	(-1.72)	-0.231	(-1.04)			0.00137	(0.11)	65
Canada	-0.00688***	(-3.61)	0.559***	(7.40)	0.0113	(0.19)	0.104*	(1.86)	0.0314	(0.43)	-0.142***	(-2.74)					0.0245	(0.28)	0.562***	(2.75)	0.0265***	(3.17)	0.00958*	(1.80)	77
Chile	-0.00874	(-1.57)	0.617***	(4.21)													0.0564	(0.41)	0.246	(0.85)	0.0109	(0.42)	-0.00614	(-0.50)	57
China	0.00145	(0.21)	0.0553	(0.56)	0.389***	(3.86)	0.270***	(3.52)	0.0820	(1.06)	0.278***	(2.88)	-0.179*	(-1.75)	-0.137**	(-2.32)	0.724***	(4.43)	-0.0171	(-0.06)			-0.00906	(-1.15)	61
Czech Republic	-0.00598**	(-2.20)	0.583***	(8.61)	-0.0255	(-0.43)	0.133**	(2.22)	-0.125*	(-1.72)							0.358**	(2.26)	0.359*	(1.68)			0.00432	(0.79)	65
Denmark	-0.00280	(-1.60)	0.246***	(2.81)	0.314***	(2.71)											0.284**	(2.38)	0.150	(1.43)	-0.00845***	(-2.40)	-0.00141	(-0.33)	81
France	-0.00550***	(-3.69)	0.182***	(2.93)	0.0198	(0.32)	0.126**	(2.05)									0.129	(1.49)	0.531**	(2.54)	0.00386*	(1.93)	0.00597**	(2.00)	73
Germany	-0.00171*	(-1.80)	0.553***	(10.19)													-0.156	(-1.36)	0.260	(1.63)	-0.00421	(-1.03)	-0.00127	(-0.21)	81
Hong Kong	-0.00407***	(-3.02)	0.228***	(3.37)													0.484***	(3.51)	0.131*	(1.91)			0.00587	(1.34)	73
Hungary	-0.00572**	(-2.14)	0.581***	(7.74)													-0.0283	(-0.41)	0.295	(1.11)	0.00379	(0.35)	-0.000790	(-0.15)	65
India	0.0132	(0.83)	0.0663	(0.39)													0.0455	(0.12)	-0.633	(-0.88)	-0.0208	(-0.73)	-0.00114	(-0.07)	48
Indonesia	0.00108	(0.08)	0.497***	(4.32)													0.0746	(0.34)	-0.413	(-0.47)			0.0122	(0.64)	44
Israel	-0.00479	(-1.48)	0.470***	(4.89)													0.392**	(2.23)	0.120	(0.50)	0.0263***	(3.43)	-0.00450	(-0.57)	65
Italy	-0.0000298	(-0.02)	0.539***	(9.29)	0.101	(1.49)	0.0812	(1.43)									-0.0720	(-0.47)	0.343	(1.64)	-0.00935***	(-2.69)	-0.00100	(-0.22)	73
Japan	0.00282	(1.29)	0.683***	(11.90)													-2.417***	(-8.61)	0.490**	(2.03)	-0.0240***	(-3.71)	0.000907	(0.14)	69
Malaysia	-0.00730**	(-2.17)	0.482***	(2.89)													0.755***	(4.34)	0.284*	(1.68)	0.0643***	(2.66)	-0.00635	(-0.66)	85
Mexico	-0.00376*	(-1.89)	0.768***	(8.24)	-0.0147	(-0.23)	-0.106*	(-1.74)									-0.321	(-1.30)	-0.420***	(-3.66)	0.0649***	(7.01)	-0.00566	(-0.72)	61
Netherlands	-0.00599***	(-4.36)	0.389***	(5.56)	0.0280	(0.46)											0.273**	(2.12)	0.521***	(3.11)	-0.00981	(-1.44)	0.00514	(1.01)	84
New Zealand	-0.00608*	(-1.93)	0.445***	(4.61)	0.0619	(0.69)	0.127	(1.62)									-0.505*	(-1.86)	0.390*	(1.82)	0.0213	(1.19)	-0.00682	(-0.58)	70
