Exchange Rates and Trade: Disconnected?

Daniel Leigh Weicheng Lian Marcos Poplawski-Ribeiro

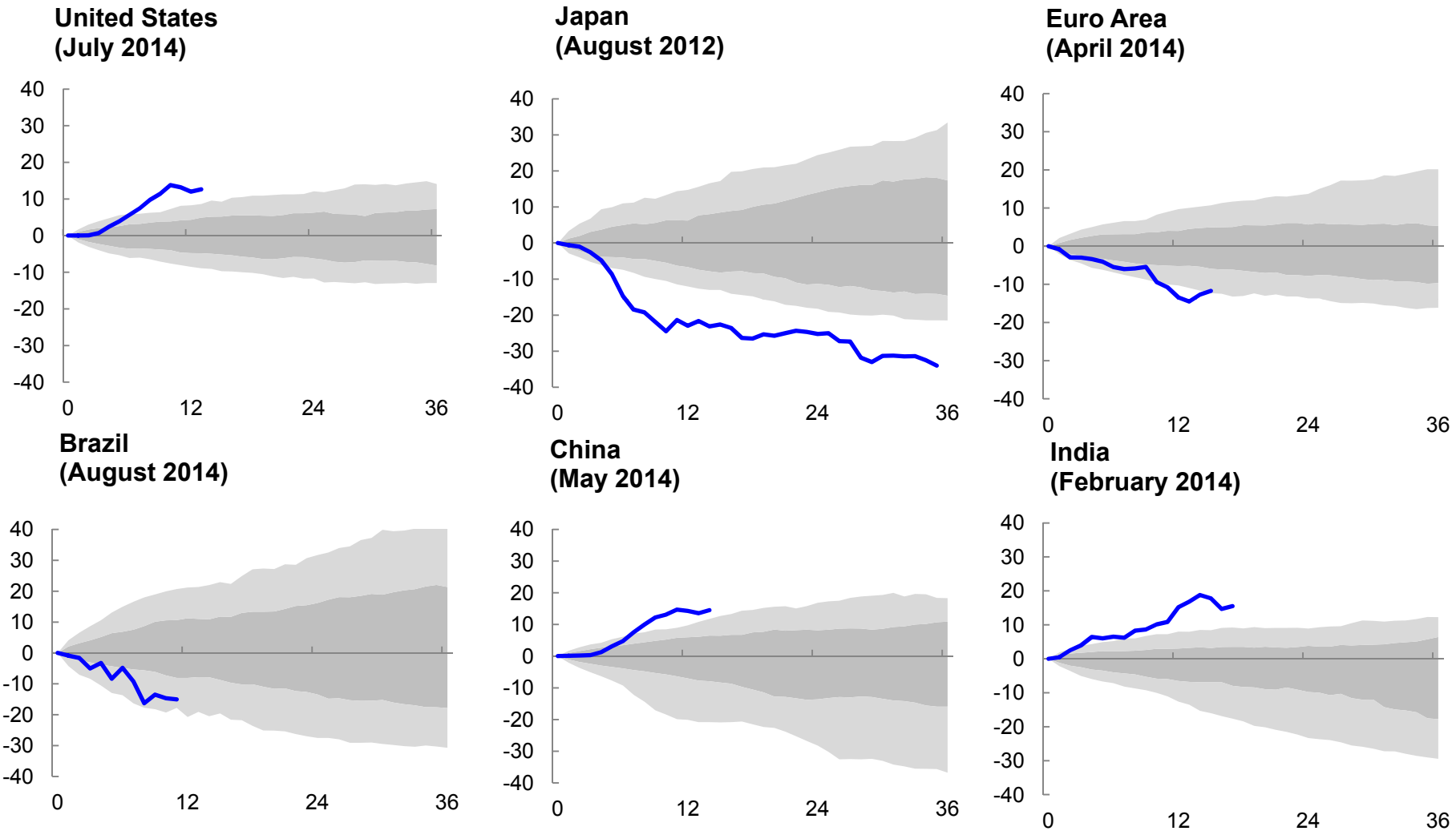
Rachel Szymanski Viktor Tsyrennikov Hong Yang

