Global Trade Flows: Revisiting the Exchange Rate Elasticities[1]

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[1] The views expressed in this paper are those of the authors and do not necessarily reflect those of the Banque de France, the Eurosystem or the Bank of Canada.

Motivation

- How do international trade prices and volumes respond to exchange rate changes?

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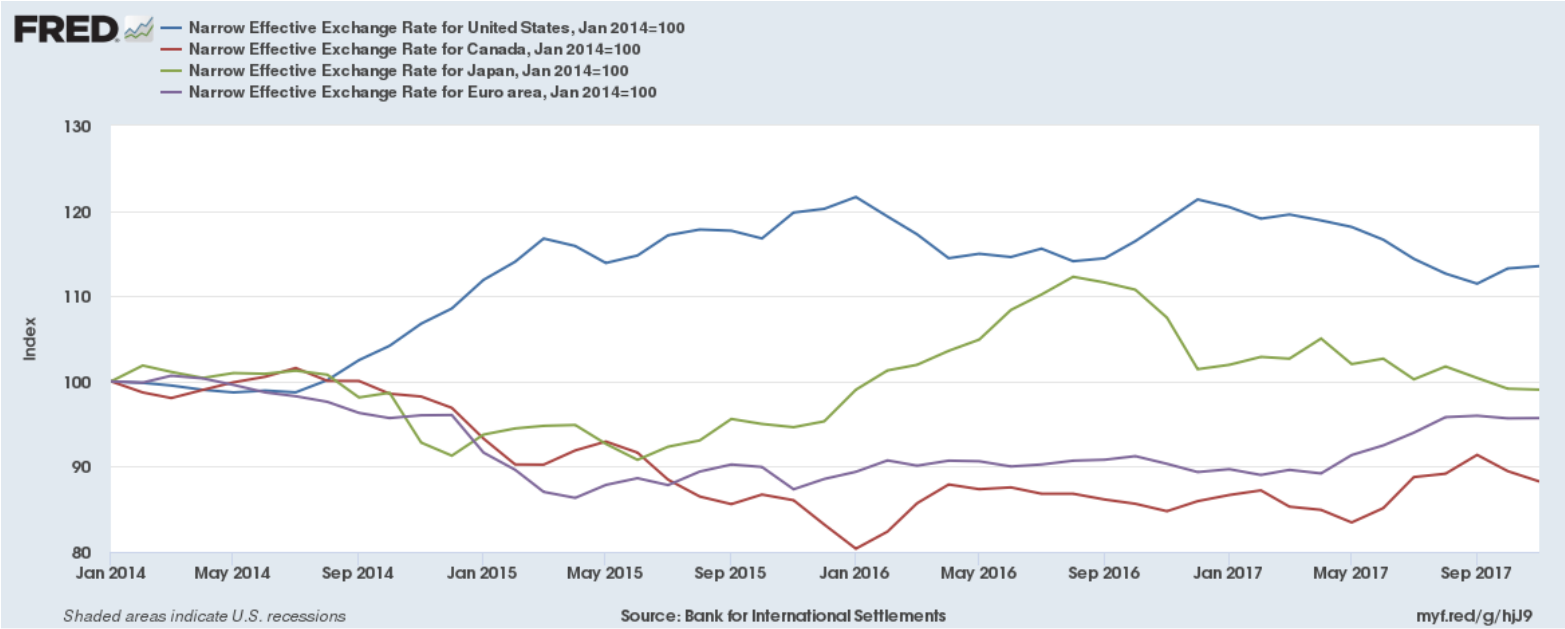
- How do international trade prices and volumes respond to exchange rate changes?
  - Important question given large exchange rate movements in the recent years



- Profound policy implications of Exchange Rate Pass Through (see recent speeches by Yellen, Fischer, Forbes, Poloz and Cœuré)

Contribution

- **We investigate the magnitude and determinants of price and quantity exchange rate elasticities**
- Use disaggregated bilateral trade flow data to estimate price and quantity elasticities for 51 countries (AEs and EMEs)
  - produce all four elasticities for a large set of countries using a unified data set based on the same estimation strategy
- Our estimation aims to address key omitted variable biases
  - unobserved marginal costs (intermediate imports)
  - competitor prices in the importing market (strategic complementarities)
- Given our estimates, we verify whether an exchange rate depreciation increases net exports, i.e. **is the Marshall-Lerner condition satisfied?**

Summary of our findings

- Quantity elasticities are significantly below one (≈0.5 on average for exports and imports).
- Exchange rate pass-through into import prices is incomplete (0.48 on average).
    - Export prices react significantly to exchange rate changes (0.65 on average)
- In spite of low quantity elasticities, the trade balance reacts positively to a depreciation in all countries because export and import prices adjust.
    - On average, a 10% depreciation is associated with a rise in the surplus (fall in the deficit) by 2 p.p. of GDP

Literature (and there are many more papers ...)