Norway	-0.00376**	(-2.05)	0.588***	(8.52)													0.384***	(5.93)	-0.139	(-1.10)	0.00355	(0.37)	0.0000270	(0.01)	85
Philippines	0.0162	(1.54)	0.846***	(4.65)													1.018***	(3.52)	-1.193	(-1.44)	-0.0104	(-0.37)	-0.0452**	(-2.27)	72
Poland	0.00167	(0.25)	0.661***	(3.78)													0.679**	(2.48)	0.210	(0.42)	-0.0124	(-0.54)	-0.00635	(-1.04)	56
Portugal	-0.000704	(-0.43)	0.788***	(6.74)													-0.00115	(-0.01)	-0.000326	(-0.00)			-0.00906**	(-2.34)	65
Russia	0.00135	(0.20)	0.473***	(3.95)													0.580***	(3.07)	-0.928*	(-1.88)			0.00183	(0.14)	41
Singapore	-0.00427***	(-3.58)	0.110	(0.98)													0.839***	(9.19)	0.0129	(0.27)	0.00617*	(1.68)	-0.0109***	(-3.78)	69
Slovakia	-0.000897	(-0.25)	0.221	(1.52)													0.701**	(2.40)	-0.0880	(-0.60)	-0.00143	(-0.14)	-0.00437	(-0.50)	65
Slovenia	-0.000895	(-0.43)	0.806***	(6.71)													-0.110	(-0.50)	-0.101	(-0.85)	0.00545	(0.37)	-0.000567	(-0.11)	65
South Africa	0.00176	(0.28)	0.449***	(4.56)	0.166*	(2.01)	-0.112*	(-2.01)									-0.0552	(-0.12)	0.178	(0.25)	0.00144	(0.07)			47
South Korea	-0.00199	(-0.63)	0.703***	(12.75)													-1.624***	(-8.21)	0.633***	(3.81)	-0.0254*	(-1.95)	-0.000971	(-0.10)	85
Spain	-0.00855	(-1.58)	0.633***	(4.66)	-0.167	(-1.00)	0.198*	(1.75)	-0.205	(-1.63)	0.167	(1.38)					0.0862	(0.60)	0.883	(1.54)			0.0110	(1.34)	59
Sweden	-0.000180	(-0.19)	0.204***	(5.65)	0.0620**	(2.41)											-0.155	(-1.28)	0.0226	(0.26)	-0.0205***	(-4.20)	0.000388	(0.23)	73
Switzerland	-0.00354*	(-1.83)	0.167***	(3.53)													0.0356	(0.14)	0.593***	(3.12)	0.00284	(0.97)	-0.00150	(-0.38)	85
Taiwan	-0.000652	(-0.36)	0.237**	(2.54)	0.00981	(0.12)	-0.136	(-1.62)	-0.128	(-1.42)	0.137*	(1.97)					-0.150*	(-1.75)	0.288***	(3.43)	0.00921	(1.41)	0.000922	(0.22)	77
Thailand	0.00505	(1.48)	0.842***	(7.48)													-0.0131	(-0.08)	-0.280*	(-1.91)	0.0113	(0.77)	-0.00311	(-0.39)	73
Turkey	0.00226	(0.42)	0.991***	(6.17)													-0.457**	(-2.35)	0.174	(0.87)	-0.0162	(-0.84)	0.000545	(0.04)	61
UK	-0.00204	(-1.43)	0.466***	(12.08)													-0.572***	(-3.62)	0.106	(0.72)	-0.00206	(-0.45)	0.000540	(0.22)	85
USA	-0.00454**	(-2.41)	0.316***	(5.24)													-0.272***	(-5.45)	0.312*	(1.73)			0.00559	(1.49)	73
Venezuela	-0.00376	(-1.20)	0.118	(1.29)	0.0916	(1.35)											-0.0109	(-0.52)	-0.125*	(-1.97)	0.0120	(0.55)	0.0126	(0.95)	65

