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# Exchange rate pass-through in the global economy –
# The role of emerging market economies

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Matthieu Bussière and Tuomas Peltonen: Exchange rate pass-through in the global economy - The role of emerging market economies

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Matthieu Bussière* and Tuomas Peltonen*

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## Abstract

This paper estimates export and import price equations for 41 countries –including 28 emerging market economies. Further, it relates the estimated elasticities to structural factors and tests for statistical breaks in the relation between trade prices and exchange rates. Results indicate that (i) the elasticity of trade prices in emerging markets is sizeable, but not significantly higher than in advanced economies; (ii) such elasticity is primarily influenced by macroeconomic factors such as the exchange rate regime and the inflationary environment, although microeconomic factors such as product differentiation also play a role; (iii) export and import price elasticities tend to be strongly correlated across countries; (iv) pass-through to import prices has declined in some advanced economies, noticeably the United States; this is consistent with a rise in pricing-to-market in several EMEs and especially with a change in the geographical composition of U.S. imports.

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# Exchange rate pass-through in the global economy – The role of emerging market economies

## Tiivistelmä

Tässä tutkimuksessa estimoidaan vienti- ja tuontihintayhtälöitä 41 maalle, joista 28 on kehittyviä talouksia. Tuonnin ja viennin estimoidut joustot voidaan tilastollisesti liittää talouksien rakenteellisiin tekijöihin ja myös testataan, muuttuuko ulkomaankaupan hintojen ja valuuttakurssin välinen yhteys. Tulosten mukaan ulkomaankaupan hintojen jousto kehittyvissä talouksissa on suhteellisen suuri, mutta ei merkittävästi suurempi kuin kehittyneissä talouksissa. Joustoon vaikuttavat erityisesti makrotaloudelliset tekijät, kuten valuuttakurssijärjestelmä ja inflaatio, mutta myös esimerkiksi tuotedifferentiaatiolla on merkitystä. Maittain katsottuna viennin ja tuonnin hintajoustot korreloivat keskenään selvästi. Valuuttakurssimuutosten välittyminen tuontihintoihin on heikentynyt kehittyneissä talouksissa, etenkin Yhdysvalloissa. Tämä muutos johtuu useiden kehittyvien talouksien tavasta ottaa tuotteidensa hinnoittelussa huomioon paikalliset olosuhteet sekä etenkin Yhdysvaltojen tuonnin maantieteellisen jakauman muutoksesta.

**Asiasanat:** kehittyvät taloudet, valuuttakurssimuutosten välittyminen, paikallisten olosuhteiden ottaminen huomioon hinnoittelussa, hinnoittelu paikallisen ja tuottajan valuutan määräisenä, valuuttakurssijärjestelmä

# 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 a rapidly increasing role in world trade: taken as an aggregate, emerging market economies now account for around 40% of world exports, against less than 30% in 1990. A precise estimate of the degree of exchange rate pass-through and of pricing-to-market in emerging economies is of high relevance for at least three reasons. First, the reaction of trade prices to exchange rate changes determines the potential role of exchange rate changes in the global 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. Obstfeld (2004), or Obstfeld and Rogoff (2004). Second, the degree of exchange rate pass-through and of pricing-to-market among emerging economies is an important parameter when it comes to assessing the role of EMEs in global inflation. Specifically, the rising share of emerging markets in world trade is often related to the ongoing decline in the degree of exchange rate pass-through among some advanced economies, especially the U.S. In particular, it has been argued that the decline in pass-through among advanced countries stems 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).[1] To check this hypothesis, one needs to estimate the exchange rate elasticities of export prices for a broad set of emerging markets, to investigate whether they increased over time, and to understand what factors accounted for this rise. Third, taking this time a domestic perspective for the emerging market economies, a precise estimate of the elasticity of export and import prices to the exchange rate is an essential input in the monitoring and forecasting of these countries. In turn, export price dynamics in emerging markets depend on the ability of EMEs exporters to price-to-market when their exchange rate fluctuates. Finally, the degree of pass-through is also a key parameter when it comes to monitoring and forecasting domestic inflation, thus being essential

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[1] A rise in pricing-to-market among emerging market economies means a higher elasticity of their export prices (expressed in the currency of the exporter). This also means, by definition, a lower elasticity of import prices in the destination markets, i.e., lower exchange rate pass-through in the importing countries. The fact that pass-through has genuinely declined in the U.S. is however disputed in Hellerstein et al. (2006).

for monetary policy in these countries, as noted for instance in Devereux, Lane and Xu (2006).

Against this background, this paper investigates the factors driving 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 prices and export prices are estimated, country by country. The empirical analysis focuses on a set of 41 countries, of which 28 emerging markets (9 in Asia, 5 in Latin America, 7 in Central and Eastern Europe, as well as 7 Middle Eastern and 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), or Campa and González-Mínguez (2005), among others. In addition, the results are also cross-checked with alternative specifications and estimators; in this process, a particular effort is made to test for the presence of structural breaks in the statistical relations. The evolution of the elasticities over time is characterised by means of rolling regressions and of Elliot-Müller (2006) stability tests. Second, the factors that may explain the cross-sectional heterogeneity in the trade price elasticities are analysed. The specific question that is addressed here is whether a change in the nature of the regime would significantly affect the magnitude of the response of trade prices, e.g. following the discontinuation of a pegged exchange rate. This question may be particularly relevant for China, if this country considers adopting a more flexible exchange rate arrangement.[2]

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. One recent exception is Vigfusson et al. (2007), who have estimated rolling regression 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, it also investigates the factors behind cross-country differences in the elasticity of

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[2] 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 U.S. dollar, and an indirect effect, which comes from the fact that foreign exporters

export prices (it is important to know not only to what extent the elasticity of export prices has increased in EMEs but also why it did, which we can do using our large country sample). 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 may reflect the high import content of exports for many countries, but also common explanatory factors.

Moreover, the cross-sectional analysis of the factors affecting trade price elasticities contributes to the debate started by Campa and Goldberg (2002) 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 microeconomic factors as they yield very 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 because it may dissipate if monetary policy becomes more accommodative. 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 mark-ups, 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). To this aim, the analysis 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.[3] The overall effect of EMEs' trade integration in world markets is not clear ex ante and needs to be tested. As EMEs have higher inflation than advanced economies, EME exporters may tend to price more in local curren-

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(e.g. Mexico) need to compete with Chinese goods in the U.S. market. Our analysis is fully consistent with the Bergin-Feenstra effect.

[3] The detailed breakdown of CEPII's dataset is available on CEPII's website:

cy when they export to advanced economies, implying lower pass-through in these countries. The role of exchange rate volatility varies across countries: while many EMEs have floating exchange rates arrangements, others –most prominently China– have pegged exchange rates. Finally, as explained above, the role of product differentiation is ambiguous. As EMEs generally export goods characterised by lower technological content, one may expect a downward effect on pass-through in the advanced economies that import more from EMEs; but if the second effect dominates the opposite may happen.

As export and import prices are related through an identity, 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: a fall in pass-through in a given country could be explained by a rise in inflation abroad, rather than a fall in domestic inflation.

The results indicate that (i) the elasticity of trade prices in emerging markets is sizeable, but not significantly higher than in advanced economies; our results are broadly in line with the existing literature and robust to alternative specifications and estimators, (ii) such elasticity is primarily influenced by macroeconomic factors, such as the exchange rate regime and the inflationary environment, although microeconomic factors such as product differentiation also play some role; (iii) export and import price elasticities tend to be strongly correlated with each other across countries, partly reflecting the high import content of exports; (iv) we document a decline in pass-through to import prices in some advanced economies, noticeably the U.S.; this is consistent with a rise in pricing-to-market in several EMEs and especially with a change in the geographical composition of U.S. imports.

http://www.cepii.fr/francgraph/ bdd/chelem/cominter/4techno.htm

The rest of the paper is organised as follows. Section 2 explains the empirical approach. The main results are presented in Section 3, which also provides robustness tests for alternative specifications and estimators, a detailed account of the stability of the parameters over time, and some further interpretation of the results. Section 4 concludes and presents possible policy implications. The figures and result tables are presented in Appendix A, while detailed information on the underlying data is reported in Appendix B.

# 2 Empirical framework and data

## 2.1 Estimating the exchange rate elasticity of export and import prices

### Estimation strategy

The first step of our analysis consists in estimating the exchange rate elasticities of export and import prices for each of the 41 countries in the sample, country by country (82 equations in all). We call these two elasticities "pricing-to-market" and "exchange rate pass-through", respectively. Regarding the estimation technique, we follow here a standard framework that is widely adopted in the literature, e.g., by Marazzi et al. (2005), Yang (1997), Corsetti, Dedola and Leduc (2005), Gagnon and Ihrig (2004), Gopinath, Itskhoky and Rigobon (2007), Campa and González-Mínguez (2005) or Campa and Goldberg (2005), among others. While the general approach of all these papers is very similar,[4] there are also a few differences between them regarding the specification and the list of control variables. This section therefore explains our modeling approach and compares it with other papers, focusing on the import price equation, which is more commonly estimated than the export price equation (the export price equation can be trivially derived from the import price equation). Accordingly, we estimate with ordinary least squares (OLS) the following dynamic equations for import (MP) and export prices (XP):

$$\Delta xp_t = \alpha_1 \Delta xp_{t-1} + \alpha_2 \Delta ppi_t + \alpha_3 \Delta cp_t + \alpha_4 \Delta x_t + \varepsilon_t \tag{1}$$

$$\Delta mp_t = \alpha'_1 \Delta mp_{t-1} + \alpha'_2 \Delta ppi_t + \alpha'_3 \Delta cp_t + \alpha'_4 \Delta x_t + \upsilon_t \tag{2}$$

Lower case characters in the equations denote variables in natural logarithms: CP represents competitors' prices for n trading partners, Pit, converted in domestic currency:

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[4] See also Hooper and Mann (1989) for a useful framework and a discussion of the estimation issues.

$$CP_t = \prod_{i=1}^{n}\left(E_i^t / P_i^t\right)^{\gamma_i}$$ with the exchange rate Eit defined as the number of foreign currency units for one unit of domestic currency (an increase in Eit indicates an appreciation).[5] An increase in CP therefore indicates an appreciation and is expected to be associated with a fall in export and import prices in domestic currency. PPI denotes the Producer Price Index. As mentioned in Bussière (2007), the variables included in equations (1) and (2) represent imperfect proxies for marginal costs; in particular, PPI measures only average costs. However, the results presented in Corsetti, Dedola and Leduc (2005) strongly suggest that it is crucial to include them: a "naïve" regression where import prices are simply regressed on the exchange rate and its lag leads to a strong bias, while including them significantly improves the performance of the regressions. We expect to find $\alpha_2 \geq 0$ and $\alpha_3 \leq 0$ in equation (1). Similarly, we expect to find $\alpha'_2 \geq 0$ and $\alpha'_3 \leq 0$ in equation (2).

One key issue to consider in equations (1) and (2) is that they are dynamic. We do not impose any sign restriction on the coefficient of lagged prices, $\alpha_1$ and $\alpha'_1$: while the literature usually reports positive coefficients, one occasionally finds negative results (indicating some overshooting in the short run). However, $\alpha_1$ and $\alpha'_1$ are expected to be smaller than unity in absolute value. The long-run effect, which is the main focus in many papers, can be calculated as $[\alpha_3 / (1 - \alpha_1)]$ for export prices and $[\alpha'_3 / (1 - \alpha'_1)]$ for import prices. The use of a dynamic specification is common in the literature (see e.g. Yang, 1997) and aims to capture the fact that pass-through does not happen immediately, but rather takes place over more than one quarter. Several papers have made a different modeling choice: they do not include the lagged dependent variable, but include several lags of the exchange rate and price variables (generally 4 lags with quarterly data), in which case the long-run effect is computed by summing all lagged coefficients. Both choices lead to broadly similar results, as noted for instance by Campa and González-Mínguez (2005), who used a distributed lag model as their main specification and compared the results with a partial adjustment model of order one, concluding that the results were "essentially the

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[5] The weights are the same as in the real effective exchange rate variable CP, which is best understood as a "real" exchange rate variable, given that it captures foreign currency prices converted in domestic currency. The fact that foreign prices and nominal fluctuations are constrained to have the same coefficient follows directly from the model proposed in Hooper and Mann (1989), as noted also by Barhoumi (2006). This hypothesis is generally accepted in the data and corresponds to standard practice (see e.g. Anderton, 2003, Corsetti, Dedola and Leduc, 2005). In practice, variations in CP mostly come from nominal exchange rate fluctuations (see also Bussière, 2007, for a discussion). In Section 3, we relax this assumption and include the nominal exchange rate and foreign prices in foreign currency terms separately; as we get similar estimates, we conclude that the fact that both specifications can be found in the literature is justified.

same". We therefore opted for the present specification, which is more parsimonious. We focus here on pass-through in the medium run rather than the long run: the parameters of interest for the present exercise are therefore $\alpha 3$ ("pricing-to-market") and $\alpha'3$ ("exchange rate pass-through").

Finally, variable X refers to additional explanatory variables not included in the standard model presented in Hooper and Mann (1989). In particular, they include oil prices and non-oil energy prices, which are used to account for additional sources of costs for the exporter (they are reported as "oil" and "noc", respectively in the tables) and to account for the fact that we consider total trade, including oil and non-oil primary products. One therefore expects to find $\alpha 4 \geq 0$. Unlike some of the modeling choices discussed above, this one is not innocuous: omitting commodity prices strongly affects the results of the parameters of interest, $\alpha 3$ and $\alpha'3$, for a number of countries (mostly in the export price equation for commodity exporters and in the import price equation for net commodity importers). Note that one key assumption we make here is that commodity prices and exchange rate changes are not correlated. This assumption runs noticeably against the view that the U.S. dollar and oil prices are negatively correlated. This issue is discussed in Hellerstein et al. (2006); however, it is to date still unclear whether the U.S. dollar and oil prices are systematically negatively correlated in the long run[6,] such that we stick to the standard specification and leave this issue for further research. The specifications also include dummy variables for specific events, such as currency crises and potential hyperinflation periods. The dummy variable for currency crises is equal to 1, when the nominal depreciation of the home currency exceeds two standard deviations of the nominal exchange rate (quarter on quarter) growth rate, and zero otherwise. The dummy variable for hyperinflation is equal to 1 when domestic quarterly annualized inflation exceeds 30% and zero otherwise (the choice of this threshold is based on Cagan, 1956). The main reason for controlling for these observations is that we focus on pass-through in "normal" times (before and after currency crises and outside hyperinflation periods) and are not primarily interested in what happens during crises. Readers interested in these specific events may refer to Burstein Eichenbaum and Rebelo (2005, 2007) and to Cook and Devereux (2006) – see also Bussière (2007) for a

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[6] For the countries in our sample, the correlation coefficient of the log changes of the nominal exchange rates and of oil prices is very low (-0.1) (see Table B3). Even in the case of the U.S., the two variables are not correlated and a partial regression of one on the other yields a coefficient that is not statistically significant (using the period 1990-2006).

more general discussion of non-linearities in the degree of pass-through.[7] Finally, the error terms in equations (1) and (2), $\varepsilon_t$ and $\upsilon_t$ can exhibit some heteroskedasticity or autocorrelation, and therefore, all models are estimated using heteroskedasticity and autocorrelation consistent (HAC) standard errors. As in the literature cited earlier, equations (1) and (2) are estimated in first differences in the benchmark models, 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.[8] The above framework, while widely used in the literature, is based on two assumptions: first, it assumes that the variables are not cointegrated (see de Bandt et al., 2007)[9] and second, it assumes that the right-hand side variables are exogenous.[10] To analyse these econometric issues, we also estimated error correction models (ECM) and generalized method of moments (GMM) models (see Section 3 for additional robustness tests). The estimated short-run elasticities from these models were broadly similar to the main specification, with a few country specific exceptions.[11] They also imply broadly similar results for the second stage equations, as reviewed in Section 3. Given these results, we kept the models presented in equations (1) and (2) as benchmark models, also in view of their simplicity and wide use in the literature. An additional consideration that calls for this particular framework is related to the

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[7] Sometimes demand terms are added to the standard equation (using e.g. the growth rate of domestic demand in the import price equation or a measure of the output gap). We did not add such measures because we already include domestic prices, which are likely to capture shifts in domestic demand (Bussière, 2007, presents some robustness tests along these lines for the G7 countries).

[8] To analyse the degree of integratedness of the series, we applied the method suggested by Dickey and Pantula (1987). Zivot-Andrews (1992) unit root test with an endogenous structural break with a break in the level or the trend were also used (some of our series go through a level break around the time of currency crises, but these episodes are dummied out in the estimation, where the variables are in first differences). The Dickey and Fuller (1979), Philips and Perron (1988), and Zivot and Andrews (1992) unit root test results are available upon request. De Bandt et al. (2007) suggest that the variables commonly used to estimate pass-through elasticities cointegrate; we have checked this possibility using the approach of Engle and Granger (1987), but found that, overall, it is not the case in our dataset. Note that many papers looked for cointegrating relations between the variables, but concluded that there was none, see e.g. Campa and Goldberg (2005).

[9] Note that many papers looked for a cointegrating relation between their variables, but concluded that there was none, see e.g. Campa and Goldberg (2005). One exception –aside from de Bandt et al. (2007)– is Bergin and Feenstra (2007), who operate, however, in a different context (with panel data). Bergin and Feenstra note that "This result likely reflects the fact that we are using disaggregated industry-level data rather than full national aggregate import prices, where the latter is the norm in the macro literature."

[10] Gopinath, Itskhoky and Rigobon (2007) explicitly mention that they operate "under the empirically relevant assumption that the exchange rate follows a random walk".

[11] Naturally, the long-run elasticities are estimated to be different for the countries where the relevant variables cointegrate; however, as mentioned we focus here on the short-run impact given its policy relevance.

short length of the time series available for many emerging markets (which becomes especially critical when investigating the variation over time of the elasticities).[12]

## Dataset

Turning to the construction of the dataset, the relevant information related to the country sample and time series properties of the variables is presented in the Appendix B. Starting with the country sample, the selection was subject to a trade-off between, one the one hand, choosing as many emerging market economies as possible in order to have enough observations for the cross-country analysis, and on the other hand, the issue of data availability. In the end, the group of EMEs includes 9 Asian countries, 5 Latin American countries, 7 Central and Eastern European countries, and 7 Middle Eastern countries and African countries. Our country list also includes a group of 13 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 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 75% of world trade.