- Micro (firm or product-level data):
  - Gopinath and Rigobon (2008), Gaulier, Lahrèche-Révil and Méjean (2008), Berman, Martin and Mayer (2012), Amiti, Itskhoki and Koenings (2014) (2015), Devereux, Dong and Tomlin (2015), Imbs and Mejean (2015), Garetto (2016), Fitzgerald, Haller and Yedid-Levi (2016), Boz, Gopinath and Palgborg-Moller (2017), Fontagné, Martin and Orefice (2017)
- Macro (aggregate time series or panel data):
  - Krugman (1986), Knetter (1989), Campa and Goldberg (2005), Bussière, Delle Chiaie and Peltonen (2014), Gräb and Lafarguette (2015), Leigh, Lian, Poplawski-Ribeiro, Szymanski, Tsyrennikov and Yang (2017)

Model

- Export price of country i in importing country j in product k denominated in importer's currency:

$$p_{ijkt} = \frac{\theta_{ijkt}\tau_{ijk}mc_{ikt}}{s_{ijt}} \tag{1}$$

  - θ_{ijkt} ... mark-up
  - τ_{ijk} ... trade costs
  - s_{ijt} ... nominal exchange rate
  - mc_{ikt} ... marginal costs

- Taking logs and consider first difference, we get:

$$d\log(p_{ijkt}) = d\log(\theta_{ijkt}) + d\log mc_{ikt} - d\log(s_{ijt}) \tag{2}$$

Econometric challenges

- Ideal estimation equation for trade sector n of country i:

$$d\log(p_{ijkt}) = \alpha_i^n - \beta_{1,i}^n d\log(s_{ijt}) + \beta_{2,i}^n d\log(\widetilde{\theta_{ijkt}}) + \beta_{3,i}^n d\log(\widetilde{mc_{ikt}}) + e_{ijkt}$$

  - Exchange Rate Pass Through (ERPT) coefficient: $\beta_{1,i}^n$
    - $\beta_{1,i}^n = 1$: complete pass through
    - $\beta_{1,i}^n = 0$: complete pricing-to-market

- Mark-up and marginal costs are unobserved and potentially correlated with the exchange rate

  $\Rightarrow$ Exchange rate elasticities will depend on the econometric specification: focus on 2 main issues

Issue #1: marginal costs

- Change in marginal costs (mc_{ikt}) are positively correlated with change in exchange rate (for example due to imported intermediate inputs)
  - E.g. Depreciation of exporter's currency ($s_{ijt} \uparrow$) increases marginal costs ($\widetilde{mc_{ikt}} \uparrow$) because of intermediate imports
  - Including proxy for marginal costs should increase the exchange rate elasticities of export prices (increase ERPT)
- We include an exporter product time fixed effects (f_{ikt})
  - sufficient because marginal costs are independent of importing country

Issue #2: importer price index

- Change in markup (θ_{ijkt}) is negatively correlated with change in exchange rate (for example due to strategic complementarity in pricing behavior)
  - E.g. Monetary policy shock (accommodative) $\Rightarrow$ depreciation of the importer's currency ($s_{jit} \uparrow \Rightarrow s_{ijt} \downarrow$), rise in importer's price index ($P_{jkt} \uparrow$) and exporter's price response ($\widetilde{\theta_{ijkt}} \uparrow$) ceteris paribus.
  - Controlling for importer's price index may decrease exchange rate pass through.
  - Presence of distribution costs can provide an alternative explanation
- We include an importer product time fixed effects (f_{jkt})
  - We cannot control for bilateral changes in the mark-up.

Product level data

- Trade prices and volumes from BACI (based on Comtrade)
  - Product is defined as 6 digit HS code (app. 5000 products)
  - Trade prices are based on unit values
- Bilateral nominal exchange rate from IMF Financial statistics
- Sample period: 1995 - 2011
- 51 countries against 190 trading partners

Econometric specification: baseline

- Export price equation of country i:

$$d\log(p_{ijkt}) = -\beta_i^X d\log(s_{ijt}) + f_{ijk} + e_{ijkt}$$

  - export prices in importer's currency
    - export pass through coefficient ($n = X$): $(\beta_{1,i}^X)$