International Monetary Fund

SNB Exchange Rates and External Adjustment Conference, Zurich, Switzerland, 24 June 2016

The opinions expressed herein are those of the authors and do not necessarily reflect those of the International Monetary Fund

Unusually Large Exchange Rate Movements



Note: Figure reports fluctuation bands for level of CPI–based REER based on all 36-month-long evolutions since January 1980. Blue lines = most recent paths of appreciation/depreciation without interruption of more than 3 months. Dates in parentheses = start of recent episode. Data ends June 2015.

Controversy: Effects of Exchange Rates on *X* and *M*

Limited changes in some trade balances (e.g., Japan, Brazil.) despite large exchange rate movements

Does exchange rates matter less for trade? Have they become disconnected over time?

- Production fragmentation across countries or rise of global value chains (Ahmed et al., 2015).

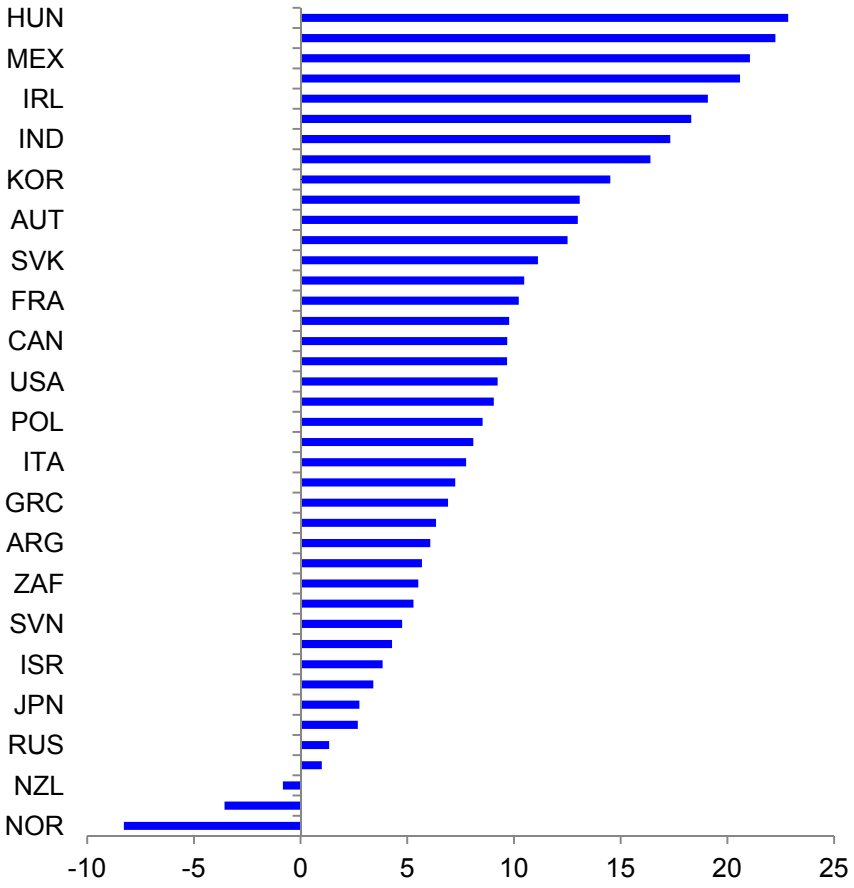
Disconnect would complicate policymaking:

- Weaker monetary policy transmission.
- Harder to reduce trade imbalances.