The quarterly data for the analysis were obtained from three sources: Global Insight, IMF International Financial Statistics (IFS), and JP Morgan. The maximum time span of the data is Q1/1980 – Q2/2006, where available. For export (XP) and import (MP) prices, as well as domestic producer prices (PPI), the main data source is Global Insight, while missing data was replaced by IFS data. Similarly, JP Morgan RBEER series are used as primary source for real effective exchange rate (REER), which, in some cases, were replaced with the IFS data. Table B1 (in Appendix B) describes the sources of the data by variable and by country, as well as the estimation sample. In addition, a plot of the time series of export and import prices, producer prices and exchange rates is reported in Appendix B. Regarding trade price data, we combined data from different sources to ensure sufficient coverage. For Australia, Colombia, Hungary, South Korea, New Zealand, Swe-

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[12] First difference VAR models are another alternative framework (see for instance McCarthy, 2000 or Hahn, 2003), but the long-run properties are also subject to discussion (see Wolden Bache, 2007).

den, the UK and the United States, we used trade prices from the IMF IFS database, code 76 for export prices and 76.x for import prices. For Brazil, Canada, Denmark, Germany, Hong Kong, Israel, Italy, Japan, Norway, Pakistan, South Africa and Thailand we used IFS series on unit value indices, lines 74 and 75 for export and import prices, respectively. For the other countries we used data from Global Insight, which calculates trade prices as explicit deflators from the individual countries' national accounts (see Table B1). Although unit value indices are widely used in research and policy papers (see in particular Campa and González-Mínguez, 2005), they are sometimes seen as imperfect proxies for trade prices. However, for many countries they are the only source of information that we have. In addition, a comparison of unit value indices and trade prices in the countries for which both series are available suggests that differences are not that large. For example, in the case of South Korea, the correlation coefficients between the IFS series line 74 (UVX) and 76 (prices), for exports, and between IFS line 75 (UVX) and 76x (prices), for imports, reach 89% and 91%, respectively; in the case of Japan these coefficients are 88% and 93%, etc. Similarly, the price series from the IFS, and the price series from Global Insight tend to be strongly correlated for the countries for which both series are available (still taking the case of South Korea and Japan, the correlation coefficients are in the ballpark of 90% or above).[13]

## 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 (2002).[14]

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[13] We reported here examples based on Japan and South Korea because they are among the few countries for which all of the above series are available. These correlations were based on the period 1980-2007 for the IFS series and on the period 1990-2007 for the Global Insight data (these series not being available before 1990).

[14] 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.

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 volatility of money growth will have relatively low rates of exchange rate pass-through (to the extent that these countries will also have lower inflation volatility). To empirically analyze the hypothesis that pass-through is related to the inflation environment, the standard deviation of domestic PPI inflation is calculated for each country and used as independent variable in the cross-sectional regression.[15] 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.[16]

A second key macroeconomic variable is the exchange rate regime. A more stable exchange rate regime is indeed likely to induce more pricing-to-market from foreign exporters, hence to decrease pass-through to import prices. It is important to note that causality may run both ways. According to Devereux and Engle (2002), the fact that pass-through is low actually induces larger exchange rate movements ("exchange rates may be highly

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[15] 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).

[16] 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.

volatile because in a sense they have little effect on macroeconomic variables", p. 913).[17]
The standard deviation of exchange rate changes is then computed for each country and used as a proxy for the de facto exchange rate regime. An alternative is to use the de jure exchange rate, but this would lead to several issues. First, de jure classifications usually apply to a bilateral setting, which is not appropriate here as we consider multilateral trade prices. Second, what matters for the determination of trade prices is not just the announced exchange rate regime, but whether it is actually implemented. In practice, de jure regimes may not coincide with the actual regime, e.g. due to fear of floating. Based on this argument, one can therefore expect higher exchange rate volatility to be associated with higher trade price elasticities, both on the export and on the import side.[18]

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 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 for pricing-to-market and therefore lower pass-

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[17] Devereux and Engle (2002) explore the conditions that are necessary to generate this high exchange rate volatility. They refer to earlier work by Krugman (1989) and Betts and Devereux (1996) who first expressed this intuition.
[18] Another effect may come into play: in a high exchange rate volatility environment, exchange rate changes may appear to be more transitory, inducing exporters to let a larger proportion of exchange rate fluctuations pass through to import prices. This would increase the exchange rate elasticity for import prices and reduce it for export prices. However, we consider here that all exchange rate changes are permanent under the random walk assumption, such that this effect is unlikely to play a role in practice (this is in line with our empirical results).

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 41 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 CHELEM (the share of high technology imports to total imports, and the share of high technology exports to total exports). The average values of the independent variables over the sample period are used in the analysis. Descriptive statistics of the variables are displayed in Table B2 in Appendix B. A few stylised facts can help gauge the importance of the explanatory variables. Starting with the macro variables, emerging market economies are characterised by higher macroeconomic volatility. They have in particular higher inflation rates (6% on average against 2% for the advanced economies), their inflation volatility is 2.7 times higher than for the advanced economies and their exchange rate volatility nearly twice higher. 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 only slightly higher for advanced economies (18%) than for EMEs (16%). 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, due to multicollinearity issues (for instance, between inflation and exchange rate volatility)[19]. Specifically, the following specifications were estimated:

$$\hat{\alpha}_3^i = \varphi_1\, ER_i + \varphi_2\, \Pi_i + \varphi_3 \overline{\left(\frac{X_i}{X_w}\right)} + \varphi_4 \overline{\left(\frac{X_{ht}}{X_i}\right)} + u_i \tag{3}$$

$$\hat{\alpha'}_3^{'i} = \varphi'_1\, ER_i + \varphi'_2\, \Pi_i + \varphi'_3 \overline{\left(\frac{M_i}{GDP_i}\right)} + \varphi'_4 \overline{\left(\frac{M_{ht}}{M_i}\right)} + v_i \tag{4}$$

The dependent variable in equation (3) and (4) is the estimated 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 both the average percent change and the standard deviation of the nominal effective exchange rate by country[20];

- $\Pi_i$ 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;

- $\overline{\left(\dfrac{X_i}{X_w}\right)}$ is the average share of country i's exports of world exports by country;

- $\overline{\left(\dfrac{M_i}{GDP_i}\right)}$ is the average share of imports to GDP by country;

- $\overline{\left(\dfrac{X_{ht}}{X_i}\right)}$ is the average share of high technology exports of total exports by country;

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

As a final remark, one may note that most factors affect the trade price elasticities in the same way on the export and on the import side: this is the case of domestic inflation and

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[19] 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%. See also Table B3 and B4 in Appendix B for a full account of cross-correlations among our explanatory variables.

exchange rate volatility (both should be associated with higher elasticities on the export and on the import side), and economic size (large countries will have low elasticities for export and import prices alike). The high-tech composition of trade flows has a different effect, but nothing says that it should be the same on the export and on the import side. For instance, one can find many examples of emerging markets exporting low-tech goods and importing high-tech goods, in which case they will have high elasticities on both sides.

# 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, while the estimation results can be found in Tables A1 and A2 in Appendix A. Overall, the estimation results show that the coefficients of the key variables are statistically significant, with expected signs and magnitudes for most countries. On average, looking at the pooled regressions, the short-run (one quarter) exchange rate elasticity is found to be around 33% for export prices and 35% for import prices.

Figure 1    Exchange rate elasticity of export prices



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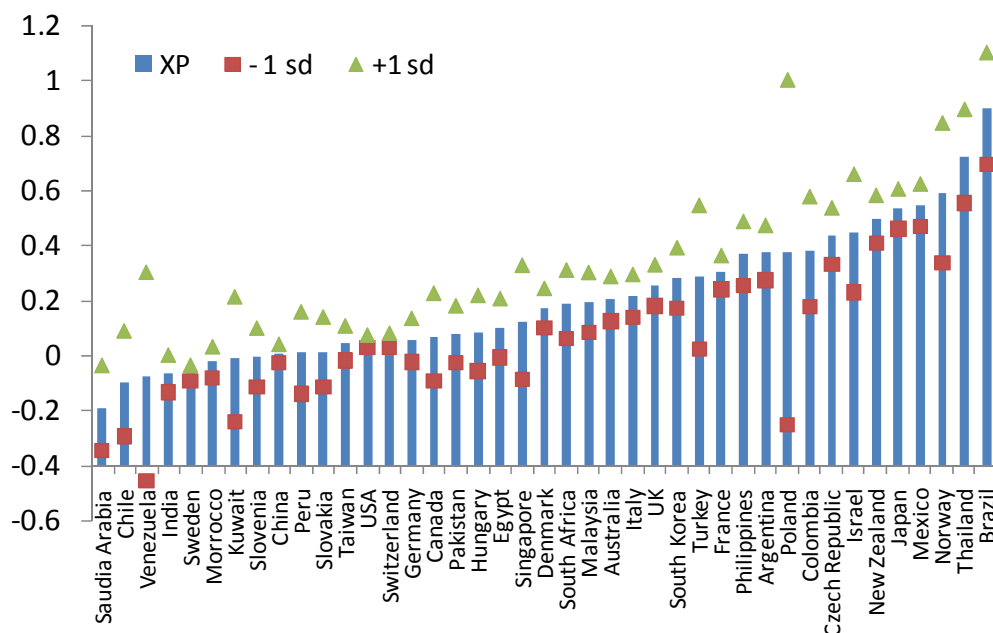
[20] We also tried replacing the nominal effective exchange rate with our CP variable with very similar results. As mentioned, CP and NEER are very strongly related (the correlation coefficient is 89%).

Figure 2          Exchange rate elasticity of import prices
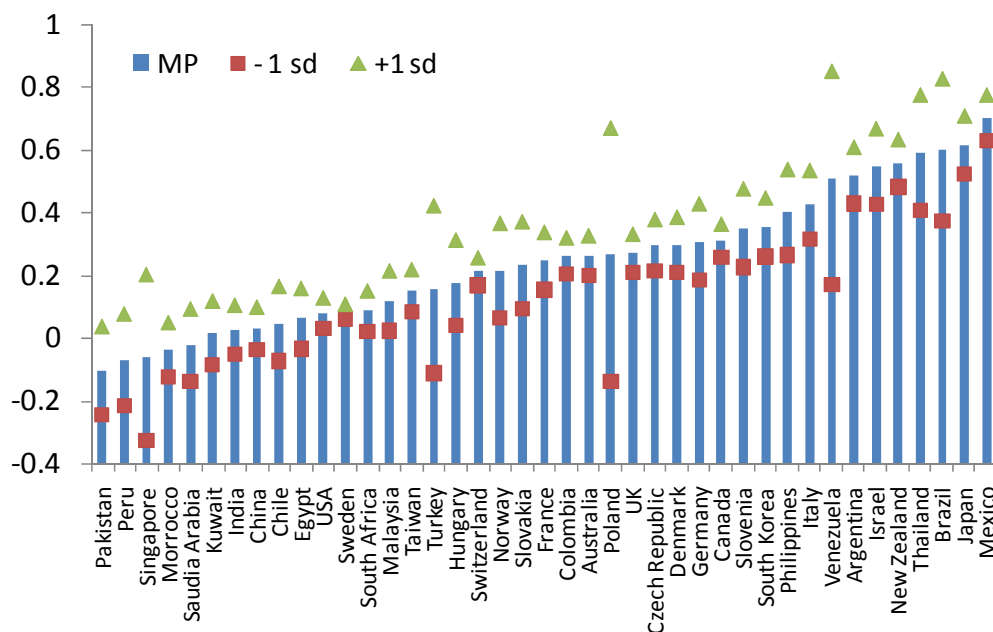


*Notes to Figures 1 and 2: import and export prices are denominated in local currencies; short-run point estimates and 95% confidence intervals correspond to the absolute values of $\alpha_3$ and $\alpha'_3$ in equations (1) and (2), respectively (see full results in Tables A1 and A2).*

Starting with export prices, significant heterogeneity can be noted across countries regarding the magnitude of the exchange rate impact –coefficient α3 in equation (1). While there is no space to review all countries individually here, some results seem particularly striking (see Figure 1). For example, China's export prices do not appear to be significantly affected by the exchange rate. This suggests that, if the renminbi appreciates, Chinese exporters may not offset the effect of the appreciation by lowering their export prices (in yuan terms), thus implying that the effect of the appreciation may be fully mapped into competitiveness developments.[21] The group of EMEs with this pattern is not restricted to China and includes India, but most of the other emerging markets where the estimated response of export prices to exchange rate changes is statistically not significant are oil exporting countries (Kuwait, Saudi Arabia and Venezuela), for which the oil price variable has a statistically significant and economically large effect. By contrast, the elasticity of export prices appears to be relatively high for many Latin American countries such as Brazil

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[21] This, of course, also depends on the nature of the exchange rate arrangement (results from the second stage suggest indeed that more flexible exchange rate regimes are associated with higher pricing-to-market). Although the renminbi was allowed some additional flexibility since 2005, there is little evidence so far of a break in the statistical relationship towards higher pricing to market.

(nearly 90%), Mexico (55%), or Colombia (38%). The export price elasticity also appears to be heterogeneous across Asian EMEs such as Malaysia (around 20%), South Korea (around 30%), the Philippines (around 40%), and Thailand (over 70%). For the advanced economies, the results are broadly in line with those of the existing literature. Our short-run estimate for the U.S. is 5%, while the long-run effect is estimated to reach roughly 10%, which is very close to the amount estimated by Marazzi et al. (12%). The long-run estimates are also comparable with those of Marazzi et al. (2005) for Germany (we find no significant impact, their estimate is almost not significant at 3%) and the U.K. (26% against 33%), while our estimate is higher for Japan (66% against 47%). These results are also consistent with the measures of invoicing presented in Bacchetta and van Wincoop (2005), showing that, among developed economies, the United States and Germany have the highest fraction of exports invoiced in their own currency and Japan the lowest. Still, some estimation results would require further analysis in the case of a few countries. In particular, results suggest that Canadian export prices would not react to exchange rate changes and entirely depend on domestic PPI, which may be driven by the statistical construction of the Canadian export prices, as noted in Vigfusson et al. (2007).

On the import side, substantial heterogeneity can also be noted (Figure 2). The short-run impact of the exchange rate appears to be high for several EMEs such as Mexico (around 70%), Thailand and Brazil (around 60%), or Argentina and Israel (slightly above 50%). However, pass-through is also high for several advanced economies. This is particularly the case for Japan, where our estimate indicates a pass-through coefficient slightly above 60% (this is both for the short and for the long run). However, one should note that Ihrig et al. (2006) find a very similar coefficient (61%) and that Campa and Goldberg (2005) find an even higher coefficient at 113%. Our results also appear to be broadly in line with existing papers for the advanced economies. For the U.S., our long-run elasticity is not significantly different from zero. This result is in line with the apparent lack of response of U.S. non-oil import prices following the dollar depreciation between 2002 and the end of 2007. We note, however, substantial heterogeneity in the literature. For example, Ihrig et al. (2006) find an estimate of 32%, while Marazzi et al. (2005)'s estimate is 20%. Also, the main estimate of Corsetti, Dedola and Leduc (2007) reaches 27% under the main assumption (when prices are kept unchanged on average for 4.3 months) but their estimate falls to 4% when their measure of price stickiness is set to 3 quarters. The main conclusion to draw from this is that pass-through in the U.S. is very likely to be lower than in

most other advanced economies. For the U.K., we find a long-term effect of nearly 40%, somewhat lower than that of Campa and Goldberg (2005), equal to 46%. For Italy, our estimate (42%) is broadly in line with Ihrig et al. (47%), somewhat below Warmedinger (2004), who finds a pass-through coefficient of 53%. Our results are significantly below those of Warmedinger (2004) for France (36% against 73%) and Germany (31% against 48%), but this again may be due to the use of different sample periods.[22]

While looking at the estimation results, two findings are noteworthy. First, the estimated elasticities are very similar, on average, between emerging markets and advanced economies, as shown through the country examples outlined above. Panel regression results estimated over two different samples (one with only emerging markets and one with only advanced economies) show indeed that the coefficient is, in absolute value, somewhat higher for the former on the export side ($\alpha 3$ equals -0.336 for the emerging markets and -0.220 for the advanced economies), whereas on the import side the coefficients are almost identical ($\alpha' 3$ equals -0.354 for the emerging markets and -0.351 for the advanced economies).[23] The result that pass-through is not significantly higher in EMEs than in advanced economies is noticeable given that pass-through is generally admitted 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 due to the fact that the impact of currency crises and hyperinflation periods is controlled for in the regressions by means of dummy variables. Without them, the import price elasticity in EMEs actually rises to 41%, which is still not substantially higher than the estimated 35% for advanced economies.

A second interesting result is the close relation between the estimated elasticities for export and import prices (see Figure 3). There are two potential explanations for this. First, exports usually have a significant import content, so that changes in import prices may also be passed-through to export prices. If this is the case, higher pass-through coefficients should also yield higher elasticities of export prices, implying a causal relationship

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[22] It is important to underline that these results are based on regressions where the euro area countries are treated independently. Results concerning the euro area as a whole (i.e., considering extra-euro area trade only) can be found for instance in Anderton (2003) and Anderton, di Mauro and Moneta (2004), and the literature reviewed therein.

from one to the other. A second explanation is that similar factors affect both export and import prices (the impact of variables like domestic inflation volatility and economic size goes in the same direction for export and import prices). A similar relationship is found for both advanced and emerging market economies. 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.

Figure 3        Estimated export and import price elasticities across countries.
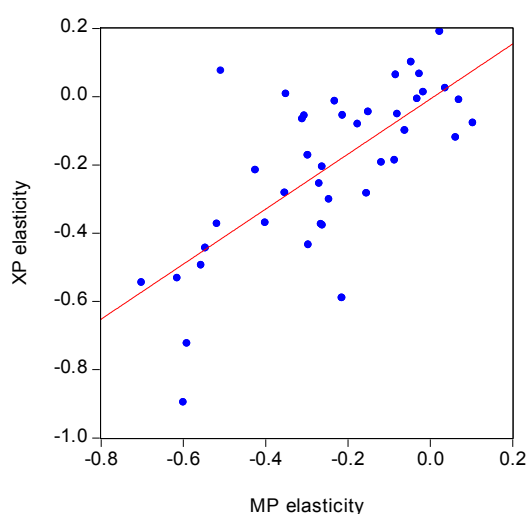


## 3.2    Which factors explain the cross-country differences in exchange rate elasticities?

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 bivariate regressions as in equations (3) and (4). The estimates are presented in Table A3 in Appendix A (panel A reports results for export prices and panel B for import prices).

The results point to a clear effect for inflation volatility and for exchange rate volatility: both enter the export price and import price regressions with a negative sign (implying higher elasticities)[24.] The bivariate regression results for the macroeconomic va-

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[23] We also looked at unweighted averages of the import and export prices elasticities in both groups and reached the same conclusion.