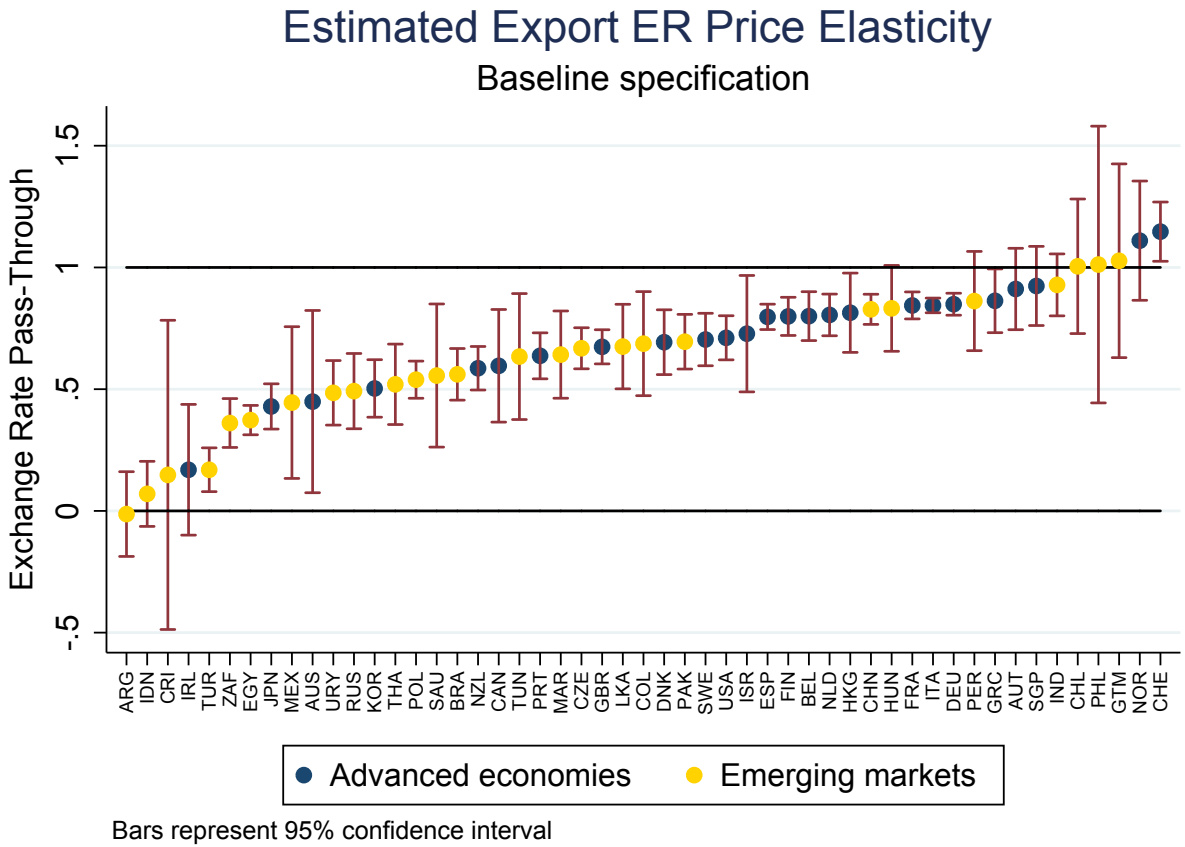
- Import price equation of country j:

$$d\log(p_{ijkt}) = -\beta_j^M d\log(s_{ijt}) + f_{ijk} + e_{ijkt}$$

  - import prices in importer's currency
    - import pass through coefficient ($n = M$): $(\beta_{1,j}^M)$

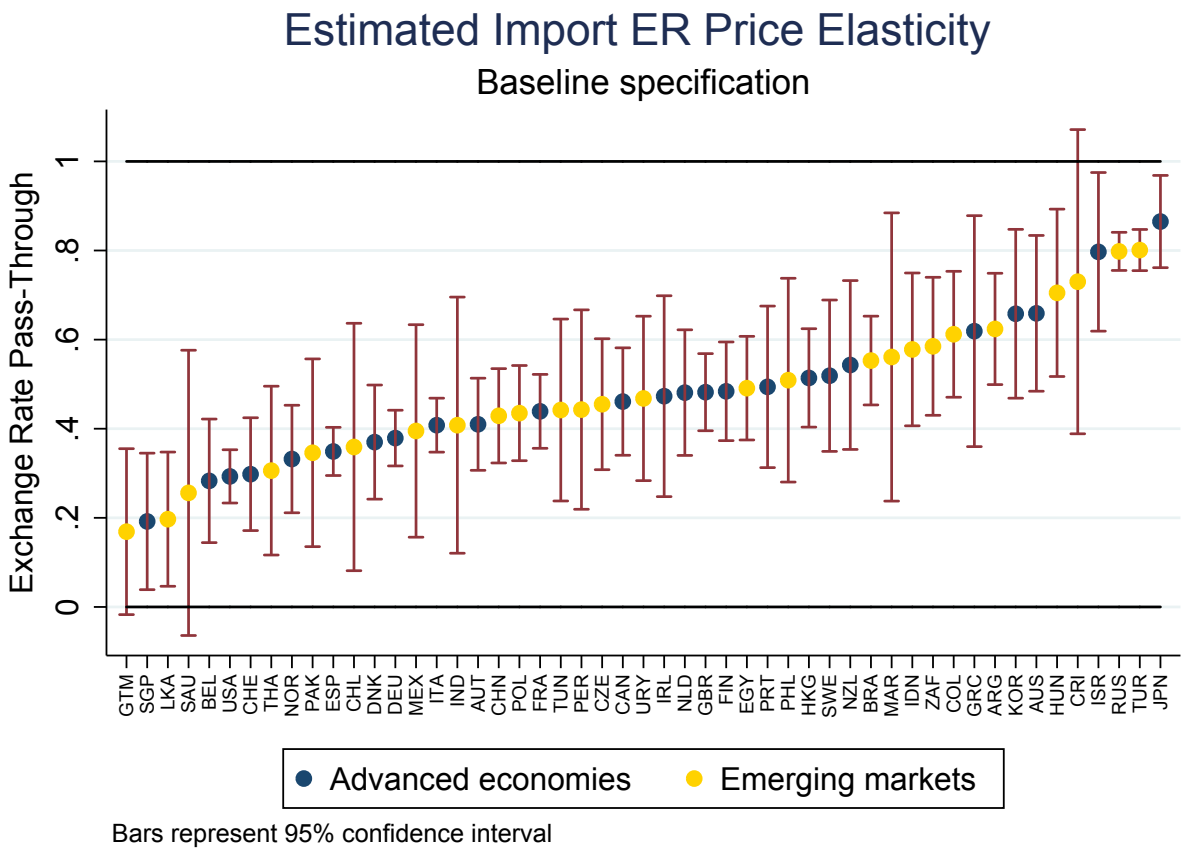
- Quantity equations include $d\log(GDP_{jt})$ but otherwise identical