Global Value Chains: Keep in Perspective

Change in Foreign Value Added Content

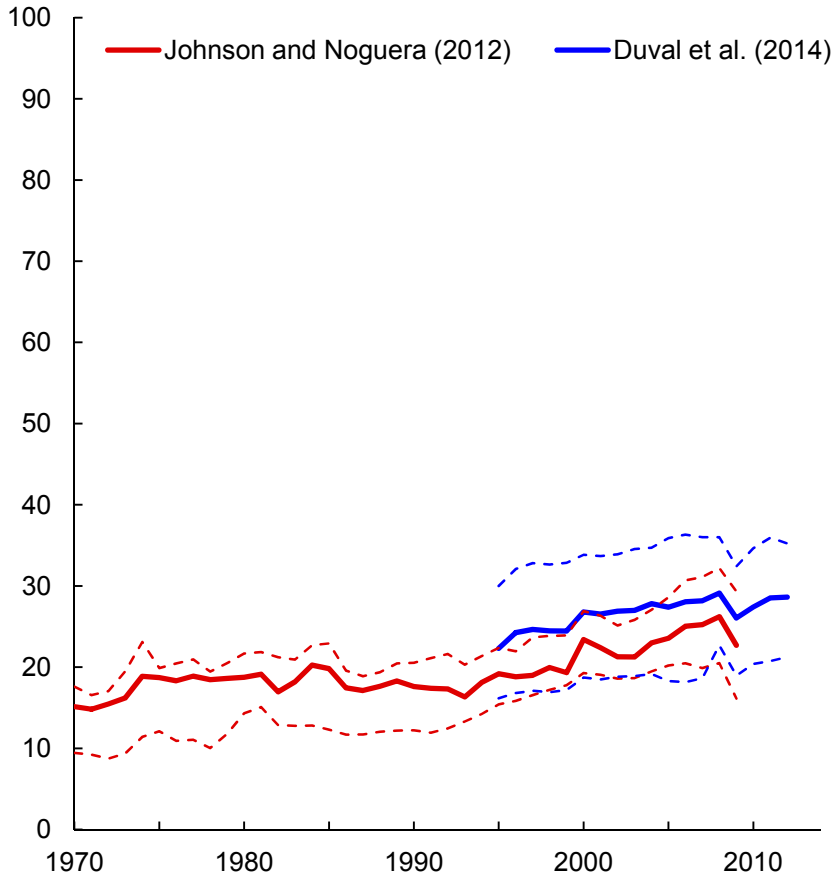
(first-latest observation; percentage points of gross exports)



Source: Johnson and Noguera (2012)

Foreign Value Added Content of Exports

(percent of gross exports; world mean and inter-quartile range)



Revisit the Exchange Rates-to-Trade Relation

- Research question:
  - Has exchange rates and trade become disconnected?
- Methodology:

1. Estimation of aggregate trade elasticities:
   - Use of standard trade equations to study how exchange rates affect relative trade prices and how relative trade prices affect trade volume.
   - Test stability of the relation between exchange rates and trade over time.
2. Analysis of Large Currency Depreciation Episodes:
   - Less noisy.
   - Less subject to reverse causality.
   - Foreign demand should be relatively stable compared to fundamentals.
3. Analysis of Disconnect at Sectoral Level
   - Exchange rate changes more likely to be exogenous to individual sectors.
   - Less subject to aggregation bias in the elasticities (Imbs & Mejean, 2015).

Preview of main findings: Exchange Rates Still Matter

- No disconnect in general. (Some products, some economies). This result is robust to the use of all approaches discussed in the previous slide.
- Broad pattern of stability holds across different samples.
- Recent exchange rate changes imply sizable redistribution of real NX.
- No need to downgrade effects of exchange rates in forecasting models ...
- Relevance: Inflation dynamics. Resolution of trade imbalances.

Aggregate Trade Elasticities

Analytical Framework

- Theoretical Framework:
  - Pricing-to-Market literature (Krugman, 1985; Campa and Goldberg, 2005; Burstein and Gopinath, 2014).
  - Incomplete pass-through of exchange rate movements into relative prices.
  - Relative prices depend on the *REER* and real production costs separately, while *trade demand* depends on relative prices and aggregate demand .