Notes: t statistics in parentheses. ***, **, * indicate statistical significance at 1%, 5% and 10% levels, respectively. The optimal lag length for the exchange rate variable is chosen based on the Akaike Information Criteria (AIC).

Table A3: Cross-country estimates of export price equation, sample period 1990Q1-2011Q2 (OLS)

Country	α		β0		β1		β2		β3		β4		β5	β6	γ^i		φ^i		crisis		global crisis		N
Argentina	-0.00623	(-0.28)	-0.464	(-1.32)											-0.389	(-0.49)	0.112	(0.07)			-0.00468	(-0.18)	31
Australia	-0.0174**	(-2.31)	-0.738***	(-6.87)	-0.0638	(-1.03)	0.299***	(3.02)	0.153*	(1.74)					-0.459**	(-2.04)	2.967***	(3.09)	0.00629	(0.26)	0.0406**	(2.41)	82
Brazil	-0.0151**	(-2.19)	-0.860***	(-20.30)	0.264***	(3.30)	0.0797**	(2.06)	0.0482	(1.04)	0.105**	(2.27)			-0.279*	(-1.75)	1.557**	(2.01)			0.0237	(1.19)	65
Canada	-0.00397	(-1.35)	-0.387***	(-4.36)											-0.108	(-0.79)	0.701*	(1.84)	-0.0435**1	(-2.90)	0.00581	(0.57)	77
Chile	0.0299**	(2.50)	-0.476**	(-2.43)											0.209	(0.86)	-2.731*	(-1.81)	-0.0562**1	(-3.26)	-0.0415	(-1.39)	57
China	-0.00461*	(-1.78)	-0.0128	(-0.29)	-0.0888*	(-2.01)	-0.0928**	(-2.39)	-0.0712*	(-1.70)	-0.147***	(-3.37)			0.880***	(12.05)	-0.122	(-0.42)			-0.00261	(-0.60)	61
Czech Republic	-0.00832**	(-2.65)	-0.566***	(-6.27)											0.452**	(2.45)	0.510	(1.48)			0.00707	(1.66)	64
Denmark	-0.00367*	(-1.89)	-0.389***	(-4.29)											0.309***	(3.40)	0.230	(1.02)	-0.00491*	(-1.87)	0.00172	(0.48)	65
France	-0.00504***	(-4.39)	-0.122***	(-3.43)	-0.0548	(-1.28)	-0.0929**	(-2.49)							0.554***	(9.43)	0.223*	(1.70)	0.00222	(1.57)	0.00237	(1.37)	73
Germany	-0.00206*	(-1.73)	-0.159***	(-5.92)											0.513***	(6.12)	-0.0346	(-0.23)	0.00237	(0.53)	0.000931	(0.42)	81
Hong Kong	-0.00410	(-1.66)	-0.184***	(-2.67)											0.532***	(3.56)	0.0266	(0.09)			0.00580	(1.06)	73
Hungary	-0.00170	(-0.39)	-0.297**	(-2.26)											0.0543	(0.48)	-0.526	(-1.31)	0.0359***	(3.61)	-0.0180***	(-2.99)	85
India	0.000780	(0.05)	-0.172	(-0.54)											0.711*	(1.69)	-0.660	(-0.52)	-0.000470	(-0.01)	-0.0177	(-0.72)	48
Indonesia	-0.0123	(-1.57)	-0.526***	(-6.10)	-0.129	(-1.54)									0.253**	(2.52)	0.911	(1.15)			0.0200	(1.28)	44
Israel	-0.00514	(-0.80)	-0.627***	(-5.71)											0.745***	(4.39)	0.247	(0.31)	0.00949	(1.16)	-0.00250	(-0.24)	77
Italy	0.000846	(0.55)	-0.142	(-1.62)	-0.0564	(-1.01)	-0.142***	(-2.66)							0.604***	(6.67)	-0.237	(-1.45)	-0.000278	(-0.07)	-0.00381*	(-1.69)	73
Japan	-0.00704***	(-2.95)	-0.599***	(-22.99)											0.656***	(5.00)	0.0395	(0.14)	0.0177***	(6.30)	0.00608	(1.33)	85
Malaysia	0.00493	(0.41)	-0.492**	(-2.05)											0.335	(1.58)	-0.960	(-0.78)	0.0371*	(1.70)	-0.00644	(-0.34)	85