ERPT on export prices in importers currency: baseline



- Unweighted average exchange rate elasticity of export prices is 0.65.
- Emerging markets have lower exchange rate elasticity

ERPT on import prices in importers currency: baseline



- Unweighted average pass through on import prices is 0.48

Econometric specification: fixed effects

- Export price equation of country i:

$$d\log(p_{ijkt}) = -\beta_i^X d\log(s_{ijt}) + f_{ijk} + f_{ikt} + e_{ijkt}$$

  - f_{ikt} controls for changes in $i's$ idiosyncratic effects, including marginal costs

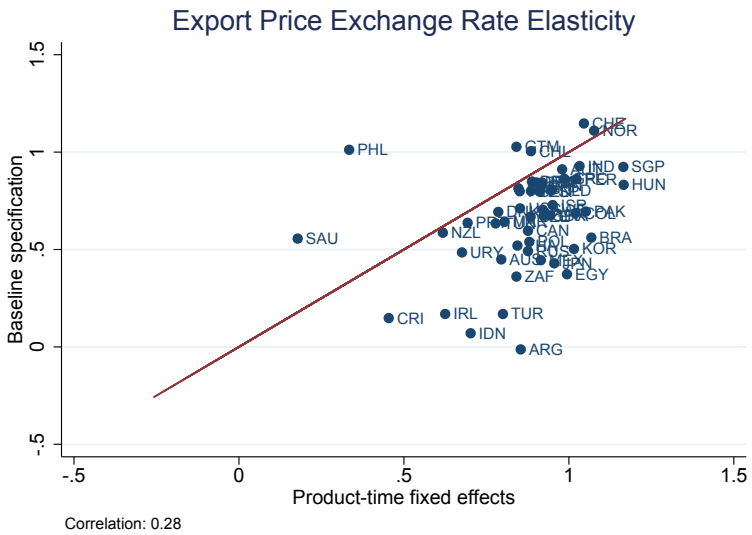
- Import price equation of country j:

$$d\log(p_{ijkt}) = -\beta_j^M d\log(s_{ijt}) + f_{ijk} + f_{jkt} + e_{ijkt}$$

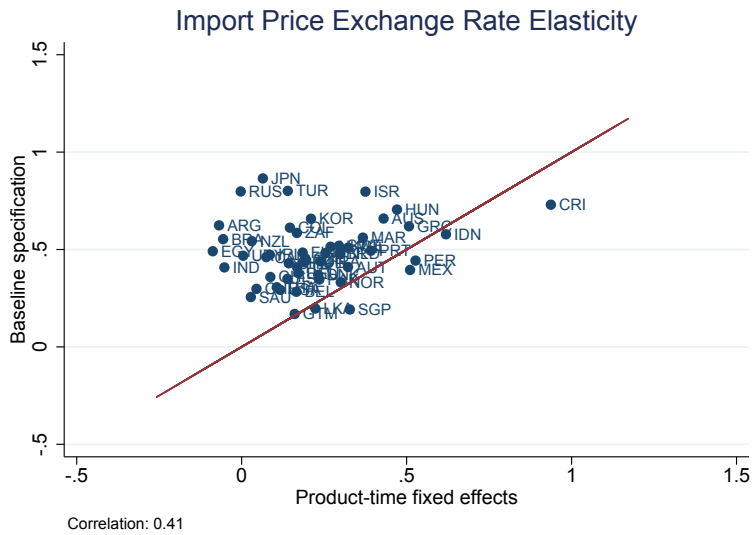
  - f_{jkt} controls for changes in $j's$ idiosyncratic effects, including mark-up changes due to strategic complementarities

- Quantity equations include $d\log(GDP_{jt})$ but otherwise identical

Comparison with baseline



(a) Exports



(b) Imports

- Direction of changes in elasticities is in line with theoretical predictions.
  - Median of export price baseline: 0.65
    - Median of export price fixed effects: 0.87
  - Median of import price baseline: 0.48
    - Median of import price fixed effects: 0.22