[24] Given the retained definition of the exchange rate (an increase implies an appreciation), higher elasticities mean more negative numbers. A negative coefficient in Table A3 therefore indicates higher elasticities.

riables are reported in columns (1)-(4) of Table A3. The results reported in Panel A indicate that higher domestic inflation average and higher inflation volatility are associated with higher export price elasticities. In addition, higher exchange rate volatility is also associated with a higher elasticity of export prices (we do not find a similar result using the average percent change as the coefficient is not statistically significantly different from zero). Panel B shows the corresponding results for the import price elasticities: higher inflation average and volatility, as well as higher exchange rate volatility, are associated with higher import price elasticities. These findings are consistent with the findings 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. The coefficients of the exchange rate and of the inflation variable are not always statistically significant in the multivariate regressions presented on Table A3 in column (7), which may be related to multicollinearity across the variables.[25]

Regarding the microeconomic variables, evidence is more mixed than with the macroeconomic variables. The bivariate regressions are presented in column (5) for the size variables and column (6) for the variables that proxy the degree of product differentiation (the share of high-tech goods in total trade flows). The coefficients reported in columns (5) and (6) are not statistically significant. In the case of the size variable (i.e., the share of exports in world exports in panel A and the ratio of imports to GDP in panel B), the expected effect comes from the Dornbusch (1987) model: the argument that large countries have low pass-through is often used to explain why pass-through is low in the U.S. This empirical result is, however, not uncommon in the literature, see for example Ca'Zorzi et al. (2007). One potential reason why empirical results do not always confirm the expected relationship between pass-through and size is that there are noticeable outliers (in particular, Japan is a large economy with a high degree of pass-through). Turning now to the regressions presented in column (6), the coefficients of the variables we use as prox-

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Higher volatility should be associated with both higher export and import price elasticities, i.e. a negative coefficient.

[25] The unconditional correlation coefficient of the standard deviation of NEER and of PPI is 0.67.

ies for the level of product differentiation do not appear to be statistically significantly different from zero. This could reflect the fact that available proxy variables 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 characterised 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.

## 3.3    Robustness tests, stability analysis and further interpretation

As mentioned in Section 2, our estimation methods are very standard, but can be subject to some questions, which we now turn to. First, we tested the validity of our assumption that foreign prices and nominal exchange rate changes are captured together in our cp variable. To this aim, we re-estimated equations (1) and (2), but replaced the variable cp by two variables: the nominal effective exchange rate (neer), and foreign prices (cpfc). The main point to note is that the coefficients of cp, in the benchmark regression, and the coefficients of neer, in the alternative regression, are strongly correlated (the correlation coefficient is equal to 94% on the export side and 95% on the import side).

Second, we investigated the possibility that the variables in equation (1) and (2) may cointegrate, as suggested in particular by de Bandt et al. (2007). We note, however, that this issue is clearly more relevant for the long-run exchange rate elasticity of trade prices than for the short-run effect, which is the focus of the paper. Overall, there is not much evidence for a cointegrating relation among our variables, as we predominantly do not find that the residuals of the long-run relationship in levels are stationary for the countries in our sample, using the Engle-Granger method. This is not surprising, given than most researchers have not found evidence in favour of cointegrating relations between the variables, and also bearing in mind the short time series available for emerging market economies.

Third, we use a Generalized Method of Moments (GMM) estimator as a way to account for the possible endogeneity of the regressors in equations (1) and (2). Specifical-

ly, we used Hansen's (1982) GMM model, using lagged values of the dependent and independent variables as instruments.[26] The validity of the instruments (Hansen's J-statistics) cannot be rejected in any of the cases, pointing that the instruments are correctly specified. The coefficients of interest $\alpha 3$ and $\alpha'3$ are strongly correlated whether one uses the GMM estimator or OLS, the correlation coefficients being 81% for equation (1) and 80% for equation (2). Overall, these additional results (available upon request) tend to confirm the validity of the benchmark model, which is widely used in the literature. Another motivation for using this particular model stems from the stability analysis that we now turn to. Indeed, alternative models and specifications use more degrees of freedom than the benchmark model, which is therefore better suited when using rolling regressions on a relatively short time window.

The analysis presented above is based on cross-country regressions of the coefficients estimated over the entire sample period (Table B1 in Appendix B). A further refinement of the analysis is to test the stability of the estimated models, focusing on the coefficient of the exchange rate. 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 developed countries have experienced a structural fall in the degree of pass-through. We proceed by using formal statistical tests and by estimating rolling regressions, with a window size of 30 quarters.

To start with, Elliot-Müller (2006) stability tests are applied for the full export and import price models, as well as for the estimated coefficients for competitors' prices only. The Elliot-Müller test results are presented in Table A4 in the Appendix A. Regarding the tests, where the instability of the estimated coefficients for export (import) prices, producer prices, competitors' prices, oil prices and non-oil commodity prices is allowed (i.e. the instability of the whole model), we find that the null hypothesis of stable coefficients in the model is rejected at the 5% level in the case of export prices in France, Morocco and South Korea. Similarly, the null hypothesis is rejected at the 5% level in the case of import prices only in the case of Chile. Regarding the export price elasticity, we find instability in Morocco, Norway and Poland, while for the import price elasticity we find instability only in the case of Switzerland. The results from the stability tests therefore indicate that there is

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[26] In the GMM models, we use as instruments the third and fourth lags of the dependent variables (xp or mp)

overall no significant instability in the estimated pass-through elasticities in the periods we considered (this of course does not mean that there were no breaks in the previous periods). The fact that we do not detect structural breaks around the time of the introduction of the euro may be surprising; however, Campa, Goldberg and González-Mínguez (2005) also do not find compelling evidence that the introduction of the euro caused a structural change in exchange rate pass-through.

To complement the above stability analysis, which does not give the direction of the structural breaks, we also estimated the benchmark equations using a rolling sample of 30 quarters, to verify in particular whether there has been a decrease in the degree of exchange rate pass-through over time (as found in the U.S., e.g. by Marazzi et al., 2005), and a corresponding increase in the elasticity of export prices. The results of the recursive estimates are reported in Figures A1 and A2 in Appendix A. Given the high number of countries, only the main results are summarised here. Starting with the regression for import prices, a noticeable reduction in the degree of pass-through can be found for the U.S.: the point estimate of $\alpha'3$ was at around 20% in the period 1990-1997 and fell considerably thereafter, being not significantly different from zero in the estimation window ending in 2006. The magnitude of the decline as measured here is somewhat smaller than what is found in Marazzi et al. (2005) and in Ihrig et al. (2006), both estimates being above 30 percentage points, while it is slightly above the estimate of Hellerstein et al., 2006 (a 10 percentage point decline). A fall in the degree of pass-through to import prices can also be observed for other advanced economies such as Switzerland, but the main point to notice on Figure A1 is that there is no universal fall in the degree of pass-through among advanced economies. One observes, for instance, stable patterns (the U.K., Denmark, Sweden), and even rises (Germany, Italy, Japan, Canada). The fact that pass-through seems to be rising in the case of Germany and Italy in recent years is somewhat puzzling and would need to be further investigated. Turning to the export price equation, an increase in the elasticity can be noted for a few EMEs: Brazil, Thailand, Israel, Peru, Turkey and the Philippines (until the mid-2000s). This increase corresponds in particular to a change in the exchange rate regime in many emerging markets, which have adopted more flexible exchange rates

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in levels, as well as the second to fourth lags of the independent variables (ppi, cp, noil and oil) in levels.

regimes (according to the theoretical argument that more volatile exchange rate changes should be associated with a higher degree of pricing-to-market). [27]

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 high elasticity of export prices, 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 account for 25% of U.S. imports but only 10% of UK imports. This second effect is therefore 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 20% in 2006), 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 analysed 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. market.[28]

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[27] In the case of several Asian EMEs such as South Korea, we found a clear increase in the degree of pricing-to-market when our regression excluded the currency crisis dummy variables, but not otherwise.

[28] The effect of China on pass-through in the U.S. may operate through yet another channel, namely the fact that the price *level* of Chinese exports is significantly below that of other countries and of local producers. When the U.S. dollar depreciates, one may expect a rise in US import prices, but this rise will be significantly counterbalanced if U.S. consumers buy more Chinese goods with a lower price level. This effect is not taken into account here as we use price *indices*. 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.

# 4     Conclusion

This paper has analysed the degree of pricing-to-market and of exchange rate pass-through among emerging market economies. It reported the exchange rate elasticities of export and import prices that we estimated for 28 emerging markets and compared them with those of a group of 13 advanced economies. Results indicate that the degree of exchange rate pass-through and pricing-to-market are found to be broadly comparable between these two groups of countries, once hyperinflation and currency crisis episodes are controlled for. Furthermore, 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. This can be attributed to the import content of exports, but also to the influence of common factors. Finally, the paper relates the elasticities to a set of structural factors and finds a key role for "macro" variables such as the exchange rate regime 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 proxies, 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. In this respect, it is particularly striking that the elasticity of export prices is not significantly different from zero in China and India. Moreover, given the relation between the export prices of exporting countries and the import prices of advanced economies, the results presented here provide an input into the debate on global inflation and the decline in pass-through recorded in the U.S. and other industrialized countries. In particular, we report an increase in the export price elasticities of several EMEs, particularly those that went through a currency crisis. The increasing elasticity of export prices in several EMEs, which relates to domestic factors in these economies, may therefore provide a partial explanation for the decline in pass-through in some advanced economies such as the U.S. This explanation could complement other interpretations in the literature, such as those related to a structural change in U.S. monetary policy (Taylor, 2000) and to a change

in the sectoral composition of U.S. imports (Campa and Goldberg, 2005). One additional explanation, as suggested in this study, is related to the changing weights of a given country's trading partners. This change can lead to a lower pass-through in the importing country if this country starts importing more from countries with a higher level of pricing-to-market, or from countries that have a pegged exchange rate arrangement with their currency. Turning to possible policy implications, the paper suggests that trade price elasticities may vary considerably over time and be endogenously determined by policy measures. Noticeably, the fact that pass-through is statistically related to monetary policy indicators implies that a given degree of pass-through should not be treated as constant: it may increase, in particular, if monetary policy becomes more accommodative.

Finally, the high correlation, across countries, of export and import prices elasticities is another noticeable finding. Partly, this can result from the internationalization of production and the traditionally high import content of exports. When an international firm imports a substantial share of its inputs from a foreign affiliate, it may benefit from a "natural hedge": a depreciation of its exchange rate would ceteris paribus lower its profits, but the loss is mitigated by the fact that this firm can raise its export prices in the same proportion. However, this result may also be explained by common factors. For example, a country that has high domestic inflation 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 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.

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# Appendix A: Estimation results

Table A1    Estimated coefficients for export prices (XP).

| Country | $\Delta(-1)$ xp | $\Delta$ppi | $\Delta$ cp | $\Delta$ noc | $\Delta$ oil | Obs | $R^2$ |
|---|---|---|---|---|---|---|---|
| ALL | 0.0405** | 0.5741*** | -0.3276*** | -0.0020 | 0.0179** | 2387 | 0.32 |
| Argentina | -0.1399 | 0.9484** | -0.3732*** | 0.2201* | -0.0031 | 44 | 0.95 |
| Australia | 0.2057* | 1.1226*** | -0.2061** | -0.0061 | -0.0194 | 64 | 0.46 |
| Brazil | -0.4882*** | 1.1376* | -0.8962*** | -0.2923 | 0.1170 | 44 | 0.76 |
| Canada | -0.0922 | 1.1142** | -0.0665 | -0.1105 | 0.0011 | 64 | 0.28 |
| Chile | -0.2175 | 1.2309** | 0.1011 | 0.0377 | 0.0127 | 40 | 0.42 |
| China | 0.6429*** | 0.2806** | -0.0073 | 0.0146 | -0.0012 | 36 | 0.82 |
| Colombia | 0.0557 | 0.8772* | -0.3771* | 0.3532*** | 0.1196** | 61 | 0.43 |
| Czech Republic | 0.1867 | 0.3236 | -0.4343*** | -0.0583 | 0.0138 | 44 | 0.58 |
| Denmark | 0.0427 | 0.7710*** | -0.1720** | 0.0103 | 0.0015 | 64 | 0.61 |
| Egypt | 0.5932*** | -0.1187 | -0.0997 | 0.0946 | 0.0020 | 48 | 0.59 |
| France | 0.0281 | -0.0127 | -0.3017*** | 0.0216 | 0.0049 | 64 | 0.40 |
| Germany | 0.0108 | 1.2083*** | -0.0561 | -0.0040 | -0.0089 | 64 | 0.32 |
| Hungary | -0.0434 | 0.8485*** | -0.0811 | -0.0759 | 0.0106 | 48 | 0.77 |
| India | 0.8638*** | 0.1148 | 0.0657 | 0.0149 | 0.0237** | 40 | 0.77 |
| Israel | -0.2839** | 0.4613 | -0.4441** | 0.0276 | -0.0652* | 63 | 0.41 |
| Italy | 0.2039* | 0.1052 | -0.2161*** | -0.0249 | 0.0280** | 64 | 0.74 |
| Japan | 0.1915** | 0.5144 | -0.5322*** | -0.0531 | -0.0219 | 64 | 0.62 |
| Kuwait | 0.5471*** | -0.7258 | 0.0126 | 0.1723 | 0.1727*** | 52 | 0.63 |
| Malaysia | -0.1077 | 0.6615*** | -0.1932* | -0.1109* | -0.0742*** | 60 | 0.63 |
| Mexico | -0.0619 | 0.7353*** | -0.5451*** | 0.1168 | 0.0095 | 52 | 0.86 |
| Morrocco | 0.5662*** | -0.0132 | 0.0243 | 0.0134 | 0.0062 | 64 | 0.42 |
| New Zealand | 0.0794 | 1.0056*** | -0.4941*** | 0.0462 | -0.0042 | 64 | 0.69 |
| Norway | 0.1032 | -0.2595 | -0.5901** | -0.1171 | 0.3323*** | 64 | 0.83 |
| Pakistan | 0.0209 | 0.5199 | -0.0774 | 0.0547 | -0.0351 | 56 | 0.50 |
| Peru | 0.0135 | 1.1326*** | -0.0104 | 0.1413 | 0.1239* | 60 | 0.37 |
| Philippines | -0.0795 | 0.1989 | -0.3702*** | -0.1490 | -0.0386 | 64 | 0.31 |
| Poland | -0.4054** | -0.2891 | -0.3743 | 0.3725 | -0.1429 | 44 | 0.22 |
| Saudia Arabia | 0.6201*** | 0.1640 | 0.1906 | 0.1717* | 0.0699** | 64 | 0.58 |
| Singapore | 0.1607 | 0.2161 | -0.1202 | -0.0680 | -0.0721 | 64 | 0.12 |
| Slovakia | 0.2057 | 0.1289 | -0.0135 | 0.0247 | 0.0033 | 52 | 0.12 |
| Slovenia | 0.1286 | 0.6257*** | 0.0075 | -0.0501 | 0.0492*** | 48 | 0.51 |
| South Africa | -0.1310 | 1.4206*** | -0.1869 | 0.1507 | 0.0086 | 63 | 0.35 |
| South Korea | -0.2710*** | 2.4863*** | -0.2825** | -0.0078 | -0.0280 | 64 | 0.85 |
| Sweden | 0.0965* | 1.3500*** | 0.0636** | -0.0107 | -0.0388*** | 64 | 0.90 |
| Switzerland | -0.0003 | 0.6451*** | -0.0554** | -0.0148 | -0.0025 | 64 | 0.24 |
| Taiwan | -0.0386 | 0.9131*** | -0.0453 | -0.0457* | -0.0384*** | 64 | 0.78 |
| Thailand | 0.0025 | 0.9974*** | -0.7237*** | -0.1345 | -0.0211 | 60 | 0.64 |
| Turkey | 0.3682*** | 0.0156 | -0.2835 | -0.1305 | 0.0692 | 60 | 0.34 |
| UK | 0.1271 | 1.0226*** | -0.2548*** | -0.0148 | 0.0238* | 64 | 0.50 |
| USA | 0.4434*** | 0.3383*** | -0.0515** | 0.0464*** | -0.0048 | 64 | 0.81 |
| Venezuela | 0.0568 | 1.3589*** | 0.0752 | -0.1820 | 0.5324*** | 52 | 0.56 |

*Notes: \*\*\*, \*\* and \* denote statistical significance at the 1%, 5% and 10% levels, respectively, based on heteroskedasticity and autocorrelation consistent (HAC) standard errors. The estimation results correspond to equation (1). A negative sign is expected for the exchange rate variable: an exchange rate appreciation lowers export prices (in the currency of the exporting country) as exporters partially offset the effect of the appreciation by decreasing their export prices in domestic currency terms.*

Table A2        Estimated coefficients for import prices (MP).