Mexico	0.00220	(0.58)	-0.781***	(-6.94)	-0.0105	(-0.14)	0.0838	(1.38)	0.151**	(2.29)					-0.0305	(-0.09)	-0.918**	(-2.26)	0.0149	(1.66)	-0.00625	(-0.87)	61
Netherlands	-0.00811***	(-2.77)	-0.352***	(-7.35)											0.253	(1.59)	0.753*	(1.92)	-0.00446	(-1.06)	0.00339	(0.65)	85
New Zealand	-0.00720	(-0.95)	-0.584***	(-5.76)	0.225**	(2.46)									-0.756***	(-2.86)	0.933	(1.15)	0.0388***	(3.15)	-0.0159	(-1.04)	70
Norway	-0.0120**	(-2.46)	-0.443***	(-4.95)											0.233**	(2.30)	1.395**	(2.15)	-0.0533**1	(-4.52)	0.00361	(0.48)	85
Philippines	0.00365	(0.40)	-0.320**	(-2.03)											0.670***	(2.72)	-0.595	(-0.55)	0.0644	(1.62)	-0.0212	(-0.93)	73
Poland	0.00207	(0.11)	-0.377	(-0.89)											0.0317	(0.04)	-0.215	(-0.15)	0.0274	(0.54)	-0.00692	(-0.26)	65
Portugal	-0.00386	(-1.61)	-0.613***	(-6.55)											0.427***	(5.99)	0.257	(0.99)			0.00144	(0.30)	65
Russia	-0.00228	(-0.10)	-0.258	(-0.59)											-0.519	(-1.05)	-0.425	(-0.19)			0.00586	(0.20)	41
Singapore	-0.00434**	(-2.43)	-0.214**	(-2.44)	0.0525**	(2.02)									0.777***	(10.42)	0.0616	(0.31)	-0.00685	(-1.57)	-0.0111***	(-3.25)	69
Slovakia	-0.00166	(-0.22)	-0.303*	(-1.90)											0.536	(1.27)	-0.0902	(-0.11)	-0.0305**1	(-3.33)	-0.00422	(-0.39)	65
Slovenia	-0.00256	(-0.62)	-0.362***	(-2.81)	-0.102	(-0.78)	0.0227	(0.16)	-0.0846	(-0.72)	-0.214**	(-2.02)			0.478***	(2.98)	-0.195	(-0.42)	0.0105***	(2.91)	0.00303	(0.60)	61
South Africa	-0.00437	(-0.46)	-0.610***	(-5.84)											-0.224	(-0.63)	0.767	(0.50)	-0.00138	(-0.07)			59
South Korea	0.00173	(0.31)	-0.793***	(-8.49)											-0.883***	(-3.79)	-1.241*	(-1.98)	-0.00850	(-0.51)	-0.0135*	(-1.70)	85
Spain	-0.00378**	(-2.51)	-0.329***	(-4.16)											0.537***	(6.25)	0.357**	(2.52)			-0.000530	(-0.25)	59
Sweden	-0.00369	(-1.63)	-0.206***	(-3.29)											0.201**	(2.02)	0.124	(0.45)	0.00839	(0.73)	0.00351	(0.57)	85
Switzerland	-0.000328	(-0.40)	0.0439**	(2.07)	-0.00874	(-0.47)	-0.0394*	(-1.84)							0.246***	(3.41)	-0.136	(-1.35)	0.00233	(1.52)	0.000804	(0.44)	71
Taiwan	-0.00718*	(-1.87)	-0.219**	(-2.15)											0.365***	(3.82)	0.332	(0.79)	0.0534***	(9.95)	-0.000217	(-0.02)	77
Thailand	-0.00307	(-0.34)	-0.492***	(-2.98)											0.325*	(1.78)	0.268	(0.30)	0.0116	(0.35)	0.00980	(0.70)	85
Turkey	-0.0119	(-1.49)	-0.608***	(-7.75)	0.0692	(0.81)	0.249**	(2.62)	-0.130	(-1.22)	0.137	(1.54)			-0.825***	(-4.54)	0.866	(1.20)	0.0361***	(3.15)	0.0175	(1.16)	61
UK	0.00175	(0.63)	-0.315***	(-5.47)	-0.184*	(-1.93)									-0.839***	(-3.70)	-0.280	(-0.95)	-0.0153**	(-2.25)	-0.00203	(-0.31)	84
USA	-0.00343**	(-2.41)	-0.168***	(-4.47)	-0.120***	(-3.13)	-0.0628*	(-1.88)							0.671***	(18.23)	0.218	(1.37)			-0.000196	(-0.08)	73
Venezuela	-0.0236	(-0.34)	-0.783*	(-1.81)											-0.0530	(-0.44)	8.004	(1.05)	-0.268**	(-2.19)	0.0348	(0.27)	65