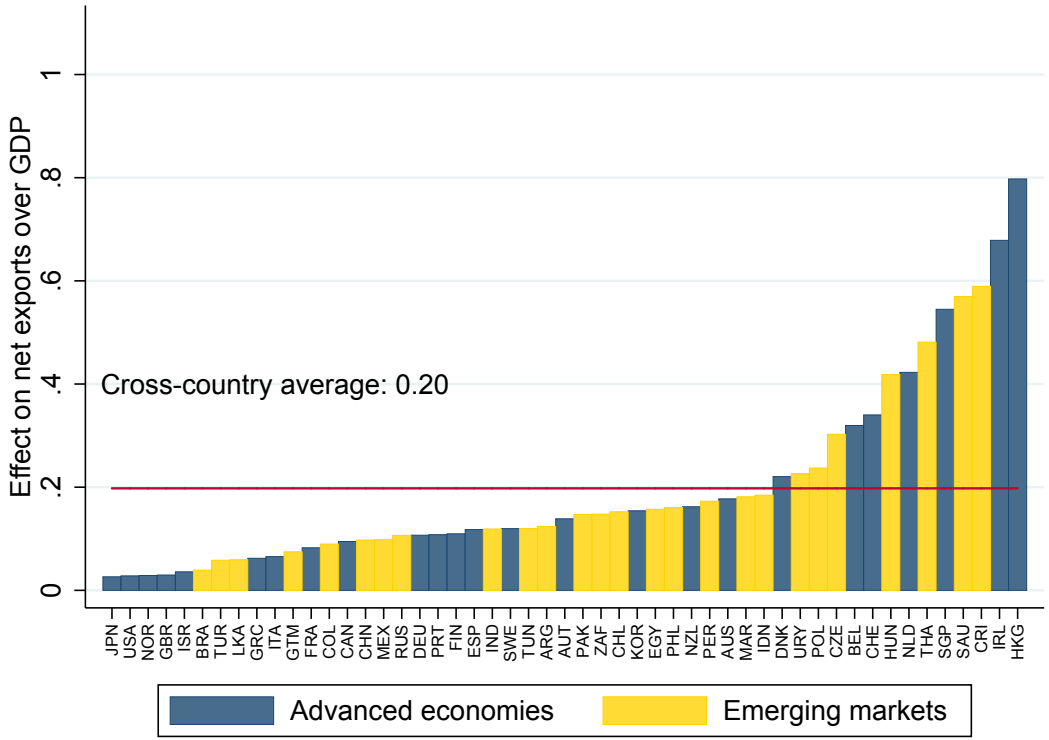
(Enhanced) Marshall Lerner Condition for baseline specification

- The Marshall-Lerner condition indicates the impact of an exchange rate change on net exports
- Assuming balanced trade, net exports increase after a depreciation if the following condition is verified:

$$\beta_i^X \left(1 - |\mu_i^X|\right) + \beta_i^M \left(1 - |\mu_i^M|\right) < 1$$

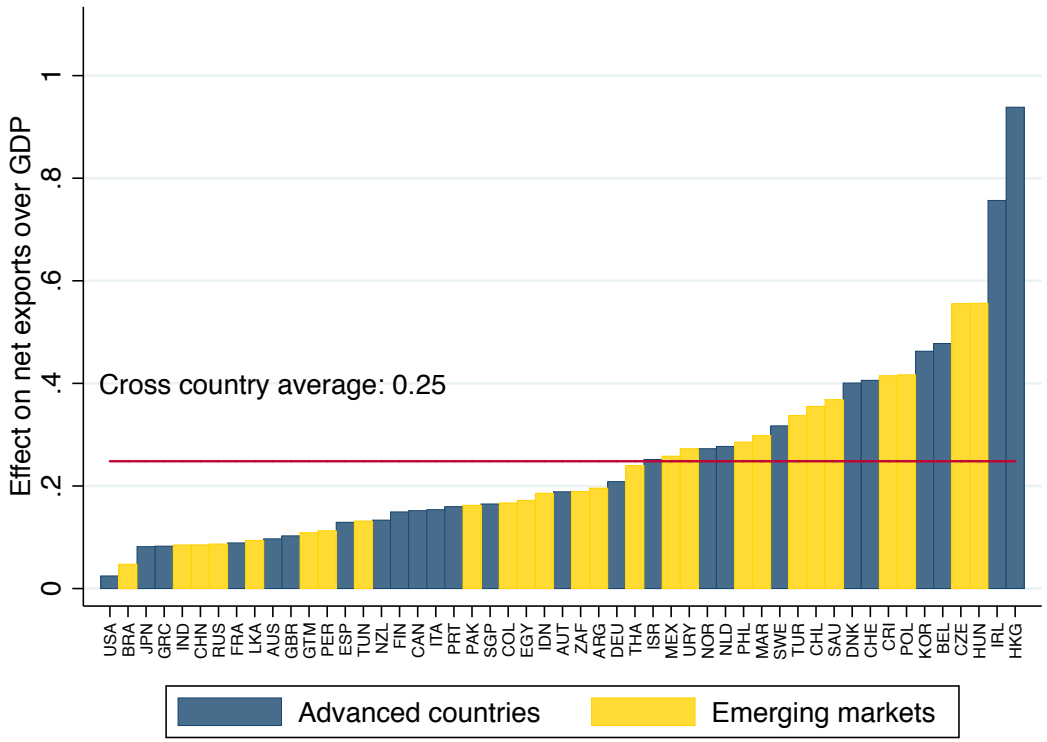
  - export (β_i^X) and import (β_i^M) exchange rate elasticities
  - export (μ_i^X) and import (μ_i^M) price elasticity
- In our sample, Marshall Lerner condition is satisfied for all countries

Effect of NEER on trade balance over GDP: baseline



- Calculation: $\frac{s_i P_i^X X_i}{P_i Y_i}\left(1-\beta_i^X(1-|\mu_i^X|)\right)-\frac{P_i^M M_i}{P_i Y_i}\left(\beta_i^M(1-|\mu_i^M|)\right)$
  - $(s_i P_i^X X_i / P_i Y_i)$ and $(P_i^M M_i / P_i Y_i)$ are nominal export and import shares of GDP in 2012

Effect of NEER on trade balance over GDP using FE estimates



- Effects are similar to baseline (in baseline the average was 0.2)
  - Rank correlation 0.8.