| Country | Δ(-1) mp | Δppi | Δ cp | Δ noc | Δ oil | Obs | R² |
|---|---|---|---|---|---|---|---|
| ALL | 0.1582*** | 0.3575*** | -0.3548*** | -0.0203 | 0.0139** | 2390 | 0.35 |
| Argentina | -0.0228 | 0.4689 | -0.5178*** | -0.0309 | -0.0553 | 44 | 0.97 |
| Australia | 0.0586 | 0.8109*** | -0.2621*** | -0.1270** | -0.0351 | 64 | 0.51 |
| Brazil | -0.4306*** | 1.2190* | -0.5996** | -0.0082 | 0.0364 | 44 | 0.50 |
| Canada | -0.0068 | 0.7115*** | -0.3104*** | -0.0585** | -0.0001 | 64 | 0.77 |
| Chile | -0.0259 | 1.4695*** | -0.0458 | -0.1532** | -0.0857** | 40 | 0.68 |
| China | 0.4423** | 0.2693 | -0.0311 | -0.0036 | 0.0167 | 36 | 0.46 |
| Colombia | 0.3039*** | 0.3260** | -0.2613*** | 0.0325 | -0.0078 | 64 | 0.67 |
| Czech Republic | 0.2925** | 0.3380 | -0.2956*** | -0.0036 | 0.0238 | 44 | 0.66 |
| Denmark | 0.0349 | 0.6232* | -0.2972*** | 0.0062 | -0.0072 | 64 | 0.60 |
| Egypt | 0.5174*** | -0.0245 | -0.0615 | 0.0668 | -0.0117 | 48 | 0.46 |
| France | 0.3162*** | 0.0363 | -0.2452** | -0.0033 | 0.0559*** | 64 | 0.60 |
| Germany | 0.1541 | 1.5159** | -0.3055** | 0.0563 | 0.0246 | 64 | 0.50 |
| Hungary | -0.0101 | 0.7125*** | -0.1759 | -0.0436 | 0.0337 | 48 | 0.76 |
| India | 0.8592*** | -0.4088 | -0.0260 | 0.0016 | -0.0015 | 40 | 0.73 |
| Israel | -0.2128** | 0.2331 | -0.5458*** | 0.0564 | 0.0142 | 63 | 0.70 |
| Italy | 0.0192 | 0.7711 | -0.4242*** | -0.0235 | 0.0873*** | 64 | 0.71 |
| Japan | 0.0937 | 1.9988*** | -0.6141*** | -0.0112 | 0.0959*** | 64 | 0.63 |
| Kuwait | 0.6370*** | -0.1617 | -0.0165 | 0.0313 | 0.0348 | 52 | 0.39 |
| Malaysia | 0.1198 | 0.2548 | -0.1183 | -0.0312 | -0.0374 | 60 | 0.74 |
| Mexico | 0.0975 | 0.5246*** | -0.7009*** | 0.1274* | -0.0012 | 52 | 0.90 |
| Morrocco | 0.6995*** | 0.0744 | 0.0370 | 0.0068 | 0.0024 | 64 | 0.50 |
| New Zealand | -0.1046 | 0.8109*** | -0.5564*** | -0.0202 | 0.0071 | 64 | 0.76 |
| Norway | -0.1629 | -0.1735 | -0.2145 | 0.0186 | 0.0339 | 64 | 0.19 |
| Pakistan | -0.2767** | 1.0717** | 0.1043 | 0.0113 | 0.2022*** | 56 | 0.39 |
| Peru | 0.0924 | 1.0385*** | 0.0700 | 0.0756 | -0.0050 | 60 | 0.38 |
| Philippines | -0.1494 | 0.4494 | -0.4007*** | 0.0723 | -0.0227 | 64 | 0.37 |
| Poland | -0.3649** | 0.3959 | -0.2648 | 0.1609 | -0.0784 | 44 | 0.19 |
| Saudia Arabia | 0.6323*** | 0.7115** | 0.0233 | 0.0424 | 0.0096 | 64 | 0.43 |
| Singapore | 0.2280* | 0.1441 | 0.0623 | -0.0701 | -0.0499 | 64 | 0.14 |
| Slovakia | 0.1968 | -0.0358 | -0.2314 | 0.0009 | 0.0377 | 52 | 0.24 |
| Slovenia | -0.0439 | 0.4626* | -0.3502*** | -0.0172 | 0.0632*** | 48 | 0.54 |
| South Africa | -0.1344 | 1.6930*** | -0.0862 | -0.0266 | -0.0033 | 63 | 0.62 |
| South Korea | -0.1855*** | 2.5727*** | -0.3533*** | -0.0002 | 0.0684*** | 64 | 0.87 |
| Sweden | 0.0181 | 1.2922*** | -0.0833*** | -0.0222 | 0.0063 | 64 | 0.94 |
| Switzerland | 0.2654** | 0.5177 | -0.2121*** | -0.0275 | 0.0150* | 64 | 0.50 |
| Taiwan | -0.1074 | 1.0810*** | -0.1502** | -0.0143 | 0.0018 | 64 | 0.81 |
| Thailand | 0.1347 | 1.2542*** | -0.5906*** | -0.1230 | 0.0079 | 60 | 0.66 |
| Turkey | 0.3668*** | 0.2837 | -0.1543 | -0.3294 | 0.1572 | 60 | 0.34 |
| UK | 0.2669*** | 0.6952** | -0.2693*** | 0.0142 | 0.0164 | 64 | 0.66 |
| USA | 0.1237* | 1.1354*** | -0.0793 | 0.0096 | 0.0407*** | 64 | 0.86 |
| Venezuela | -0.0262 | 0.8538*** | -0.5084 | -0.1388 | -0.2376* | 52 | 0.42 |

*Notes: \*\*\*, \*\* and \* denote statistical significance at the 1%, 5% and 10% levels, respectively, based on heteroskedasticity and autocorrelation consistent (HAC) standard errors. The estimation results correspond to equation (2).A negative sign is expected for the exchange rate variable: an exchange rate appreciation lowers import prices (in the currency of the importing country).*

Table A3      Factors affecting export and import elasticities.

Panel A: Export prices (XP)

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|
| Domestic PPI inflation, (avg) | -2.3172** [0.9296] | | | | | | -2.5089 [1.6769] |
| NEER change, (avg) | | 0.3311 [0.5491] | | | | | -1.1403 [0.7764] |
| Domestic PPI inflation, (sd) | | | -1.5868** [0.5913] | | | | 0.4739 [1.1837] |
| NEER change, (sd) | | | | -0.7287** [0.2965] | | | -0.9980* [0.5542] |
| Share of high tech exports, (% total) | | | | | | -0.1547 [0.2288] | -0.3325 [0.2308] |
| Share of exports of world exports, (%) | | | | | 0.3216 [1.4986] | | -0.6891 [1.5210] |
| Constant | -0.1002* [0.0550] | -0.1970*** [0.0403] | -0.0994* [0.0527] | -0.0844 [0.0606] | -0.2107*** [0.0473] | -0.1787*** [0.0541] | 0.0837 [0.0961] |
| Observations | 41 | 41 | 41 | 41 | 41 | 41 | 41 |
| R-squared | 0.14 | 0.01 | 0.16 | 0.13 | 0.00 | 0.01 | 0.28 |

Panel B: Import prices (MP)

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|
| Domestic PPI inflation, (avg) | -1.5322* [0.8467] | | | | | | -1.7029 [1.4579] |
| NEER change, (avg) | | 0.5103 [0.4789] | | | | | -1.0867 [0.7100] |
| Domestic PPI inflation, (sd) | | | -0.9325* [0.5468] | | | | 1.4246 [1.0833] |
| NEER change, (sd) | | | | -0.7843*** [0.2510] | | | -1.3366** [0.5305] |
| Share of high tech imports, (% total) | | | | | | -0.1061 [0.4170] | -0.4419 [0.4941] |
| Imports to GDP, (%) | | | | | 0.1534 [0.1175] | | 0.0664 [0.1467] |
| Constant | -0.1763*** [0.0501] | -0.2334*** [0.0351] | -0.1835*** [0.0487] | -0.1159** [0.0513] | -0.3023*** [0.0547] | -0.2237** [0.0920] | -0.0018 [0.1115] |
| Observations | 41 | 41 | 41 | 41 | 41 | 41 | 41 |
| R-squared | 0.08 | 0.03 | 0.07 | 0.20 | 0.04 | 0.00 | 0.29 |

*Notes: The dependent variables are the elasticity of export and import prices for panel A and B, respectively, as derived in the regressions presented in Table A1 and A2. Robust standard errors are presented in brackets. \*\*\*, \*\* and \* denote statistical significance at the 1%, 5% and 10% levels, respectively. A negative sign indicates that a rise in the independent variable increases the absolute value of the dependent variable (a higher elasticity).*

Figure A1    Estimated export price elasticities, rolling sample with a window size of 30 quarters (end Q2/2006).
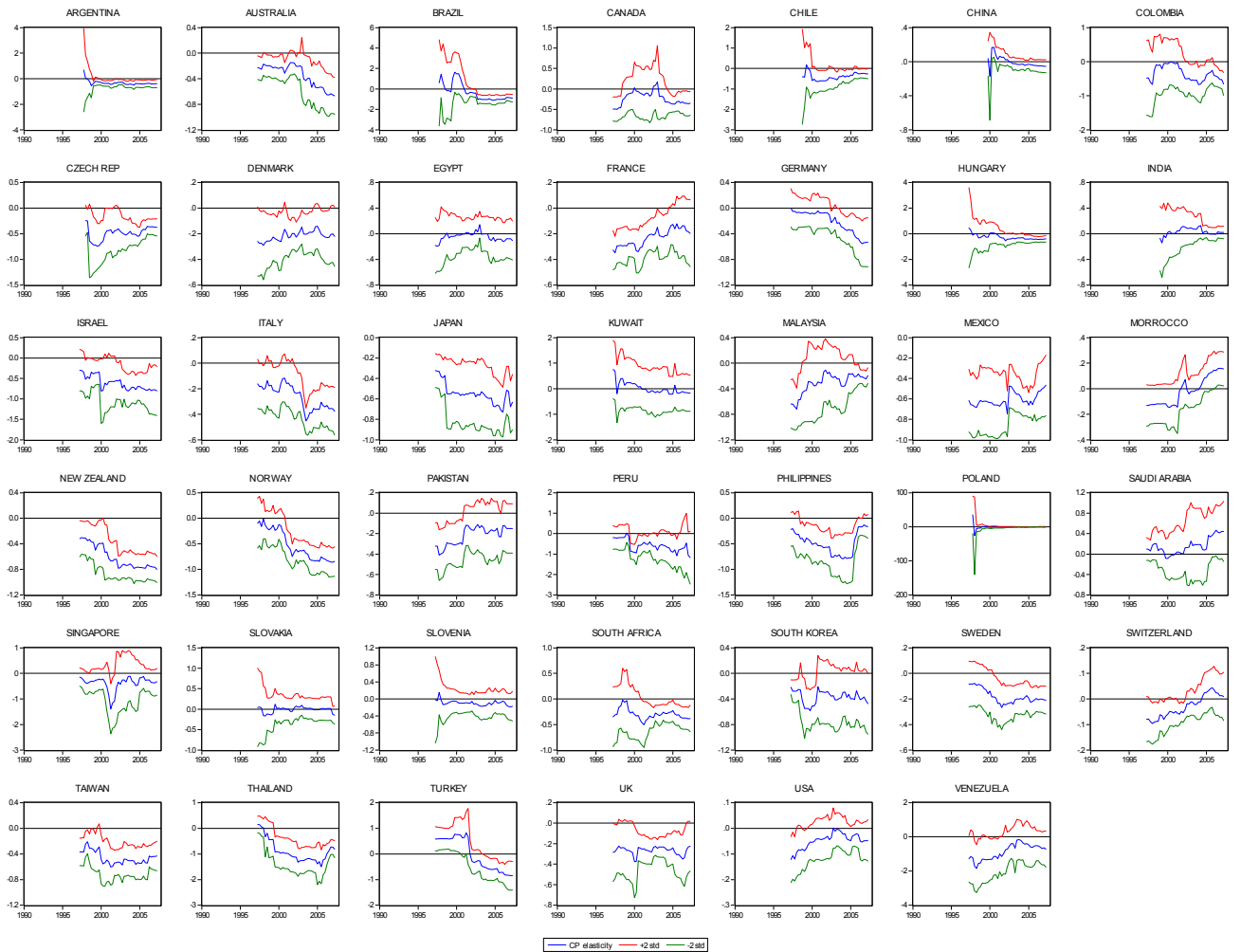
Figure A2      Estimated import price elasticities, rolling sample with a window size of 30 quarters (end Q2/2006).
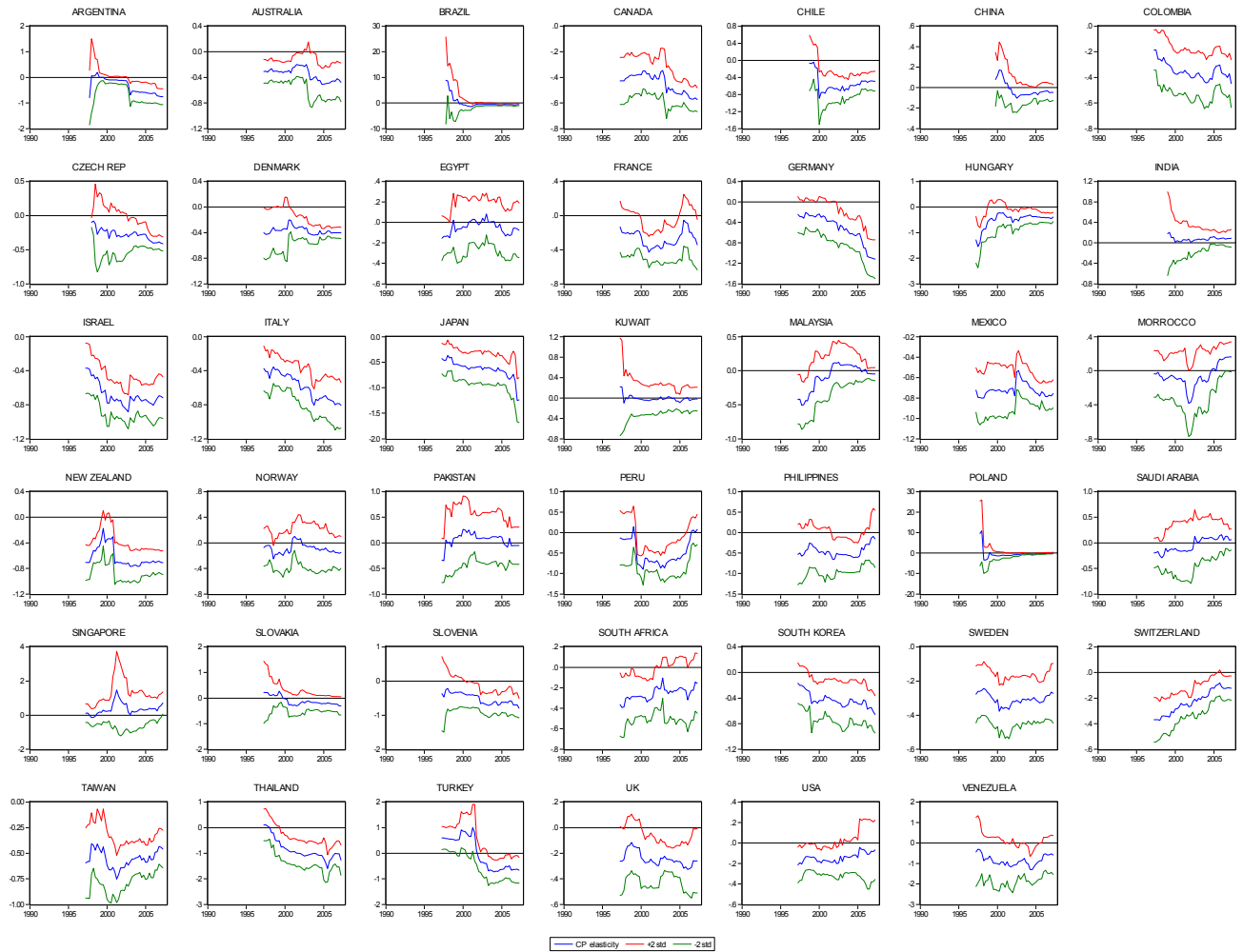
Table A4      Elliot-Müller (2006) stability test for regression coefficients.

|  | Export price (XP) | | Import price (MP) | |
| --- | --- | --- | --- | --- |
|  | 5 vars | CP | 5 vars | CP |
| Argentina | -20.591 | -3.671 | -19.963 | -4.767 |
| Australia | -24.084 | -7.809* | -29.271* | -4.774 |
| Brazil | -25.539 | -5.375 | -20.265 | -2.448 |
| Canada | -19.545 | -4.984 | -26.790 | -7.333* |
| Chile | -27.423 | -5.610 | -36.357*** | -6.108 |
| China | -25.179 | -5.863 | -27.378 | -4.343 |
| Colombia | -28.677* | -2.466 | -27.129 | -6.610 |
| Czech Republic | -26.212 | -5.800 | -21.694 | -6.973 |
| Denmark | -29.824* | -3.365 | -16.488 | -2.880 |
| Egypt | -25.668 | -1.927 | -21.372 | -2.398 |
| France | -36.097*** | -2.473 | -16.694 | -5.899 |
| Germany | -27.849 | -5.525 | -26.468 | -6.517 |
| Hungary | -23.424 | -4.732 | -21.812 | -3.270 |
| India | -30.401* | -3.375 | -24.446 | -4.370 |
| Israel | -24.259 | -6.577 | -25.840 | -7.060* |
| Italy | -26.931 | -3.312 | -24.206 | -7.635* |
| Japan | -24.405 | -2.962 | -19.322 | -3.541 |
| Kuwait | -18.724 | -3.668 | -18.715 | -4.400 |
| Malaysia | -27.124 | -5.267 | -29.918* | -2.892 |
| Mexico | -19.617 | -2.033 | -19.376 | -1.914 |
| Morrocco | -31.849** | -8.929** | -24.244 | -5.085 |
| New Zealand | -25.662 | -6.380 | -22.537 | -4.317 |
| Norway | -20.201 | -7.551** | -22.425 | -2.721 |
| Pakistan | -18.299 | -2.802 | -23.860 | -4.863 |
| Peru | -19.631 | -1.648 | -27.511 | -1.605 |
| Philippines | -28.881* | -6.564 | -18.561 | -3.206 |
| Poland | -24.305 | -8.706** | -21.212 | -6.350 |
| Saudia Arabia | -28.837* | -6.419 | -21.133 | -2.842 |
| Singapore | -29.602* | -6.680 | -28.626* | -6.979 |
| Slovakia | -25.918 | -2.882 | -24.972 | -5.277 |
| Slovenia | -19.372 | -3.215 | -19.525 | -6.128 |
| South Africa | -22.515 | -4.209 | -28.783* | -3.813 |
| South Korea | -35.02** | -5.408 | -26.380 | -5.946 |
| Sweden | -26.505 | -5.644 | -25.277 | -2.369 |
| Switzerland | -26.048 | -6.405 | -25.628 | -8.594** |
| Taiwan | -27.494 | -6.741 | -22.892 | -2.609 |
| Thailand | -26.969 | -6.185 | -29.554* | -5.949 |
| Turkey | -18.388 | -4.884 | -21.542 | -5.107 |
| UK | -21.598 | -2.726 | -20.977 | -3.729 |
| USA | -24.493 | -4.465 | -27.421 | -5.242 |
| Venezuela | -18.638 | -2.475 | -26.948 | -4.910 |

*Notes: The first (and third) column shows test statistics for model, where instability of estimated coefficients for export (import) prices, producer prices, competitors' prices, oil prices and non-oil commodity prices is allowed. The second (and fourth) column show test statistics for models, where instability of estimated coefficients is allowed only for competitors' prices. \*\*\*, \*\* and \* denote the probability that the null hypothesis of stable coefficients is rejected at 1%, 5% and 10% levels, respectively. The critical values are: -35.09 (1%), -30.60 (5%), and -28.55 (10%).*

# Appendix B: Data tables and figures

Table B1    Sample countries, estimation sample, and data sources for import prices (MP), export prices (XP), real effective exchange rate (REER), and domestic producer prices (PPI).