Notes: t statistics in parentheses. ***, **, * indicate statistical significance at 1%, 5% and 10% levels, respectively. The optimal lag length for the exchange rate variable is chosen based on the Akaike Information Criteria (AIC).

Table A4: Panel estimates, sample period 1990Q1-2011Q2 (fixed effects)

Import price equation

	All countries	Advanced economies	Emerging countries
α	-0.000840	-0.00196***	-0.000252
	(-1.65)	(-3.96)	(-0.28)
β0	0.632***	0.593***	0.642***
	(6.59)	(9.64)	(4.59)
β1	0.0382**	0.0823***	0.0158
	(2.07)	(5.10)	(0.66)
γi	0.105	0.0976	0.105
	(1.39)	(0.81)	(1.12)
φi	-0.0387	0.137	-0.1000*
	(-0.83)	(1.66)	(-1.75)
crisis	-0.00823	-0.00697	-0.00826
	(-1.31)	(-1.62)	(-0.68)
global crisis	-0.00129	-0.000712	0.0000717
	(-0.66)	(-0.60)	(0.02)
N	2701	1528	1173

Export price equation

	All countries	Advanced economies	Emerging countries
α	-0.00438**	-0.00494**	-0.00456
	(-2.17)	(-2.43)	(-1.32)
β0	-0.543***	-0.473***	-0.581***
	(-8.56)	(-7.67)	(-6.78)
β1	0.0222	0.00845	0.0253
	(0.54)	(0.32)	(0.41)
γi	0.0722	0.163*	0.0412
	(0.79)	(2.05)	(0.35)
φi	0.410	0.435	0.487
	(1.37)	(1.54)	(0.89)
crisis	-0.0108	-0.000939	-0.0213
	(-0.86)	(-0.16)	(-0.80)
global crisis	0.00237	0.00303	0.00170
	(0.86)	(1.02)	(0.37)
N	2764	1552	1212

Notes: t statistics in parentheses. ***, **, * indicate statistical significance at 1%, 5% and 10% levels, respectively. Advanced economies consist of Australia, Canada, Czech Republic, Denmark, France, Germany, Hungary, Italy, Japan, the Netherlands, New Zealand, Norway, Poland, Portugal, Slovakia, Slovenia, Spain, Sweden, Switzerland, the UK, and the USA. Emerging economies consist of Argentina, Brazil, Chile, China, Hong Kong SAR, India, Indonesia, Israel, Malaysia, Mexico, Philippines, Russia, Singapore, South Africa, South Korea, Taiwan ROC. Thailand, Turkey and Venezuela.