Conclusion

- We estimate exchange rate pass through and price elasticities for exports and imports
  - Our estimates reveal higher elasticities compared to previous studies (Bussière, Delle Chiaie, Peltonen (2014), Leigh et al. (2017))

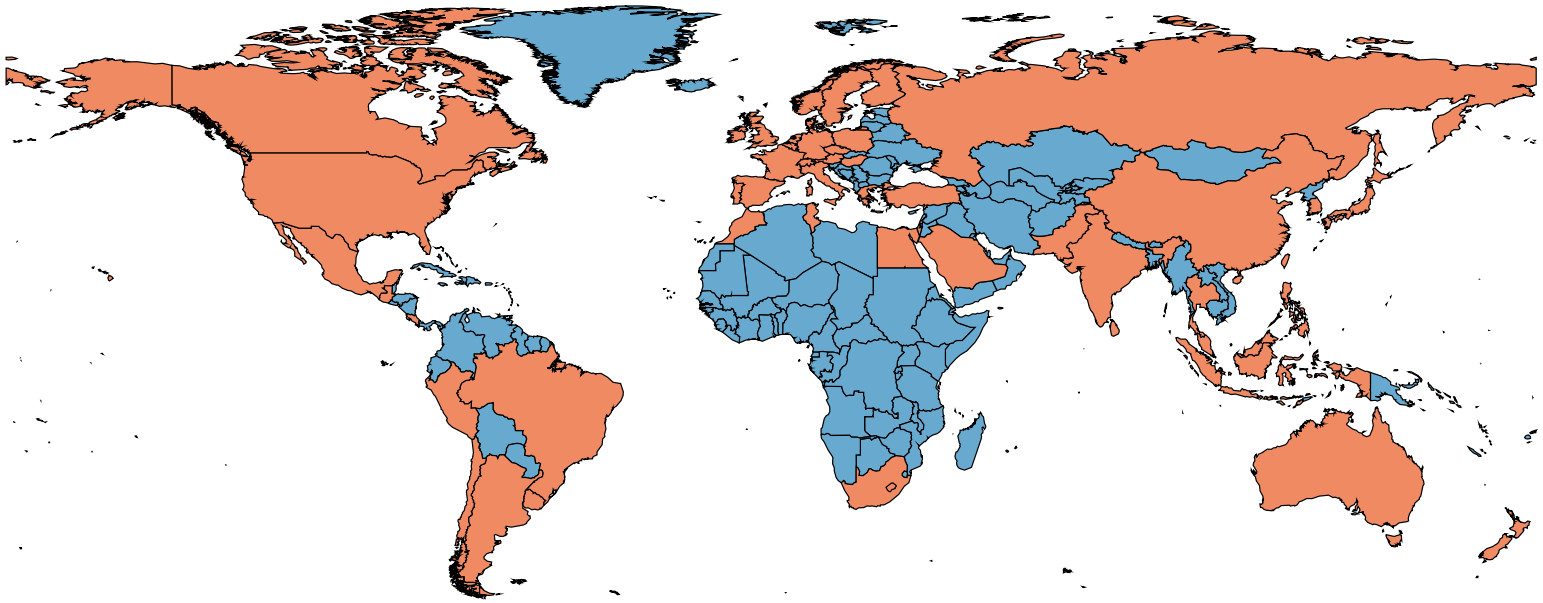
- Observed Exchange Rate Pass Through depends crucially on:
  - Marginal costs and pricing strategies
    - prices react stronger to changes in marginal costs rather than to adjustments of profit margins

- Our estimates imply that the enhanced Marshall Lerner conditions under incomplete pass-through are verified for all countries.
  - mainly due to the reaction of prices rather than quantities