| Country | Sample | XP | MP | REER | PPI |
|---|---|---|---|---|---|
| Argentina | Q1 / 1995 - Q2 / 2006 | GI | GI | JPM | GI |
| Australia | Q1 / 1990 - Q2 / 2006 | IFS | IFS | JPM | IFS |
| Brazil | Q1 / 1995 - Q2 / 2006 | IFS | IFS | JPM | IFS |
| Canada | Q1 / 1990 - Q2 / 2006 | IFS | IFS | JPM | IFS |
| Chile | Q1 / 1996 - Q2 / 2006 | GI | GI | JPM | GI |
| China | Q1 / 1997 - Q2 / 2006 | GI | GI | JPM | GI |
| Colombia | Q1 / 1990 - Q2 / 2006 | IFS | IFS | JPM | IFS |
| Czech Republic | Q1 / 1995 - Q2 / 2006 | GI | GI | JPM | GI |
| Denmark | Q1 / 1990 - Q2 / 2006 | IFS | IFS | JPM | IFS |
| Egypt | Q1 / 1994 - Q2 / 2006 | GI | GI | JPM | GI |
| France | Q1 / 1990 - Q2 / 2006 | IFS | IFS | IFS | IFS |
| Germany | Q1 / 1990 - Q2 / 2006 | IFS | IFS | IFS | IFS |
| Hungary | Q1 / 1994 - Q2 / 2006 | IFS | IFS | JPM | GI |
| India | Q1 / 1996 - Q2 / 2006 | GI | GI | JPM | GI |
| Israel | Q1 / 1990 - Q2 / 2006 | IFS | IFS | IFS | GI |
| Italy | Q1 / 1990 - Q2 / 2006 | IFS | IFS | IFS | IFS |
| Japan | Q1 / 1990 - Q2 / 2006 | IFS | IFS | JPM | GI |
| Kuwait | Q1 / 1993 - Q2 / 2006 | GI | GI | JPM | GI |
| Malaysia | Q1 / 1991 - Q2 / 2006 | GI | GI | JPM | GI |
| Mexico | Q1 / 1993 - Q2 / 2006 | GI | GI | JPM | GI |
| Morrocco | Q1 / 1991 - Q2 / 2006 | GI | GI | JPM | GI |
| New Zealand | Q1 / 1990 - Q2 / 2006 | IFS | IFS | JPM | GI |
| Norway | Q1 / 1990 - Q2 / 2006 | IFS | IFS | JPM | GI |
| Pakistan | Q3 / 1991 - Q2 / 2006 | IFS | IFS | JPM | GI |
| Peru | Q1 / 1991 - Q2 / 2006 | GI | GI | JPM | GI |
| Philippines | Q1 / 1990 - Q2 / 2006 | GI | GI | JPM | GI |
| Poland | Q1 / 1995 - Q2 / 2006 | GI | GI | IFS | GI |
| Saudia Arabia | Q1 / 1990 - Q2 / 2006 | GI | GI | JPM | GI |
| Singapore | Q1 / 1990 - Q2 / 2006 | GI | GI | JPM | GI |
| Slovakia | Q1 / 1993 - Q2 / 2006 | GI | GI | IFS | GI |
| Slovenia | Q1 / 1994 - Q2 / 2006 | GI | GI | JPM | GI |
| South Africa | Q1 / 1990 - Q2 / 2006 | IFS | IFS | JPM | GI |
| South Korea | Q1 / 1990 - Q2 / 2006 | IFS | IFS | JPM | GI |
| Sweden | Q1 / 1990 - Q2 / 2006 | IFS | IFS | JPM | GI |
| Switzerland | Q1 / 1990 - Q2 / 2006 | GI | GI | JPM | GI |
| Taiwan | Q1 / 1990 - Q2 / 2006 | GI | GI | JPM | GI |
| Thailand | Q1 / 1991 - Q2 / 2006 | IFS | IFS | JPM | IFS |
| Turkey | Q1 / 1991 - Q2 / 2006 | GI | GI | JPM | GI |
| UK | Q1 / 1990 - Q2 / 2006 | IFS | IFS | JPM | GI |
| USA | Q1 / 1990 - Q2 / 2006 | IFS | IFS | JPM | GI |
| Venezuela | Q1 / 1993 - Q2 / 2006 | GI | GI | JPM | GI |

*Notes: GI = Global Insight, IFS = IMF IFS, and JPM = JPMorgan.*

Table B2  Descriptive statistics of log changes in import prices (MP), export prices (XP), domestic producer prices (PPI), and competitors' prices (CP).

| Country | Obs | Δ log Export prices (XP) Mean | St. Dev. | Δ log Import prices (MP) Mean | St. Dev. | Δ log Producer prices (PPI) Mean | St. Dev. | Δ log Competitors' prices (CP) Mean | St. Dev. |
|---|---|---|---|---|---|---|---|---|---|
| Argentina | 46 | 0.0243 | 0.1163 | 0.0238 | 0.1264 | 0.0219 | 0.0676 | -0.0301 | 0.1461 |
| Australia | 66 | 0.0057 | 0.0329 | 0.0027 | 0.0269 | 0.0058 | 0.0147 | -0.0027 | 0.0420 |
| Brazil | 47 | 0.0286 | 0.1402 | 0.0308 | 0.1107 | 0.0265 | 0.0311 | -0.0227 | 0.0887 |
| Canada | 67 | 0.0049 | 0.0299 | 0.0030 | 0.0177 | 0.0048 | 0.0116 | -0.0063 | 0.0303 |
| Chile | 42 | 0.0172 | 0.0383 | 0.0036 | 0.0325 | 0.0138 | 0.0193 | -0.0087 | 0.0425 |
| China | 38 | -0.0064 | 0.0099 | -0.0031 | 0.0117 | 0.0019 | 0.0117 | -0.0012 | 0.0276 |
| Colombia | 66 | 0.0298 | 0.0585 | 0.0242 | 0.0239 | 0.0304 | 0.0200 | -0.0314 | 0.0492 |
| Czech Republic | 46 | 0.0027 | 0.0198 | 0.0005 | 0.0174 | 0.0079 | 0.0083 | -0.0004 | 0.0310 |
| Denmark | 67 | 0.0026 | 0.0122 | 0.0021 | 0.0145 | 0.0039 | 0.0080 | -0.0019 | 0.0202 |
| Egypt | 50 | 0.0146 | 0.0285 | 0.0139 | 0.0226 | 0.0146 | 0.0178 | -0.0170 | 0.0510 |
| France | 66 | -0.0003 | 0.0064 | 0.0000 | 0.0118 | 0.0008 | 0.0067 | -0.0033 | 0.0138 |
| Germany | 67 | -0.0010 | 0.0118 | 0.0012 | 0.0215 | 0.0031 | 0.0044 | -0.0032 | 0.0190 |
| Hungary | 50 | 0.0184 | 0.0305 | 0.0200 | 0.0297 | 0.0236 | 0.0238 | -0.0210 | 0.0327 |
| India | 42 | 0.0123 | 0.0144 | 0.0206 | 0.0155 | 0.0120 | 0.0068 | -0.0129 | 0.0248 |
| Israel | 65 | 0.0147 | 0.0422 | 0.0143 | 0.0321 | 0.0167 | 0.0123 | -0.0197 | 0.0324 |
| Italy | 66 | 0.0107 | 0.0208 | 0.0103 | 0.0266 | 0.0071 | 0.0078 | -0.0057 | 0.0296 |
| Japan | 67 | -0.0042 | 0.0289 | 0.0019 | 0.0367 | -0.0009 | 0.0054 | -0.0012 | 0.0380 |
| Kuwait | 54 | 0.0274 | 0.0578 | 0.0044 | 0.0203 | 0.0030 | 0.0115 | -0.0033 | 0.0275 |
| Malaysia | 62 | 0.0085 | 0.0279 | 0.0065 | 0.0294 | 0.0088 | 0.0203 | -0.0106 | 0.0446 |
| Mexico | 54 | 0.0259 | 0.0656 | 0.0266 | 0.0709 | 0.0279 | 0.0309 | -0.0260 | 0.0792 |
| Morocco | 66 | 0.0046 | 0.0071 | 0.0053 | 0.0117 | 0.0088 | 0.0173 | -0.0073 | 0.0277 |
| New Zealand | 66 | 0.0020 | 0.0302 | 0.0017 | 0.0289 | 0.0057 | 0.0099 | -0.0056 | 0.0379 |
| Norway | 67 | 0.0113 | 0.0637 | -0.0006 | 0.0177 | 0.0127 | 0.0450 | -0.0095 | 0.0444 |
| Pakistan | 61 | 0.0181 | 0.0431 | 0.0238 | 0.0512 | 0.0197 | 0.0161 | -0.0178 | 0.0568 |
| Peru | 62 | 0.0344 | 0.0612 | 0.0301 | 0.0603 | 0.0307 | 0.0517 | -0.0317 | 0.0922 |
| Philippines | 66 | 0.0217 | 0.0484 | 0.0200 | 0.0590 | 0.0173 | 0.0188 | -0.0160 | 0.0563 |
| Poland | 46 | 0.0112 | 0.1218 | 0.0132 | 0.0760 | 0.0142 | 0.0130 | -0.0064 | 0.0406 |
| Saudi Arabia | 66 | 0.0129 | 0.0462 | 0.0038 | 0.0299 | 0.0028 | 0.0097 | -0.0046 | 0.0318 |
| Singapore | 66 | 0.0076 | 0.0296 | 0.0085 | 0.0374 | 0.0026 | 0.0287 | 0.0008 | 0.0294 |
| Slovakia | 54 | 0.0100 | 0.0157 | 0.0109 | 0.0186 | 0.0152 | 0.0126 | -0.0053 | 0.0246 |
| Slovenia | 50 | 0.0142 | 0.0155 | 0.0138 | 0.0185 | 0.0146 | 0.0104 | -0.0143 | 0.0198 |
| South Africa | 65 | 0.0190 | 0.0510 | 0.0186 | 0.0349 | 0.0174 | 0.0129 | -0.0187 | 0.0644 |
| South Korea | 66 | 0.0008 | 0.0598 | 0.0099 | 0.0549 | 0.0075 | 0.0149 | -0.0101 | 0.0624 |
| Sweden | 67 | 0.0042 | 0.0163 | 0.0075 | 0.0193 | 0.0063 | 0.0120 | -0.0099 | 0.0348 |
| Switzerland | 66 | 0.0014 | 0.0056 | -0.0001 | 0.0121 | 0.0004 | 0.0035 | 0.0009 | 0.0288 |
| Taiwan | 66 | 0.0010 | 0.0176 | 0.0048 | 0.0206 | 0.0030 | 0.0153 | -0.0073 | 0.0238 |
| Thailand | 63 | 0.0133 | 0.0524 | 0.0166 | 0.0578 | 0.0097 | 0.0184 | -0.0117 | 0.0500 |
| Turkey | 62 | 0.1001 | 0.1001 | 0.1013 | 0.1022 | 0.0307 | 0.0517 | -0.0336 | 0.0846 |
| UK | 67 | 0.0028 | 0.0170 | 0.0019 | 0.0167 | 0.0055 | 0.0059 | -0.0043 | 0.0273 |
| USA | 67 | 0.0025 | 0.0074 | 0.0037 | 0.0176 | 0.0052 | 0.0085 | -0.0055 | 0.0264 |
| Venezuela | 54 | 0.0803 | 0.1449 | 0.0668 | 0.1210 | 0.0755 | 0.0614 | -0.0634 | 0.1067 |

Table B3    Unconditional correlation coefficients for log changes in import prices (MP),
            export prices (XP), domestic producer prices (PPI), competitors' prices (CP),
            oil prices (OIL), non-oil commodity prices (NOIL), currency crises (CRISIS), and
            hyperinflation periods (HYPERINF).

Correlation in log-differences

| Obs 2386 | $\Delta$Log(XP) | $\Delta$Log(MP) | $\Delta$Log(PPI) | $\Delta$Log(CP) | $\Delta$Log(noil) | $\Delta$Log(oil) | Crisis | Hyperinf. |
|---|---|---|---|---|---|---|---|---|
| $\Delta$Log(XP) | 1.000 | | | | | | | |
| $\Delta$Log(MP) | 0.659 | 1.000 | | | | | | |
| $\Delta$Log(PPI) | 0.488 | 0.475 | 1.000 | | | | | |
| $\Delta$Log(CP) | -0.479 | -0.510 | -0.572 | 1.000 | | | | |
| $\Delta$Log(noil) | 0.043 | 0.017 | 0.071 | -0.044 | 1.000 | | | |
| $\Delta$Log(oil) | 0.111 | 0.089 | 0.136 | -0.100 | -0.001 | 1.000 | | |
| Crisis | 0.253 | 0.299 | 0.210 | -0.520 | -0.013 | 0.001 | 1.000 | |
| Hyperinflation | 0.264 | 0.208 | 0.419 | -0.255 | 0.062 | 0.047 | 0.066 | 1.000 |

Table B4    Unconditional correlation coefficients for the second-stage variables: domestic
            producer prices (PPI), nominal effective exchange rate (NEER), imports (M) to GDP,
            export (X) share of the world exports, share of high-tech (HT) exports of total exports,
            share of high-tech imports of total imports.

| Correlation Obs 41 | avg $\Delta$Log(PPI) | avg $\Delta$Log(NEER) | sd $\Delta$Log(PPI) | sd $\Delta$Log(NEER) | Ratio M to GDP | Ratio HT Imports | Ratio X to World | Ratio HT Exports |
|---|---|---|---|---|---|---|---|---|
| avg $\Delta$Log(PPI) | 1.000 | | | | | | | |
| avg $\Delta$Log(NEER) | -0.452 | 1.000 | | | | | | |
| sd $\Delta$Log(PPI) | 0.774 | -0.299 | 1.000 | | | | | |
| sd $\Delta$Log(NEER) | 0.598 | -0.684 | 0.673 | 1.000 | | | | |
| M to GDP | -0.154 | 0.109 | -0.035 | -0.284 | 1.000 | | | |
| HT Imports | -0.159 | 0.144 | 0.099 | -0.054 | 0.562 | 1.000 | | |
| X to World | -0.396 | 0.245 | -0.262 | -0.248 | -0.148 | 0.213 | 1.000 | |
| HT Exports | -0.261 | 0.190 | -0.076 | -0.221 | 0.669 | 0.899 | 0.275 | 1.000 |

Table B5    Export prices (XP) and import prices (MP) in first differences, Augmented Dickey-Fuller test statistics and respective p-values for AR(1) and AR(2) models both with constant and with constant and a linear trend.