Table A5: Potential determinants of exchange rate elasticities, sample period 1990Q1-2011Q2 (OLS)

Import price equation

		Bivariate regressions				
PPI inflation (average)	0.80	0.82*				
	(0.81)	(1.72)				
PPI inflation volatility	-0.69		0.46			
	(-0.61)		(0.60)			
Exchange rate volatility	0.24			0.74*		
	(0.79)			(1.72)		
Imports to GDP	-0.22				-0.32	
	(-0.84)				(-1.66)	
Share of high-tech imports	0.08					-0.51
	(0.11)					(-0.90)
Constant	0.55***	0.48***	0.49***	0.42***	0.63***	0.62***
	(3.91)	(10.48)	(6.87)	(6.11)	(9.44)	(5.58)
N	40	40	40	40	40	40

Export price equation

		Bivariate regressions				
PPI inflation (average)	-0.02	0.33				
	(-0.02)	(0.87)				
PPI inflation volatility	-0.84		0.31			
	(-0.86)		(0.52)			
Exchange rate volatility	1.07**			0.84**		
	(2.08)			(2.64)		
Share of world exports	-0.54				-1.06	
	(-0.46)				(-0.91)	
Share of high-tech exports	-0.09					-0.23
	(-0.39)					(-1.15)
Constant	0.35***	0.39***	0.38***	0.29***	0.43***	0.45***
	(4.37)	(0.87)	(6.88)	(5.64)	(11.40)	(10.00)
N	40	40	40	40	40	40

Notes: t statistics in parentheses. ***, **, * indicate statistical significance at 1%, 5% and 10% levels, respectively.

Table A6: Test of stability of estimated exchange rate elasticities

Country	Import price elasticity	Export price elasticity
Argentina	-15.70	-14.17
Australia	-14.26	-16.94
Brazil	-13.11	-18.91*
Canada	-11.12	-12.86
Chile	-13.47	-26.91***
China	-16.16	-14.46
Czech Republic	-13.74	-8.43
Denmark	-13.10	-9.93
France	-12.83	-14.92
Germany	-15.40	-25.40***
Hong Kong	-13.73	-15.36
Hungary	-12.51	-6.36
India	-14.42	-13.70
Indonesia	-10.71	-12.79
Israel	-5.31	-12.10
Italy	-6.76	-6.67
Japan	-18.10*	-11.91
Malaysia	-10.82	-7.17
Mexico	-10.77	-5.76
Netherlands	-17.85	-8.27
New Zealand	-8.75	-10.66
Norway	-12.67	-15.86
Philippines	-5.99	-13.44
Poland	-8.09	-6.26
Portugal	-10.62	-8.04
Russia	-14.50	-7.36
Singapore	-20.02**	-22.52**
Slovakia	-13.03	-13.46
Slovenia	-9.54	-14.81
South Africa	-7.65	-6.95
South Korea	-10.92	-13.29
Spain	-12.91	-13.30
Sweden	-10.42	-11.97
Switzerland	-17.14	-10.24
Taiwan	-14.10	-19.31*
Thailand	-18.67*	-11.01
Turkey	-14.46	-9.18
UK	-9.58	-10.11
USA	-11.19	-27.73***
Venezuela	-13.50	-11.88

***, **, * indicate rejection of null hypothesis of stable exchange rate elasticity coefficients at 1%, 5% and 10% significance levels, respectively. See Elliott, G. and Müller, U.K., 2006. Efficient Tests for General Persistent Time Variation in Regression Coefficients. Review of Economic Studies, Vol. 73, pp. 907-940.