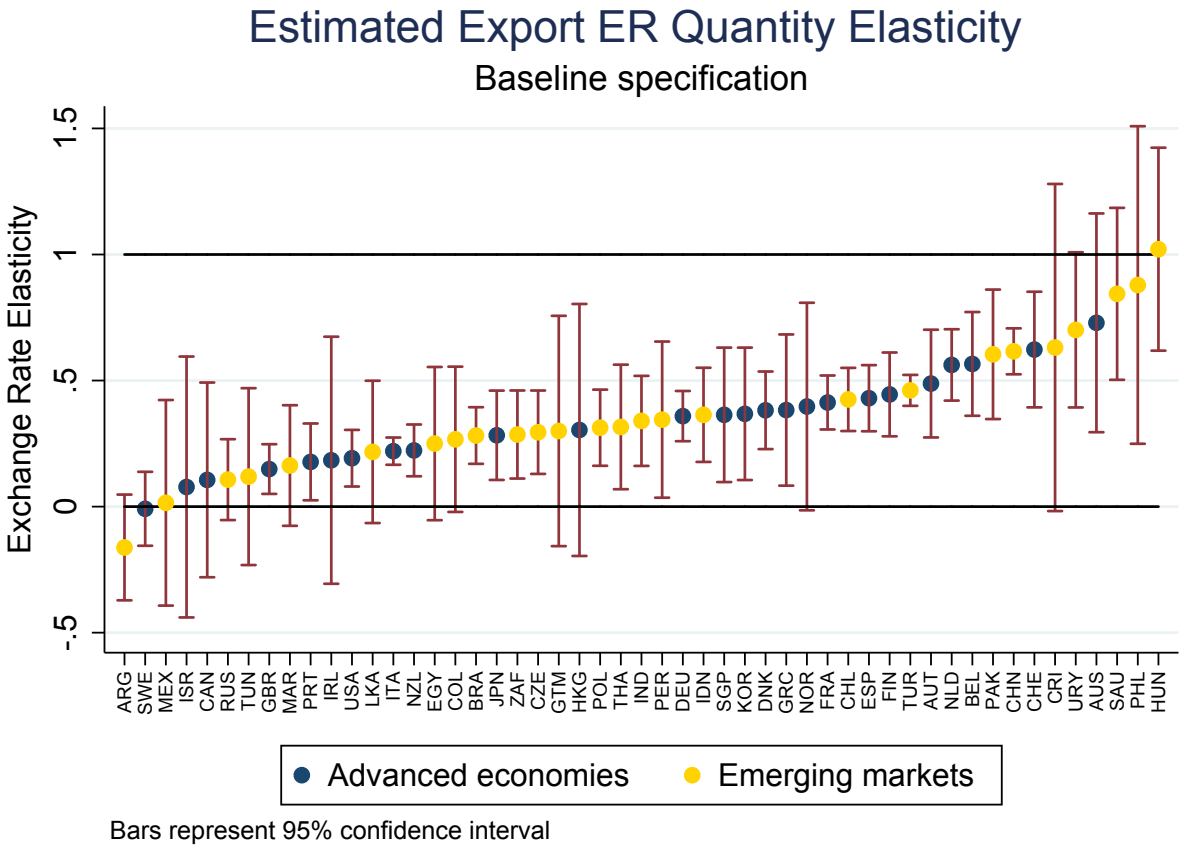
$\Rightarrow$ Exchange rate movements are important in correcting global imbalances

Appendix

Countries in the sample (orange)