| | | Export prices (XP) | | | | | | | | Import prices (MP) | | | | | | | |
| | | Lag 1 | | Lag 2 | | Lag 1 with trend | | Lag 2 with trend | | Lag 1 | | Lag 2 | | Lag 1 with trend | | Lag 2 with trend | |
| Country | Obs | Statistic | p-value | Statistic | p-value | Statistic | p-value | Statistic | p-value | Statistic | p-value | Statistic | p-value | Statistic | p-value | Statistic | p-value |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Argentina | 46 | -3.6967 | 0.0042 | -3.9301 | 0.0018 | -3.6784 | 0.0238 | -3.9495 | 0.0104 | -3.7322 | 0.0037 | -3.7785 | 0.0031 | -3.7222 | 0.0209 | -3.7930 | 0.0169 |
| Australia | 66 | -5.2139 | 0.0000 | -3.5058 | 0.0078 | -5.5276 | 0.0000 | -3.8190 | 0.0156 | -6.4433 | 0.0000 | -4.1656 | 0.0008 | -6.4614 | 0.0000 | -4.0789 | 0.0068 |
| Brazil | 47 | -11.8818 | 0.0000 | -4.5360 | 0.0002 | -11.8897 | 0.0000 | -4.6070 | 0.0010 | -8.5174 | 0.0000 | -4.9686 | 0.0000 | -8.5000 | 0.0000 | -5.1191 | 0.0001 |
| Canada | 67 | -8.5631 | 0.0000 | -5.7109 | 0.0000 | -8.5199 | 0.0000 | -5.6808 | 0.0000 | -6.6374 | 0.0000 | -3.8611 | 0.0023 | -6.8215 | 0.0000 | -4.0049 | 0.0087 |
| Chile | 42 | -6.8211 | 0.0000 | -4.4822 | 0.0002 | -7.4301 | 0.0000 | -5.8224 | 0.0000 | -4.7078 | 0.0001 | -4.3664 | 0.0003 | -4.7118 | 0.0007 | -4.5701 | 0.0012 |
| China | 38 | -1.6351 | 0.4648 | -1.4375 | 0.5642 | -3.1454 | 0.0958 | -2.9090 | 0.1593 | -3.1532 | 0.0229 | -2.5785 | 0.0975 | -3.2383 | 0.0770 | -2.6537 | 0.2558 |
| Colombia | 66 | -6.8116 | 0.0000 | -4.7719 | 0.0001 | -6.8274 | 0.0000 | -4.6046 | 0.0010 | -4.9084 | 0.0000 | -3.2386 | 0.0179 | -5.3605 | 0.0000 | -3.5785 | 0.0317 |
| Czech Republic | 46 | -5.8810 | 0.0000 | -3.3330 | 0.0135 | -6.3862 | 0.0000 | -3.8430 | 0.0145 | -3.8908 | 0.0021 | -3.7123 | 0.0039 | -3.9537 | 0.0102 | -3.7683 | 0.0182 |
| Denmark | 67 | -6.7959 | 0.0000 | -2.9745 | 0.0373 | -7.1644 | 0.0000 | -3.2918 | 0.0676 | -7.2084 | 0.0000 | -4.0945 | 0.0010 | -7.2896 | 0.0000 | -4.2809 | 0.0034 |
| Egypt | 50 | -2.8124 | 0.0565 | -2.9448 | 0.0404 | -2.8183 | 0.1903 | -3.0488 | 0.1189 | -3.3336 | 0.0134 | -3.7003 | 0.0041 | -3.3018 | 0.0660 | -3.6573 | 0.0253 |
| France | 66 | -6.4459 | 0.0000 | -3.0325 | 0.0320 | -6.6349 | 0.0000 | -3.0698 | 0.1136 | -6.3697 | 0.0000 | -3.1929 | 0.0204 | -6.3771 | 0.0000 | -3.3946 | 0.0521 |
| Germany | 67 | -7.5302 | 0.0000 | -4.3715 | 0.0003 | -7.5727 | 0.0000 | -4.4374 | 0.0019 | -6.1066 | 0.0000 | -2.7730 | 0.0622 | -6.1509 | 0.0000 | -2.9165 | 0.1569 |
| Hungary | 50 | -3.9408 | 0.0018 | -2.1759 | 0.2151 | -5.3666 | 0.0000 | -2.8809 | 0.1688 | -3.6449 | 0.0050 | -1.7828 | 0.3890 | -4.6684 | 0.0008 | -2.2053 | 0.4869 |
| India | 42 | -1.7977 | 0.3816 | -2.9620 | 0.0386 | -1.7664 | 0.7207 | -2.8948 | 0.1639 | -1.8732 | 0.3448 | -2.4663 | 0.1239 | -2.8842 | 0.1677 | -3.4909 | 0.0404 |
| Israel | 65 | -10.6333 | 0.0000 | -6.2611 | 0.0000 | -10.5354 | 0.0000 | -6.3681 | 0.0000 | -11.4581 | 0.0000 | -5.4161 | 0.0000 | -11.3651 | 0.0000 | -5.3960 | 0.0000 |
| Italy | 66 | -10.2347 | 0.0000 | -6.2756 | 0.0000 | -10.1526 | 0.0000 | -6.2210 | 0.0000 | -7.2097 | 0.0000 | -3.9052 | 0.0020 | -7.1704 | 0.0000 | -3.9902 | 0.0091 |
| Japan | 67 | -7.6701 | 0.0000 | -4.6541 | 0.0001 | -7.9015 | 0.0000 | -4.8274 | 0.0004 | -6.3565 | 0.0000 | -3.1283 | 0.0245 | -7.1941 | 0.0000 | -4.2835 | 0.0033 |
| Kuwait | 54 | -2.9540 | 0.0394 | -4.0091 | 0.0014 | -2.9993 | 0.1323 | -4.1117 | 0.0061 | -3.7407 | 0.0036 | -4.1134 | 0.0009 | -3.7123 | 0.0216 | -4.1018 | 0.0063 |
| Malaysia | 62 | -5.4420 | 0.0000 | -4.8627 | 0.0000 | -5.3951 | 0.0000 | -4.8195 | 0.0004 | -4.9120 | 0.0000 | -4.2500 | 0.0005 | -4.8684 | 0.0004 | -4.2146 | 0.0043 |
| Mexico | 54 | -6.6540 | 0.0000 | -2.9283 | 0.0422 | -6.9826 | 0.0000 | -3.4295 | 0.0476 | -5.4831 | 0.0000 | -2.6532 | 0.0825 | -5.7220 | 0.0000 | -2.9312 | 0.1524 |
| Morrocco | 66 | -4.7996 | 0.0001 | -3.7485 | 0.0035 | -4.8223 | 0.0004 | -3.7750 | 0.0179 | -3.4026 | 0.0109 | -4.2816 | 0.0005 | -3.5090 | 0.0384 | -4.3819 | 0.0023 |
| New Zealand | 66 | -4.7343 | 0.0001 | -2.8442 | 0.0522 | -4.7183 | 0.0006 | -2.8199 | 0.1897 | -6.6125 | 0.0000 | -2.9161 | 0.0435 | -6.5359 | 0.0000 | -2.7444 | 0.2181 |
| Norway | 67 | -7.0528 | 0.0000 | -3.4433 | 0.0096 | -7.1621 | 0.0000 | -3.9937 | 0.0090 | -8.9314 | 0.0000 | -3.9836 | 0.0015 | -8.9130 | 0.0000 | -4.0478 | 0.0075 |
| Pakistan | 61 | -8.2472 | 0.0000 | -4.1316 | 0.0009 | -8.5108 | 0.0000 | -4.5006 | 0.0015 | -9.2249 | 0.0000 | -4.1294 | 0.0009 | -9.1805 | 0.0000 | -4.1220 | 0.0059 |
| Peru | 62 | -5.6886 | 0.0000 | -3.2662 | 0.0165 | -6.1146 | 0.0000 | -3.4038 | 0.0509 | -5.6369 | 0.0000 | -3.2859 | 0.0155 | -6.6648 | 0.0000 | -3.7482 | 0.0194 |
| Philippines | 66 | -7.3885 | 0.0000 | -4.8503 | 0.0000 | -7.4715 | 0.0000 | -4.7771 | 0.0005 | -8.2759 | 0.0000 | -6.5503 | 0.0000 | -8.3802 | 0.0000 | -6.4439 | 0.0000 |
| Poland | 46 | -9.4847 | 0.0000 | -11.3466 | 0.0000 | -9.3710 | 0.0000 | -12.6209 | 0.0000 | -9.1497 | 0.0000 | -8.0615 | 0.0000 | -9.1269 | 0.0000 | -10.2979 | 0.0000 |
| Saudi Arabia | 66 | -3.0373 | 0.0316 | -3.9423 | 0.0017 | -3.3743 | 0.0549 | -4.4234 | 0.0020 | -3.9599 | 0.0016 | -4.9062 | 0.0000 | -3.9077 | 0.0118 | -4.8563 | 0.0004 |
| Singapore | 66 | -6.6390 | 0.0000 | -3.3934 | 0.0112 | -6.6008 | 0.0000 | -3.3894 | 0.0528 | -5.8661 | 0.0000 | -3.0543 | 0.0301 | -5.8541 | 0.0000 | -3.0779 | 0.1116 |
| Slovakia | 54 | -5.4460 | 0.0000 | -2.6475 | 0.0836 | -5.8324 | 0.0000 | -3.0452 | 0.1199 | -5.5268 | 0.0000 | -3.1210 | 0.0250 | -5.8932 | 0.0000 | -3.5849 | 0.0311 |
| Slovenia | 50 | -5.3383 | 0.0000 | -3.4055 | 0.0108 | -5.6416 | 0.0000 | -3.7911 | 0.0170 | -6.4178 | 0.0000 | -2.9613 | 0.0387 | -6.4319 | 0.0000 | -2.9785 | 0.1382 |
| South Africa | 65 | -8.3620 | 0.0000 | -5.0511 | 0.0000 | -8.2943 | 0.0000 | -5.0065 | 0.0002 | -7.1016 | 0.0000 | -3.7684 | 0.0032 | -7.0981 | 0.0000 | -3.7934 | 0.0169 |
| South Korea | 66 | -7.8862 | 0.0000 | -4.6966 | 0.0001 | -7.9004 | 0.0000 | -4.7798 | 0.0005 | -7.3653 | 0.0000 | -5.2871 | 0.0000 | -7.3055 | 0.0000 | -5.2525 | 0.0001 |
| Sweden | 67 | -4.8308 | 0.0000 | -3.9088 | 0.0020 | -4.8257 | 0.0004 | -3.9086 | 0.0118 | -6.3495 | 0.0000 | -3.5936 | 0.0059 | -6.2903 | 0.0000 | -3.5934 | 0.0304 |
| Switzerland | 66 | -6.9327 | 0.0000 | -3.7591 | 0.0034 | -7.0461 | 0.0000 | -3.7941 | 0.0169 | -6.2137 | 0.0000 | -2.8204 | 0.0554 | -6.1718 | 0.0000 | -2.8693 | 0.1727 |
| Taiwan | 66 | -6.8356 | 0.0000 | -4.4974 | 0.0002 | -6.8062 | 0.0000 | -4.5123 | 0.0014 | -6.7911 | 0.0000 | -4.9520 | 0.0000 | -6.7597 | 0.0000 | -4.9927 | 0.0002 |
| Thailand | 63 | -6.1305 | 0.0000 | -5.8981 | 0.0000 | -6.0776 | 0.0000 | -5.8450 | 0.0000 | -5.3590 | 0.0000 | -5.6236 | 0.0000 | -5.3132 | 0.0001 | -5.5745 | 0.0000 |
| Turkey | 62 | -5.0300 | 0.0000 | -3.0968 | 0.0268 | -6.3247 | 0.0000 | -4.7985 | 0.0005 | -4.9244 | 0.0000 | -3.2050 | 0.0197 | -6.0109 | 0.0000 | -4.6058 | 0.0010 |
| UK | 67 | -6.4611 | 0.0000 | -3.4952 | 0.0081 | -6.4436 | 0.0000 | -3.4950 | 0.0399 | -5.3122 | 0.0000 | -3.4323 | 0.0099 | -5.2999 | 0.0001 | -3.4388 | 0.0464 |
| USA | 67 | -3.6164 | 0.0055 | -2.5691 | 0.0996 | -3.7103 | 0.0217 | -2.7416 | 0.2192 | -5.9884 | 0.0000 | -3.5146 | 0.0076 | -6.0600 | 0.0000 | -3.9677 | 0.0098 |
| Venezuela | 54 | -4.9607 | 0.0000 | -4.1768 | 0.0007 | -4.9477 | 0.0003 | -4.1622 | 0.0051 | -5.9850 | 0.0000 | -3.8891 | 0.0021 | -6.0762 | 0.0000 | -3.8455 | 0.0144 |

Table B5 (cont.)  Producer prices (PPI) and competitors' prices (CP) in first differences, Augmented Dickey-Fuller test statistics and respective p-values for AR(1) and AR(2) models both with constant and with constant and a linear trend.

| Country | Obs | PPI | | | | | | | | Competitors' prices (CP) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Lag 1 | | Lag 2 | | Lag 1 with trend | | Lag 2 with trend | | Lag 1 | | Lag 2 | | Lag 1 with trend | | Lag 2 with trend | |
| | | Statistic | p-value | Statistic | p-value | Statistic | p-value | Statistic | p-value | Statistic | p-value | Statistic | p-value | Statistic | p-value | Statistic | p-value |
| Argentina | 46 | -3.0585 | 0.0298 | -3.2828 | 0.0157 | -3.1081 | 0.1043 | -3.4121 | 0.0498 | -4.1445 | 0.0008 | -3.5545 | 0.0067 | -4.1607 | 0.0051 | -3.6130 | 0.0288 |
| Australia | 66 | -6.0737 | 0.0000 | -3.0238 | 0.0327 | -6.3013 | 0.0000 | -3.4304 | 0.0475 | -8.1263 | 0.0000 | -4.8056 | 0.0001 | -8.2550 | 0.0000 | -4.8735 | 0.0003 |
| Brazil | 47 | -3.9080 | 0.0020 | -3.4206 | 0.0103 | -3.8631 | 0.0136 | -3.3620 | 0.0567 | -5.9854 | 0.0000 | -4.2832 | 0.0005 | -6.0192 | 0.0000 | -4.4343 | 0.0019 |
| Canada | 67 | -5.9105 | 0.0000 | -4.1657 | 0.0008 | -5.8713 | 0.0000 | -4.1300 | 0.0057 | -6.9628 | 0.0000 | -4.8398 | 0.0000 | -7.2185 | 0.0000 | -5.3040 | 0.0001 |
| Chile | 42 | -4.7192 | 0.0001 | -3.7851 | 0.0031 | -4.7684 | 0.0005 | -3.7940 | 0.0169 | -5.3163 | 0.0000 | -3.5253 | 0.0074 | -5.2940 | 0.0001 | -3.6537 | 0.0256 |
| China | 38 | -2.9015 | 0.0452 | -1.8201 | 0.3705 | -4.0006 | 0.0088 | -2.8454 | 0.1808 | -5.5021 | 0.0000 | -3.4481 | 0.0094 | -6.0666 | 0.0000 | -3.3789 | 0.0543 |
| Colombia | 67 | -4.4547 | 0.0002 | -2.6238 | 0.0882 | -6.6975 | 0.0000 | -4.8643 | 0.0004 | -6.5748 | 0.0000 | -4.4870 | 0.0002 | -6.6307 | 0.0000 | -4.4555 | 0.0018 |
| Czech Republic | 46 | -2.8215 | 0.0553 | -3.5903 | 0.0059 | -2.7488 | 0.2164 | -3.7009 | 0.0223 | -6.6748 | 0.0000 | -4.2442 | 0.0006 | -6.7899 | 0.0000 | -4.4048 | 0.0022 |
| Denmark | 67 | -6.2400 | 0.0000 | -2.9079 | 0.0444 | -6.6257 | 0.0000 | -3.4039 | 0.0509 | -5.7362 | 0.0000 | -2.9570 | 0.0391 | -5.7713 | 0.0000 | -3.0116 | 0.1289 |
| Egypt | 50 | -4.9041 | 0.0000 | -1.8118 | 0.3746 | -5.0429 | 0.0002 | -2.0054 | 0.5985 | -5.3134 | 0.0000 | -2.4917 | 0.1175 | -5.4340 | 0.0000 | -2.6648 | 0.2510 |
| France | 67 | -2.9087 | 0.0443 | -4.1602 | 0.0008 | -3.1129 | 0.1032 | -4.6599 | 0.0008 | -6.3461 | 0.0000 | -4.0887 | 0.0010 | -6.3152 | 0.0000 | -4.0553 | 0.0073 |
| Germany | 67 | -4.6332 | 0.0001 | -2.8784 | 0.0479 | -4.6954 | 0.0007 | -3.0573 | 0.1168 | -6.4963 | 0.0000 | -3.0445 | 0.0309 | -6.7777 | 0.0000 | -3.4343 | 0.0470 |
| Hungary | 50 | -2.5775 | 0.0977 | -1.6997 | 0.4313 | -3.7341 | 0.0202 | -2.2967 | 0.4358 | -3.8921 | 0.0021 | -2.0660 | 0.2584 | -4.7297 | 0.0006 | -1.9894 | 0.6072 |
| India | 42 | -5.3997 | 0.0000 | -3.5422 | 0.0070 | -5.3304 | 0.0000 | -3.4948 | 0.0399 | -6.8947 | 0.0000 | -4.1575 | 0.0008 | -6.7853 | 0.0000 | -4.0589 | 0.0072 |
| Israel | 66 | -4.8698 | 0.0000 | -3.1113 | 0.0257 | -5.7644 | 0.0000 | -3.5321 | 0.0361 | -9.3536 | 0.0000 | -4.6245 | 0.0001 | -9.2994 | 0.0000 | -4.5778 | 0.0011 |
| Italy | 67 | -3.5221 | 0.0074 | -3.7456 | 0.0035 | -3.4938 | 0.0401 | -3.6874 | 0.0232 | -5.1012 | 0.0000 | -3.4328 | 0.0099 | -5.3353 | 0.0000 | -3.6551 | 0.0255 |
| Japan | 67 | -3.7199 | 0.0038 | -2.4831 | 0.1196 | -4.0308 | 0.0079 | -3.1171 | 0.1022 | -6.9373 | 0.0000 | -3.1707 | 0.0217 | -7.3158 | 0.0000 | -3.4855 | 0.0410 |
| Kuwait | 54 | -6.4078 | 0.0000 | -3.2915 | 0.0153 | -6.4363 | 0.0000 | -3.3536 | 0.0579 | -7.2194 | 0.0000 | -2.8779 | 0.0480 | -7.2620 | 0.0000 | -2.8943 | 0.1641 |
| Malaysia | 62 | -5.5445 | 0.0000 | -3.8483 | 0.0025 | -5.5775 | 0.0000 | -3.9285 | 0.0111 | -6.2338 | 0.0000 | -3.8408 | 0.0025 | -6.3020 | 0.0000 | -4.0037 | 0.0087 |
| Mexico | 54 | -3.3971 | 0.0111 | -2.1262 | 0.2341 | -3.8202 | 0.0156 | -2.6124 | 0.2742 | -6.5804 | 0.0000 | -3.1092 | 0.0259 | -6.7936 | 0.0000 | -3.4774 | 0.0419 |
| Morocco | 66 | -4.7711 | 0.0001 | -3.6063 | 0.0056 | -4.7633 | 0.0005 | -3.6337 | 0.0271 | -7.8904 | 0.0000 | -3.6013 | 0.0057 | -8.3460 | 0.0000 | -3.9804 | 0.0094 |
| New Zealand | 66 | -5.2860 | 0.0000 | -2.0352 | 0.2714 | -5.5657 | 0.0000 | -2.3902 | 0.3848 | -5.0984 | 0.0000 | -2.5422 | 0.1055 | -5.0087 | 0.0002 | -2.3787 | 0.3910 |
| Norway | 66 | -5.3718 | 0.0000 | -2.4616 | 0.1251 | -5.4872 | 0.0000 | -2.6140 | 0.2735 | -5.6189 | 0.0000 | -2.7312 | 0.0688 | -5.6187 | 0.0000 | -2.7519 | 0.2152 |
| Pakistan | 60 | -5.3386 | 0.0000 | -2.9039 | 0.0449 | -5.5961 | 0.0000 | -3.3177 | 0.0634 | -6.9589 | 0.0000 | -3.9312 | 0.0018 | -7.1247 | 0.0000 | -4.2433 | 0.0038 |
| Peru | 62 | -7.5456 | 0.0000 | -2.3433 | 0.1584 | -9.0272 | 0.0000 | -2.5066 | 0.3247 | -13.6022 | 0.0000 | -3.5010 | 0.0080 | -15.7105 | 0.0000 | -4.4055 | 0.0021 |
| Philippines | 66 | -5.6845 | 0.0000 | -4.9229 | 0.0000 | -5.6395 | 0.0000 | -4.9300 | 0.0003 | -6.9685 | 0.0000 | -4.7872 | 0.0001 | -6.9759 | 0.0000 | -4.7171 | 0.0007 |
| Poland | 46 | -3.2826 | 0.0157 | -2.8041 | 0.0577 | -3.5655 | 0.0329 | -3.1512 | 0.0946 | -6.0385 | 0.0000 | -3.5792 | 0.0062 | -6.0119 | 0.0000 | -3.5695 | 0.0325 |
| Saudia Arabia | 66 | -7.1746 | 0.0000 | -4.4933 | 0.0002 | -7.1754 | 0.0000 | -4.4848 | 0.0016 | -7.2313 | 0.0000 | -4.0771 | 0.0011 | -7.2073 | 0.0000 | -4.1782 | 0.0048 |
| Singapore | 67 | -8.0136 | 0.0000 | -4.5651 | 0.0001 | -8.4298 | 0.0000 | -6.3307 | 0.0000 | -9.5563 | 0.0000 | -5.8170 | 0.0000 | -9.7479 | 0.0000 | -7.3447 | 0.0000 |
| Slovakia | 54 | -5.6181 | 0.0000 | -3.3275 | 0.0137 | -5.5955 | 0.0000 | -3.2272 | 0.0791 | -6.6099 | 0.0000 | -4.3149 | 0.0004 | -7.0239 | 0.0000 | -4.5506 | 0.0012 |
| Slovenia | 50 | -2.9645 | 0.0383 | -5.3648 | 0.0000 | -3.0248 | 0.1253 | -5.3711 | 0.0000 | -6.6428 | 0.0000 | -3.1258 | 0.0247 | -6.7845 | 0.0000 | -3.3319 | 0.0612 |
| South Africa | 67 | -4.3863 | 0.0003 | -3.3899 | 0.0113 | -4.3355 | 0.0028 | -3.0540 | 0.1176 | -6.6356 | 0.0000 | -3.6215 | 0.0054 | -6.5952 | 0.0000 | -3.6014 | 0.0297 |
| South Korea | 67 | -6.5224 | 0.0000 | -4.9653 | 0.0000 | -6.4818 | 0.0000 | -4.9064 | 0.0003 | -7.8380 | 0.0000 | -4.5089 | 0.0002 | -7.9664 | 0.0000 | -4.6653 | 0.0008 |
| Sweden | 67 | -5.5680 | 0.0000 | -3.5863 | 0.0060 | -5.5226 | 0.0000 | -3.6028 | 0.0296 | -6.5899 | 0.0000 | -3.5629 | 0.0065 | -6.5450 | 0.0000 | -3.5336 | 0.0359 |
| Switzerland | 66 | -3.8277 | 0.0026 | -2.2363 | 0.1933 | -3.9911 | 0.0091 | -2.3433 | 0.4102 | -8.9442 | 0.0000 | -4.1716 | 0.0007 | -9.0693 | 0.0000 | -4.2413 | 0.0039 |
| Taiwan | 66 | -5.1159 | 0.0000 | -4.2404 | 0.0006 | -5.1520 | 0.0001 | -4.3702 | 0.0024 | -7.4893 | 0.0000 | -5.3083 | 0.0000 | -7.4827 | 0.0000 | -5.5784 | 0.0000 |
| Thailand | 63 | -5.5595 | 0.0000 | -4.3094 | 0.0004 | -5.6265 | 0.0000 | -4.3796 | 0.0024 | -5.9700 | 0.0000 | -4.9076 | 0.0000 | -5.9221 | 0.0000 | -4.8625 | 0.0004 |
| Turkey | 62 | -7.5456 | 0.0000 | -2.3433 | 0.1584 | -9.0272 | 0.0000 | -2.5066 | 0.3247 | -6.6828 | 0.0000 | -3.6852 | 0.0043 | -7.6367 | 0.0000 | -4.4200 | 0.0020 |
| UK | 67 | -5.5867 | 0.0000 | -3.2333 | 0.0181 | -5.7976 | 0.0000 | -3.0527 | 0.1179 | -6.1524 | 0.0000 | -4.2336 | 0.0006 | -6.1231 | 0.0000 | -4.2728 | 0.0035 |
| USA | 67 | -6.6014 | 0.0000 | -3.7219 | 0.0038 | -6.8179 | 0.0000 | -4.4620 | 0.0017 | -6.3104 | 0.0000 | -2.9465 | 0.0402 | -6.4836 | 0.0000 | -3.4839 | 0.0411 |
| Venezuela | 54 | -3.1487 | 0.0232 | -2.8676 | 0.0492 | -3.6757 | 0.0240 | -3.3127 | 0.0642 | -5.5050 | 0.0000 | -3.9460 | 0.0017 | -5.6457 | 0.0000 | -4.1586 | 0.0052 |