Table A7: Data description

Country	import prices	export prices	CPI	Real GDP	PPI	sample	
Argentina	IFS	IFS	IFS	National Statistics	IFS	2003q1	2011q2
Australia	IFS	IFS	IFS	National Statistics	IFS	1990q1	2011q2
Brazil	National Statistics	National Statistics	IFS	Oxford Economics	IFS	1995q1	2011q2
Canada	IFS	IFS	IFS	National Statistics	IFS	1992q1	2011q2
Chile	Global Insight	Global Insight	IFS	Global Insight	IFS	1996q1	2011q2
China	Global Insight	Global Insight	OECD Economic Outlook	Oxford Economics	Oxford Economics	1996q1	2011q2
Czech Republic	IFS	IFS	IFS	Global Insight	IFS	1995q1	2011q2
Denmark	IFS	IFS	IFS	National Statistics	IFS	1991q1	2011q2
France	National Statistics	National Statistics	IFS	National Statistics	IFS	1993q1	2011q2
Germany	IFS	IFS	IFS	National Statistics	IFS	1991q1	2011q2
Hong Kong	IFS	IFS	IFS	Oxford Economics	IFS	1993q1	2011q2
Hungary	IFS	IFS	IFS	National Statistics	IFS	1993q1	2011q2
India	Global Insight	Global Insight	IFS	Oxford Economics	IFS	1999q2	2011q2
Indonesia	IFS	IFS	Global Insight	Oxford Economics	IFS	2000q2	2011q2
Israel	Global Insight	Global Insight	IFS	OECD Economic Outlook	IFS	1992q1	2011q2
Italy	IFS	IFS	IFS	National Statistics	IFS	1993q1	2011q2
Japan	IFS	IFS	IFS	National Statistics	IFS	1994q1	2011q2
Malaysia	IFS	IFS	IFS	Oxford Economics	IFS	1990q1	2011q2
Mexico	Global Insight	Global Insight	IFS	National Statistics	IFS	1996q1	2011q2
Netherlands	IFS	IFS	IFS	National Statistics	IFS	1990q1	2011q2
New Zealand	IFS	IFS	IFS	National Statistics	IFS	1993q4	2011q2
Norway	IFS	IFS	IFS	National Statistics	IFS	1990q1	2011q2
Philippines	Global Insight	Global Insight	IFS	Global Insight	IFS	1993q2	2011q2
Poland	Global Insight	Global Insight	IFS	Oxford Economics	IFS	1997q2	2011q2
Portugal	IFS	IFS	IFS	National Statistics	National Statistics	1995q1	2011q2
Russia	Global Insight	IFS	IFS	Global Insight	National Statistics	2001q1	2011q2
Singapore	Global Insight	Global Insight	IFS	National Statistics	IFS	1994q1	2011q2
Slovakia	Global Insight	Global Insight	IFS	Global Insight	IFS	1995q1	2011q2
Slovenia	Global Insight	Global Insight	IFS	National Statistics	IFS	1995q1	2011q2
South Africa	IFS	IFS	IFS	National Statistics	IFS	1990q1	2011q2
South Korea	IFS	IFS	OECD Economic Outlook	National Statistics	IFS	1990q1	2011q2
Spain	Global Insight	Global Insight	OECD Economic Outlook	National Statistics	IFS	1995q1	2011q2
Sweden	IFS	IFS	IFS	National Statistics	IFS	1993q1	2011q2
Switzerland	IFS	IFS	IFS	National Statistics	IFS	1990q1	2011q2
Taiwan	IFS	IFS	IFS	National Statistics	Oxford Economics	1992q1	2011q2
Thailand	IFS	IFS	IFS	National Statistics	IFS	1993q1	2011q2
Turkey	Global Insight	Global Insight	IFS	Global Insight	IFS	1996q1	2011q2
UK	IFS	IFS	IFS	National Statistics	IFS	1990q1	2011q2
USA	IFS	IFS	IFS	National Statistics	IFS	1993q1	2011q2
Venezuela	IFS	IFS	IFS	Global Insight	IFS	1995q1	2011q2

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