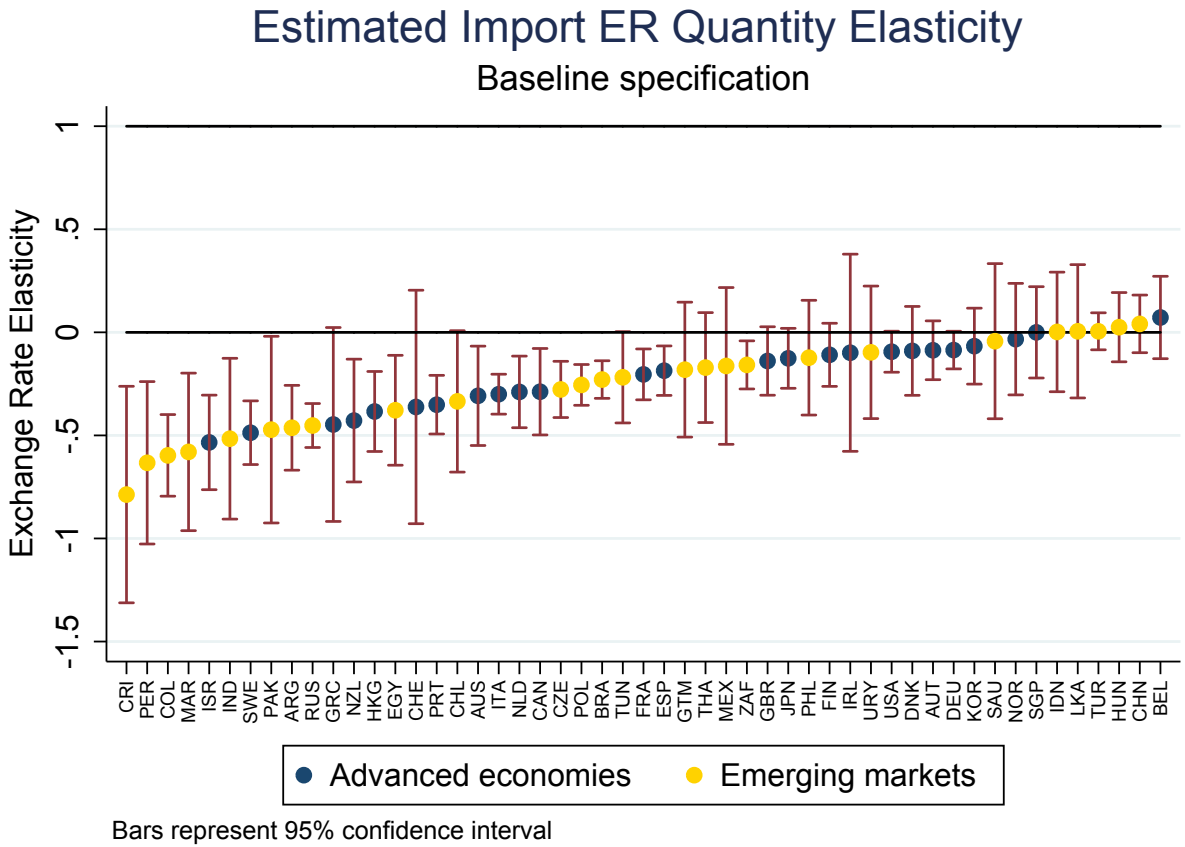


Exchange rate elasticity of export quantity: baseline



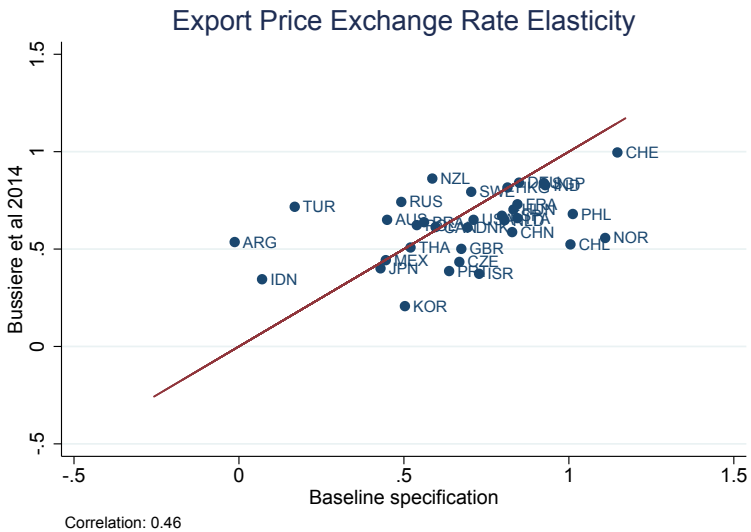
- A depreciation increases export quantities
- Average export quantity elasticity : 0.35 (compare to IMF: 0.32)

Exchange rate elasticity of import quantity: baseline

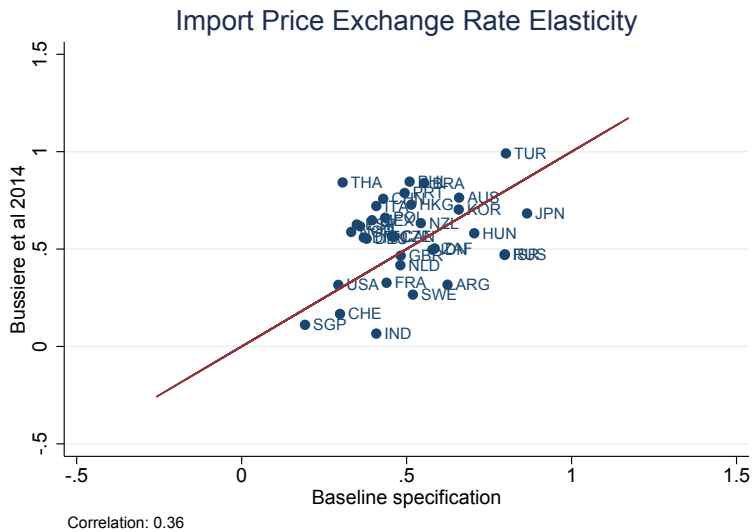


- A appreciation increases import quantities
- Average import quantity elasticity : -0.24 (compare to IMF: -0.29)

Comparison with previous estimates at the macro level



(c) Correlation is 0.45



(d) Correlation is 0.36

- We also find a strong negative correlation (-0.52) between export and import pass-through.

Price elasticities of quantities

- Use the baseline regression framework
- Obtain the export (import) price elasticities (μ_i^X):

$$\frac{\partial \log Q_i^X}{\partial \log s_i} = \frac{\partial \log Q_i^X}{\partial \log P_i^X} \frac{\partial \log P_i^X}{\partial \log s_i} = \mu_i^X \beta_i^X$$

  - where $\frac{\partial \log Q^X}{\partial \log s}$ is the elasticity of export quantity wrt to the nominal exchange rate

Robustness section

- We include inflation as control variables
  - Results remain unchanged
- We include two period lags to analyze dynamic exchange rate adjustments
  - Results show that most of the adjustment is completed in first year.
- Results are robust to unweighted regressions and definition of outliers.

Summary statistics on exchange rate elasticities for volumes and prices

	Median	Mean	Std. Dev.
Exports			
Price exchange rate elasticity – baseline	0.655	0.687	0.217
Price exchange rate elasticity – product-time fixed effects	0.866	0.885	0.184
Price exchange rate elasticity – 2-way fixed effects	0.570	0.576	0.226
Quantity elasticity – baseline	0.347	0.345	0.222
Quantity elasticity – product-time fixed effects	0.469	0.431	0.280
Quantity elasticity – 2-way fixed effects	0.364	0.353	0.250
Imports			
Price elasticity – baseline	0.480	0.468	0.161
Price elasticity – product-time fixed effects	0.220	0.188	0.192
Price elasticity – 2-way fixed effects	0.682	0.625	0.192
Quantity elasticity – baseline	-0.245	-0.204	0.202
Quantity elasticity – product-time fixed effects	-0.217	-0.158	0.268
Quantity elasticity – 2-way fixed effects	-0.520	-0.447	0.233