## Table B6

Export prices (XP) and import prices (MP) in levels, Augmented Dickey-Fuller test statistics and respective p-values for AR(1) and AR(2) models both with constant and with constant and a linear trend.

| Country | Obs | Export prices (XP) Lag 1 Statistic | Lag 1 p-value | Lag 2 Statistic | Lag 2 p-value | Lag 1 with trend Statistic | Lag 1 with trend p-value | Lag 2 with trend Statistic | Lag 2 with trend p-value | Import prices (MP) Lag 1 Statistic | Lag 1 p-value | Lag 2 Statistic | Lag 2 p-value | Lag 1 with trend Statistic | Lag 1 with trend p-value | Lag 2 with trend Statistic | Lag 2 with trend p-value |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Argentina | 46 | -0.1954 | 0.9391 | -0.7060 | 0.8452 | -1.5478 | 0.8122 | -2.0629 | 0.5668 | -0.3343 | 0.9205 | -0.6391 | 0.8619 | -1.6356 | 0.7782 | -2.0775 | 0.5587 |
| Australia | 66 | 0.8611 | 0.9926 | -0.4593 | 0.8997 | -1.2434 | 0.9012 | -2.5166 | 0.3197 | -1.8974 | 0.3333 | -2.4986 | 0.1158 | -1.7297 | 0.7376 | -2.5227 | 0.3167 |
| Brazil | 47 | -1.6425 | 0.4610 | -1.2450 | 0.6539 | -3.6606 | 0.0251 | -1.2221 | 0.9059 | -1.6434 | 0.4605 | -1.1055 | 0.7129 | -3.5856 | 0.0311 | -2.5568 | 0.3002 |
| Canada | 67 | -1.2092 | 0.6696 | -1.2779 | 0.6392 | -2.1848 | 0.4984 | -1.9316 | 0.6382 | -1.8036 | 0.3787 | -2.0383 | 0.2700 | -1.0689 | 0.9341 | -1.2004 | 0.9104 |
| Chile | 42 | 1.0274 | 0.9945 | 1.2464 | 0.9963 | -1.9835 | 0.6104 | -1.8255 | 0.6923 | -1.3339 | 0.6135 | -1.3013 | 0.6286 | -0.8597 | 0.9603 | -1.0441 | 0.9379 |
| China | 38 | -5.1709 | 0.0000 | -3.0558 | 0.0300 | 0.0967 | 0.9951 | -1.7431 | 0.7315 | -2.2494 | 0.1888 | -2.2435 | 0.1908 | -1.3088 | 0.8857 | -3.0838 | 0.1101 |
| Colombia | 66 | -1.6515 | 0.4563 | -0.7983 | 0.8196 | -2.2096 | 0.4844 | -1.4706 | 0.8390 | -3.5101 | 0.0077 | -2.0198 | 0.2780 | 0.1118 | 0.9952 | -0.2839 | 0.9899 |
| Czech Republic | 46 | -2.6220 | 0.0885 | -2.6878 | 0.0762 | -1.7184 | 0.7427 | -1.8907 | 0.6595 | -1.5215 | 0.5229 | -2.4214 | 0.1358 | -1.6024 | 0.7915 | -2.5185 | 0.3188 |
| Denmark | 67 | 1.1896 | 0.9959 | 0.5065 | 0.9851 | -1.3320 | 0.8798 | -1.6552 | 0.7701 | 0.0370 | 0.9615 | -0.4792 | 0.8960 | -2.2506 | 0.4614 | -2.4628 | 0.3468 |
| Egypt | 50 | 0.9623 | 0.9939 | -0.4302 | 0.9049 | -1.2264 | 0.9049 | -2.0118 | 0.5950 | -0.4747 | 0.8969 | -0.8396 | 0.8072 | -1.3221 | 0.8824 | -2.8342 | 0.1847 |
| France | 66 | -2.1710 | 0.2169 | -2.7196 | 0.0707 | -1.9536 | 0.6265 | -2.6550 | 0.2552 | -1.9076 | 0.3285 | -2.5672 | 0.1000 | -1.5665 | 0.8053 | -2.4036 | 0.3777 |
| Germany | 67 | -2.2069 | 0.2037 | -2.5171 | 0.1114 | -2.1361 | 0.5259 | -2.5087 | 0.3236 | -1.3061 | 0.6264 | -2.5601 | 0.1015 | -1.3035 | 0.8871 | -2.4802 | 0.3379 |
| Hungary | 50 | -5.7818 | 0.0000 | -4.5503 | 0.0002 | -2.6627 | 0.2519 | -3.6231 | 0.0279 | -5.6129 | 0.0000 | -4.1483 | 0.0008 | -2.7040 | 0.2344 | -3.3256 | 0.0622 |
| India | 42 | -1.1870 | 0.6792 | -0.7646 | 0.8293 | -1.4834 | 0.8347 | -3.0683 | 0.1140 | 4.7472 | 1.0000 | 1.2675 | 0.9964 | 0.0189 | 0.9944 | -2.1360 | 0.5259 |
| Israel | 65 | -0.6083 | 0.8691 | -1.2929 | 0.6324 | -3.1591 | 0.0929 | -2.6991 | 0.2365 | -0.5912 | 0.8730 | -0.7672 | 0.8286 | -3.0326 | 0.1232 | -2.0823 | 0.5560 |
| Italy | 66 | -0.3856 | 0.9125 | -0.6014 | 0.8707 | -2.5716 | 0.2931 | -2.6263 | 0.2680 | 0.3646 | 0.9801 | -0.1649 | 0.9426 | -2.0990 | 0.5466 | -2.7574 | 0.2130 |
| Japan | 67 | -2.3482 | 0.1569 | -2.4457 | 0.1293 | -2.3425 | 0.4106 | -1.8888 | 0.6605 | -0.4981 | 0.8924 | -0.9120 | 0.7840 | -0.2635 | 0.9903 | -0.5271 | 0.9823 |
| Kuwait | 54 | 1.0518 | 0.9948 | -0.2931 | 0.9265 | -1.2957 | 0.8890 | -3.9372 | 0.0108 | -1.3253 | 0.6175 | -1.7463 | 0.4074 | -1.6030 | 0.7913 | -4.2278 | 0.0041 |
| Malaysia | 62 | -0.6616 | 0.8564 | -0.9105 | 0.7845 | -1.7669 | 0.7205 | -2.7327 | 0.2227 | -0.8821 | 0.7938 | -1.1036 | 0.7136 | -1.5474 | 0.8124 | -2.4334 | 0.3620 |
| Mexico | 54 | -2.5367 | 0.1068 | -2.4835 | 0.1195 | -1.6029 | 0.7913 | -2.0344 | 0.5826 | -2.7869 | 0.0602 | -2.3265 | 0.1636 | -1.8509 | 0.6797 | -2.0802 | 0.5572 |
| Morocco | 66 | 0.5451 | 0.9862 | -0.0003 | 0.9585 | -2.1517 | 0.5170 | -3.7393 | 0.0199 | 0.8561 | 0.9925 | -0.1387 | 0.9454 | -2.0896 | 0.5519 | -4.7418 | 0.0006 |
| New Zealand | 66 | -1.1300 | 0.7030 | -2.1078 | 0.2414 | -1.5502 | 0.8113 | -2.5784 | 0.2899 | -1.6314 | 0.4667 | -2.1755 | 0.2153 | -1.6081 | 0.7892 | -2.1720 | 0.5056 |
| Norway | 67 | 0.4279 | 0.9825 | 0.0608 | 0.9633 | -1.4077 | 0.8586 | -1.8803 | 0.6648 | -2.0672 | 0.2579 | -2.0444 | 0.2674 | -2.3259 | 0.4197 | -2.3937 | 0.3830 |
| Pakistan | 61 | -2.0363 | 0.2709 | -1.3388 | 0.6113 | -1.2604 | 0.8974 | -0.6575 | 0.9758 | 0.2018 | 0.9724 | 0.0452 | 0.9621 | -3.5096 | 0.0384 | -2.5900 | 0.2845 |
| Peru | 62 | -4.4522 | 0.0002 | -3.6922 | 0.0042 | -3.8596 | 0.0138 | -4.3212 | 0.0029 | -5.1501 | 0.0000 | -6.1525 | 0.0000 | -3.6179 | 0.0284 | -6.4782 | 0.0000 |
| Philippines | 66 | -1.4115 | 0.5768 | -1.3186 | 0.6206 | -1.3643 | 0.8711 | -1.6102 | 0.7884 | -1.7581 | 0.4015 | -1.6294 | 0.4678 | -2.3482 | 0.4075 | -1.8690 | 0.6706 |
| Poland | 46 | -2.5210 | 0.1104 | -1.0840 | 0.7214 | -5.3028 | 0.0001 | -2.3808 | 0.3899 | -1.7465 | 0.4073 | -1.4179 | 0.5736 | -3.2421 | 0.0763 | -1.2596 | 0.8976 |
| Saudi Arabia | 66 | 2.0280 | 0.9987 | -0.0487 | 0.9543 | -1.1838 | 0.9138 | -2.4478 | 0.3545 | -2.1079 | 0.2413 | -3.5761 | 0.0062 | -2.0746 | 0.5603 | -3.6212 | 0.0281 |
| Singapore | 66 | -0.6201 | 0.8664 | -0.8894 | 0.7914 | -1.8748 | 0.6676 | -3.2575 | 0.0735 | -0.0542 | 0.9538 | -0.9689 | 0.7645 | -1.6440 | 0.7747 | -3.1277 | 0.0998 |
| Slovakia | 54 | -2.3300 | 0.1625 | -2.3495 | 0.1565 | -1.0616 | 0.9352 | -2.5668 | 0.2954 | -2.3367 | 0.1604 | -2.4311 | 0.1331 | -1.3147 | 0.8842 | -2.3359 | 0.4142 |
| Slovenia | 50 | -2.4920 | 0.1174 | -2.3217 | 0.1651 | -1.9835 | 0.6104 | -2.2154 | 0.4812 | -1.4936 | 0.5367 | -1.0480 | 0.7354 | -2.3350 | 0.4147 | -2.3281 | 0.4185 |
| South Africa | 65 | -0.4857 | 0.8948 | -0.4318 | 0.9047 | -2.8597 | 0.1759 | -2.1190 | 0.5354 | -0.8538 | 0.8028 | -1.1498 | 0.6948 | -1.2284 | 0.9045 | -1.4305 | 0.8517 |
| South Korea | 66 | -2.6152 | 0.0899 | -2.1704 | 0.2171 | -2.4774 | 0.3394 | -1.9830 | 0.6107 | -1.0010 | 0.7529 | -0.7422 | 0.8355 | -3.1587 | 0.0929 | -2.7930 | 0.1995 |
| Sweden | 67 | -1.3882 | 0.5879 | -1.5910 | 0.4881 | -1.4302 | 0.8518 | -2.0890 | 0.5523 | -0.2377 | 0.9339 | -0.3794 | 0.9135 | -1.8739 | 0.6681 | -2.4517 | 0.3525 |
| Switzerland | 66 | -2.8312 | 0.0540 | -3.6897 | 0.0043 | -2.9114 | 0.1586 | -4.2976 | 0.0032 | -1.7939 | 0.3835 | -2.0950 | 0.2465 | -1.5421 | 0.8143 | -2.0662 | 0.5650 |
| Taiwan | 63 | -1.6836 | 0.4396 | -1.9645 | 0.3023 | -1.5408 | 0.8148 | -1.9429 | 0.6322 | -0.6073 | 0.8693 | -0.7338 | 0.8378 | -2.1266 | 0.5312 | -3.0200 | 0.1266 |
| Thailand | 62 | -0.7096 | 0.8442 | -0.9588 | 0.7680 | -2.2612 | 0.4555 | -3.4171 | 0.0491 | -0.4194 | 0.9068 | -0.7785 | 0.8254 | -2.3378 | 0.4132 | -3.3465 | 0.0590 |
| Turkey | 67 | -4.1142 | 0.0009 | -3.0297 | 0.0322 | 0.8293 | 1.0000 | 0.7059 | 1.0000 | -3.7583 | 0.0034 | -2.6972 | 0.0745 | 0.8992 | 1.0000 | 0.3189 | 0.9963 |
| UK | 67 | -1.6648 | 0.4493 | -1.8633 | 0.3495 | -1.5498 | 0.8115 | -1.7792 | 0.7147 | -1.4312 | 0.5672 | -2.3972 | 0.1425 | -1.3648 | 0.8709 | -2.3299 | 0.4175 |
| USA | 67 | 1.0533 | 0.9948 | -0.2920 | 0.9266 | 0.2269 | 0.9959 | -1.0794 | 0.9324 | 0.6595 | 0.9890 | -0.0456 | 0.9546 | -0.2076 | 0.9914 | -0.8708 | 0.9592 |
| Venezuela | 54 | -1.3120 | 0.6237 | -1.1062 | 0.7126 | -2.3367 | 0.4138 | -3.4403 | 0.0462 | -2.7859 | 0.0603 | -1.4606 | 0.5529 | -3.1398 | 0.0971 | -2.3516 | 0.4056 |

Table B6 (cont.) Producer prices (PPI) and competitors' prices (CP) in levels, Augmented Dickey-Fuller test statistics and respective p-values for AR(1) and AR(2) models both with constant and with constant and a linear trend.

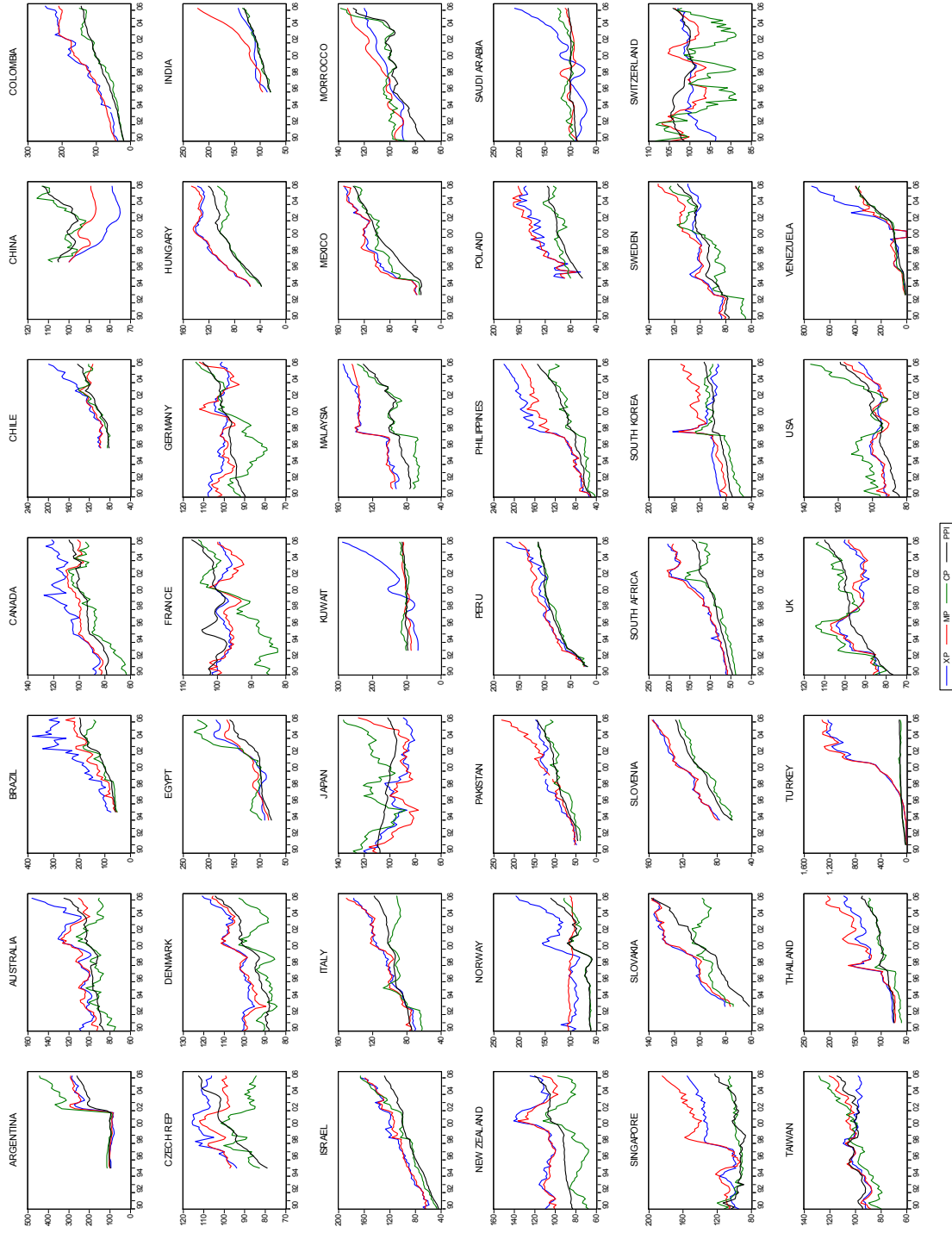| Country | Obs | PPI Lag 1 Statistic | p-value | Lag 2 Statistic | p-value | Lag 1 with trend Statistic | p-value | Lag 2 with trend Statistic | p-value | CP Lag 1 Statistic | p-value | Lag 2 Statistic | p-value | Lag 1 with trend Statistic | p-value | Lag 2 with trend Statistic | p-value |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Argentina | 46 | 0.4496 | 0.9833 | -0.0034 | 0.9583 | -1.3265 | 0.8812 | -1.7066 | 0.7480 | -0.1125 | 0.9482 | -0.5173 | 0.8886 | -1.6389 | 0.7768 | -2.0263 | 0.5871 |
| Australia | 66 | 1.5070 | 0.9975 | 1.2437 | 0.9963 | 0.0985 | 0.9951 | -0.5453 | 0.9815 | -2.5605 | 0.1014 | -2.8589 | 0.0503 | -2.2679 | 0.4518 | -2.4149 | 0.3718 |
| Brazil | 47 | -0.3129 | 0.9237 | -0.3311 | 0.9210 | -1.3505 | 0.8749 | -1.9311 | 0.6384 | -1.4023 | 0.5812 | -1.2527 | 0.6505 | -1.2128 | 0.9078 | -1.3938 | 0.8627 |
| Canada | 67 | -0.6971 | 0.8475 | -0.8890 | 0.7916 | -1.4547 | 0.8441 | -1.9844 | 0.6099 | -2.1022 | 0.2436 | -2.2883 | 0.1758 | -1.1876 | 0.9130 | -0.6812 | 0.9744 |
| Chile | 42 | 0.4696 | 0.9839 | 0.1805 | 0.9711 | -2.1724 | 0.5054 | -2.5722 | 0.2929 | -1.0329 | 0.7411 | -1.1954 | 0.6756 | -1.3535 | 0.8740 | -0.5885 | 0.9795 |
| China | 38 | 0.7828 | 0.9914 | -0.5537 | 0.8811 | -0.7326 | 0.9709 | -1.3960 | 0.8621 | -0.9636 | 0.7663 | -1.0600 | 0.7308 | -1.9730 | 0.6161 | -2.3772 | 0.3918 |
| Colombia | 67 | -7.6747 | 0.0000 | -5.4513 | 0.0000 | -1.0419 | 0.9382 | -0.6715 | 0.9750 | -1.8721 | 0.3453 | -1.3894 | 0.5874 | -1.6906 | 0.7550 | -1.4088 | 0.8583 |
| Czech Republic | 46 | -2.8822 | 0.0475 | -1.1524 | 0.6937 | -2.3543 | 0.4042 | -2.2824 | 0.4437 | -1.9743 | 0.2980 | -1.9393 | 0.3138 | -2.3730 | 0.3941 | -2.2978 | 0.4351 |
| Denmark | 67 | 2.0600 | 0.9987 | 1.2915 | 0.9966 | -0.8263 | 0.9634 | -1.8712 | 0.6695 | -0.7927 | 0.8213 | -1.9066 | 0.3290 | -1.6396 | 0.7765 | -2.7877 | 0.2015 |
| Egypt | 50 | 1.1085 | 0.9953 | 0.8108 | 0.9918 | -0.4053 | 0.9867 | -0.8505 | 0.9612 | 0.3332 | 0.9788 | 0.1342 | 0.9683 | -0.9250 | 0.9534 | -1.2324 | 0.9037 |
| France | 67 | 0.3623 | 0.9800 | -1.5929 | 0.4872 | -0.5892 | 0.9795 | -2.4182 | 0.3700 | -0.3721 | 0.9146 | -0.7460 | 0.8345 | -1.8715 | 0.6693 | -2.5361 | 0.3102 |
| Germany | 67 | 1.1904 | 0.9959 | 0.7566 | 0.9909 | 0.0142 | 0.9944 | -1.4104 | 0.8578 | 0.3999 | 0.9815 | -0.2904 | 0.9269 | -1.0525 | 0.9366 | -1.7860 | 0.7115 |
| Hungary | 50 | -7.7430 | 0.0000 | -3.6344 | 0.0051 | -3.0047 | 0.1308 | -3.4584 | 0.0441 | -6.0121 | 0.0000 | -2.8571 | 0.0506 | -3.5888 | 0.0308 | -2.6983 | 0.2368 |
| India | 42 | -0.1302 | 0.9464 | 0.1589 | 0.9699 | -2.3885 | 0.3858 | -3.4023 | 0.0511 | -0.4419 | 0.9029 | 0.0156 | 0.9598 | -3.8005 | 0.0165 | -3.5279 | 0.0365 |
| Israel | 66 | -4.9381 | 0.0000 | -2.9928 | 0.0356 | -3.1176 | 0.1021 | -3.1363 | 0.0979 | -0.8543 | 0.8026 | -0.5825 | 0.8749 | -2.7711 | 0.2078 | -2.3110 | 0.4279 |
| Italy | 67 | -0.1479 | 0.9445 | -0.3151 | 0.9233 | -1.1786 | 0.9148 | -2.3328 | 0.4159 | -2.2020 | 0.2055 | -2.4542 | 0.1270 | -1.2446 | 0.9010 | -1.9889 | 0.6075 |
| Japan | 67 | -1.3399 | 0.6107 | -1.6768 | 0.4431 | 2.3220 | 1.0000 | -0.0132 | 0.9941 | -1.1712 | 0.6859 | -1.1031 | 0.7138 | -1.5335 | 0.8174 | -1.4381 | 0.8494 |
| Kuwait | 54 | -0.0735 | 0.9520 | 0.1187 | 0.9673 | -1.4687 | 0.8396 | -1.3932 | 0.8629 | -0.8200 | 0.8132 | -0.7403 | 0.8360 | -0.8650 | 0.9598 | -0.7275 | 0.9713 |
| Malaysia | 62 | 0.9562 | 0.9938 | 0.6046 | 0.9877 | -1.3169 | 0.8837 | -1.5290 | 0.8190 | 0.3633 | 0.9801 | 0.1186 | 0.9673 | -2.2652 | 0.4533 | -2.4958 | 0.3301 |
| Mexico | 54 | -2.6113 | 0.0907 | -1.8801 | 0.3415 | -0.0656 | 0.9935 | -1.3072 | 0.8861 | -2.0783 | 0.2533 | -2.4947 | 0.1168 | -1.7417 | 0.7322 | -2.0889 | 0.5523 |
| Morrocco | 66 | 0.1693 | 0.9705 | -0.3078 | 0.9244 | -0.8101 | 0.9648 | -2.2720 | 0.4495 | 0.3888 | 0.9811 | 0.4845 | 0.9844 | -0.2831 | 0.9899 | -0.6387 | 0.9769 |
| New Zealand | 66 | 1.7064 | 0.9981 | 1.0517 | 0.9948 | -0.3808 | 0.9874 | -1.1031 | 0.9286 | -1.2905 | 0.6335 | -1.5904 | 0.4884 | -1.4273 | 0.8527 | -1.9887 | 0.6076 |
| Norway | 66 | 0.9038 | 0.9931 | -0.0692 | 0.9524 | -1.1692 | 0.9166 | -2.3396 | 0.4122 | -0.0299 | 0.9560 | -1.1494 | 0.6950 | -1.7497 | 0.7285 | -3.5132 | 0.0380 |
| Pakistan | 60 | -2.2371 | 0.1930 | -2.1412 | 0.2283 | -1.3489 | 0.8753 | -2.0818 | 0.5563 | -1.6526 | 0.4557 | -2.0278 | 0.2745 | -1.3117 | 0.8850 | -1.4023 | 0.8602 |
| Peru | 62 | -12.4288 | 0.0000 | -4.9626 | 0.0000 | -9.4426 | 0.0000 | -4.7845 | 0.0005 | -5.0133 | 0.0000 | -3.6645 | 0.0046 | -4.5928 | 0.0011 | -3.3848 | 0.0534 |
| Philippines | 66 | -0.3186 | 0.9228 | -0.1380 | 0.9455 | -2.3925 | 0.3836 | -4.1099 | 0.0061 | -1.4520 | 0.5571 | -1.1093 | 0.7113 | -2.4502 | 0.3533 | -2.6727 | 0.2476 |
| Poland | 46 | -7.3579 | 0.0000 | -2.2352 | 0.1937 | -4.0855 | 0.0066 | -2.5354 | 0.3105 | -1.8701 | 0.3463 | -1.7133 | 0.4242 | -2.1142 | 0.5381 | -2.1731 | 0.5050 |
| Saudia Arabia | 66 | -2.1353 | 0.2306 | -1.7609 | 0.4001 | -2.1842 | 0.4988 | -2.2346 | 0.4704 | -1.1817 | 0.6814 | -0.6194 | 0.8665 | -1.4543 | 0.8443 | -1.0099 | 0.9428 |
| Singapore | 67 | -0.1541 | 0.9438 | 0.2093 | 0.9728 | -1.1241 | 0.9249 | -0.9489 | 0.9506 | -2.2495 | 0.1888 | -2.2506 | 0.1884 | -2.4934 | 0.3313 | -2.9639 | 0.1424 |
| Slovakia | 54 | -1.0932 | 0.7178 | -0.6647 | 0.8557 | -2.5619 | 0.2978 | -3.1462 | 0.0957 | -2.9506 | 0.0398 | -2.2210 | 0.1987 | -2.2158 | 0.4809 | -1.9392 | 0.6341 |
| Slovenia | 50 | -5.7347 | 0.0000 | -1.4258 | 0.5698 | -3.7172 | 0.0212 | -2.0791 | 0.5578 | -1.6866 | 0.4380 | -1.9081 | 0.3283 | -1.4216 | 0.8545 | -2.1094 | 0.5408 |
| South Africa | 67 | -2.1903 | 0.2098 | -1.2712 | 0.6422 | -1.9069 | 0.6511 | -2.6407 | 0.2615 | -1.2418 | 0.6554 | -1.2355 | 0.6582 | -1.6464 | 0.7737 | -1.6252 | 0.7824 |
| South Korea | 67 | -1.1511 | 0.6943 | -0.8808 | 0.7942 | -2.0678 | 0.5641 | -2.1031 | 0.5443 | -2.0683 | 0.2574 | -1.8244 | 0.3684 | -1.8882 | 0.6608 | -1.4957 | 0.8306 |
| Sweden | 67 | 0.0543 | 0.9628 | -0.1105 | 0.9484 | -1.5143 | 0.8242 | -2.4869 | 0.3345 | -1.0047 | 0.7515 | -1.1023 | 0.7141 | -2.1592 | 0.5129 | -2.5968 | 0.2814 |
| Switzerland | 66 | -0.2849 | 0.9276 | -1.4037 | 0.5805 | 0.4583 | 0.9968 | -0.5205 | 0.9826 | -2.5012 | 0.1152 | -1.9526 | 0.3077 | -2.1003 | 0.5459 | -1.7557 | 0.7257 |
| Taiwan | 66 | -0.1200 | 0.9474 | -0.6591 | 0.8571 | -1.1482 | 0.9206 | -2.0365 | 0.5814 | -0.2556 | 0.9316 | 0.5528 | 0.9864 | -2.5487 | 0.3041 | -2.8741 | 0.1711 |
| Thailand | 63 | 1.0629 | 0.9949 | 0.3575 | 0.9798 | -1.7029 | 0.7496 | -2.9165 | 0.1569 | -0.9214 | 0.7809 | -0.8215 | 0.8127 | -2.5591 | 0.2991 | -2.8663 | 0.1736 |
| Turkey | 62 | -12.4288 | 0.0000 | -4.9626 | 0.0000 | -9.4426 | 0.0000 | -4.7845 | 0.0005 | -6.4553 | 0.0000 | -5.0323 | 0.0000 | -4.3734 | 0.0024 | -3.8798 | 0.0129 |
| UK | 67 | -4.4202 | 0.0003 | -2.1773 | 0.2146 | -3.9276 | 0.0111 | -2.6354 | 0.2639 | -1.4561 | 0.5551 | -2.5441 | 0.1051 | -1.6214 | 0.7840 | -2.4975 | 0.3292 |
| USA | 67 | 1.6951 | 0.9981 | 1.4660 | 0.9974 | 0.0713 | 0.9949 | -0.6265 | 0.9776 | 0.6184 | 0.9881 | 0.8661 | 0.9926 | 0.0142 | 0.9944 | 0.2288 | 0.9959 |
| Venezuela | 54 | -3.7995 | 0.0029 | -2.7894 | 0.0598 | -1.8577 | 0.6763 | -3.0440 | 0.1202 | -1.8639 | 0.3492 | -1.8354 | 0.3630 | -1.8520 | 0.6792 | -2.8999 | 0.1622 |

Table B7    Zivot-Andrews (1992) unit root test with an endogenous structural break with a break in the level or the trend.

| | Export price (XP) | | Import price (MP) | | Producer price (PPI) | | Competitors' price (CP) | |
|---|---|---|---|---|---|---|---|---|
| | Date | t-stat | Date | t-stat | Date | t-stat | Date | t-stat |
| Argentina | 2002q1 | -16.044*** | 2002q1 | -29.112*** | 2002q1 | -7.601*** | 2002q1 | -23.096*** |
| Australia | | -4.134 | | -3.644 | | -2.869 | | -3.524 |
| Brazil | | -4.512 | 2003q2 | -5.405** | | -4.420 | | -4.038 |
| Canada | | -4.428 | | -2.838 | | -3.963 | | -2.820 |
| Chile | | -4.407 | | -3.953 | | -3.776 | | -3.607 |
| China | | -3.989 | | -3.803 | | -3.774 | | -3.210 |
| Colombia | | -3.965 | 2002q4 | -4.862* | | -3.750 | | -4.102 |
| Czech Republic | | -3.916 | | -4.719 | | -4.343 | | -4.237 |
| Denmark | | -2.593 | | -2.860 | | -2.428 | | -3.010 |
| Egypt | | -3.754 | | -4.377 | | -2.779 | | -3.066 |
| France | | -3.850 | | -3.096 | | -4.631 | | -3.289 |
| Germany | | -3.130 | | -2.772 | | -4.142 | | -4.042 |
| Hungary | | -3.135 | | -3.076 | | -3.382 | | -2.527 |
| India | 2003q2 | -5.819*** | 2002q2 | -5.242** | | -4.667 | | -4.661 |
| Israel | 1992q4 | -5.101** | | -4.096 | | -3.471 | | -4.351 |
| Italy | | -4.517 | | -2.801 | | -3.882 | 1992q4 | -5.140** |
| Japan | | -2.885 | | -2.266 | | -4.212 | | -2.907 |
| Kuwait | 2002q2 | -5.256** | 1998q4 | -5.004* | | -3.701 | | -3.227 |
| Malaysia | 1997q4 | -6.994*** | 1997q4 | -10.103*** | | -4.775 | | -3.787 |
| Mexico | 1995q1 | -10.194*** | 1995q1 | -9.643*** | | -4.145 | 1995q1 | -8.346*** |
| Morrocco | 1995q1 | -5.303** | 1999q2 | -5.656*** | | -3.784 | | -4.389 |
| New Zealand | | -3.195 | | -3.232 | | -2.475 | | -2.935 |
| Norway | | -2.981 | | -4.109 | | -3.768 | 1999q2 | -4.831* |
| Pakistan | | -4.161 | 2002q1 | -5.258** | | -3.878 | | -4.262 |
| Peru | | -3.492 | | -3.873 | 2004q1 | -8.220*** | | -3.186 |
| Philippines | 1998q1 | -7.426*** | 1997q3 | -5.726*** | 2003q2 | -5.789*** | 1997q3 | -5.831*** |
| Poland | 1999q2 | -6.555*** | | -4.494 | | -3.243 | | -2.930 |
| Saudia Arabia | | -4.809 | 1999q1 | -5.781*** | | -3.761 | | -3.076 |
| Singapore | 1997q3 | -6.409*** | 1997q2 | -5.120** | | -2.484 | | -4.271 |
| Slovakia | | -4.645 | | -3.160 | | -3.089 | | -3.377 |
| Slovenia | | -2.914 | | -3.377 | 2000q3 | -5.399** | | -3.450 |
| South Africa | 2001q4 | -4.936* | | -3.405 | | -3.982 | | -4.310 |
| South Korea | 1997q4 | -5.746*** | 1997q4 | -6.348*** | | -4.461 | 1997q4 | -7.928*** |
| Sweden | | -4.427 | | -3.970 | | -3.436 | | -3.657 |
| Switzerland | | -3.181 | | -3.199 | | -2.636 | | -3.187 |
| Taiwan | | -3.681 | | -3.852 | | -3.450 | | -3.542 |
| Thailand | 1997q3 | -6.481*** | 1997q3 | -5.453** | | -3.714 | 1997q3 | -8.619*** |
| Turkey | | -2.359 | | -2.641 | 2004q1 | -8.220*** | | -3.847 |
| UK | | -2.888 | | -3.753 | | -2.479 | 1996q4 | -5.333** |
| USA | | -2.395 | | -3.576 | | -3.883 | | -2.788 |
| Venezuela | | -4.650 | | -3.982 | | -4.446 | | -4.085 |

*Note: Date denotes the timing of the minimum t-statistics (t-stat) of the Zivot-Andrews (1992) unit root test, in case of a structural break. ***, **, and * denote statistical significance at the 10%, 5%, and 1% level, respectively.*

Figure B1    Import prices (MP), export prices (XP), inverse of competitors' prices (CP), and domestic producer prices (PPI) in levels, by country.

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