- Trade equations (Frankel et al., 2012; Morin and Schwellnus, 2014):
  - Exchange rate → Relative trade prices → Trade volumes

P^X (supply): $\frac{eP^X}{P^*} = S\left(\frac{ULC}{P}, \frac{eP}{P^*}\right)$ X (demand): $X = D\left(\frac{eP^X}{P^*}, Y^*\right)$

P^M (supply): $\frac{P^M}{P} = S\left(\frac{eP}{P^*}, Y\right)$ M (demand): $M = D\left(\frac{P^M}{P}, Y\right)$

Data and Estimation Strategy

- Objective:
  - Maximize information from the data while acknowledging country heterogeneity (country-specific estimations) and using a flexible econometric framework (cointegration).

- Sample: 1980-2014 annual data (WEO); 23 AEs, 37 EMDEs
  - Broader sample than in other studies that allows to account for the rising importance of EMDEs
  - Minimum 25 years/economy; includes goods and services

- Special cases excluded: countries with population < 1 million; HKG, IRL, SGP.

- Test for Cointegration: If *yes*, estimate in *levels*. If no, take Δ, estimate *Autoregressive Distributed Lag (ARDL)* models
  - Single economy estimations (Dickey-Fuller test): cointegration in approx. 1/2 of the cases.
  - Panel estimations (Pedroni test): no evidence of cointegration between variables.

Estimation Strategy (cont.)

- Single economy estimations additional controls:
  - time trend to account for differences in countries growth rates and for global shocks;
  - Indicator of global financial crisis (e.g., credit availability); and
  - fuel and non-fuel commodity prices to control for shifts in global commodity prices.
- Panel estimations additional controls:
  - Control for differences in countries' normal growth rates and global shocks using fixed effects.
- Caveats:
  - Simultaneity and omitted-variables can lead to underestimation of trade price elasticities.
  - Movements in domestic or foreign demand also complicate the estimation.

Estimation Strategy (cont.)

- Exchange-rate pass-through to export prices:

$$\Delta \ln\left(\frac{eP^{X}}{P^{*}}\right)_{it} = \mu_i + \tau_t + \rho\Delta \ln\left(\frac{eP^{X}}{P^{*}}\right)_{i,t-1} + \sum_{j=0}^{2}\beta_j \Delta \ln\left(\frac{eP}{P^{*}}\right)_{i,t-j} + \sum_{j=0}^{2}\gamma_j \Delta \ln\left(\frac{ULC}{P}\right)_{i,t-j} + \varepsilon_{it},$$

- The price elasticity of export volumes:

$$\Delta \ln X_{it} = \mu_i + \tau_t + \rho\Delta \ln X_{i,t-1} + \sum_{j=0}^{2}\beta_j \Delta \ln\left(\frac{eP^{X}}{P^{*}}\right)_{i,t-j} + \gamma\Delta \ln Y_{it}^{*} + \lambda\left(\ln Y^{*} \times gfc\right)_{it} + \varepsilon_{it},$$

Estimation Strategy (cont.)

- Exchange-rate pass-through to import prices:

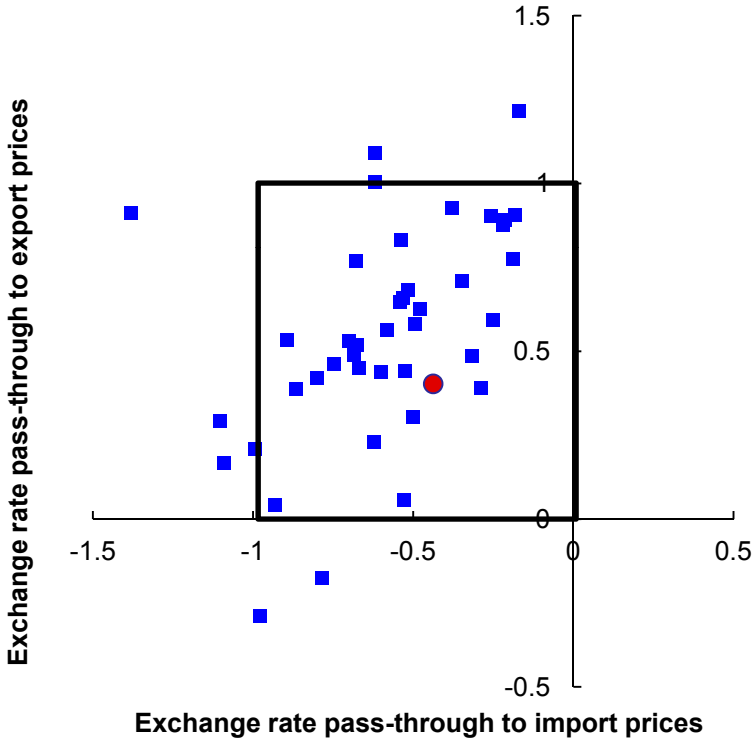
$$\Delta \ln \left(\frac{P^{\mathrm{M}}}{P} \right)_{it} = \mu_i + \tau_t + \rho \Delta \ln \left(\frac{P^{\mathrm{M}}}{P} \right)_{i,t-1} + \sum_{j=0}^{2} \beta_j \Delta \ln \left(\frac{eP}{P^*} \right)_{i,t-j} + \Delta \ln Y_{it} + \varepsilon_{it},$$

- The price elasticity of import volumes:

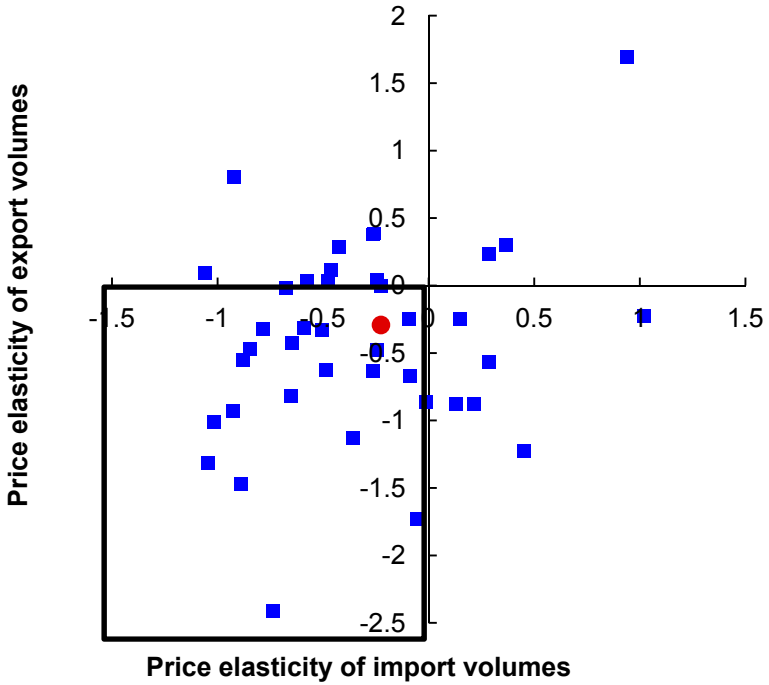
$$\Delta \ln M_{it} = \mu_i + \tau_t + \rho \Delta \ln M_{i,t-1} + \sum_{j=0}^{2} \beta_j \Delta \ln \left(\frac{eP}{P^*} \right)_{i,t-j} + \delta \Delta \ln X_{it} + \gamma \Delta \ln DD_{it} + \lambda \left(\ln Y \times gfc \right)_{it} + \varepsilon_{it},$$

Exchange Rates Pass-through and Price Elasticities

1. Exchange Rate Pass-Through



2. Price Elasticities



- Individual economy estimates vary substantially.
- Pass-through elasticities have the expected sign and lies in the 0,1 intervals.
- More heterogeneity and unexpected values for price-to-volume elasticities

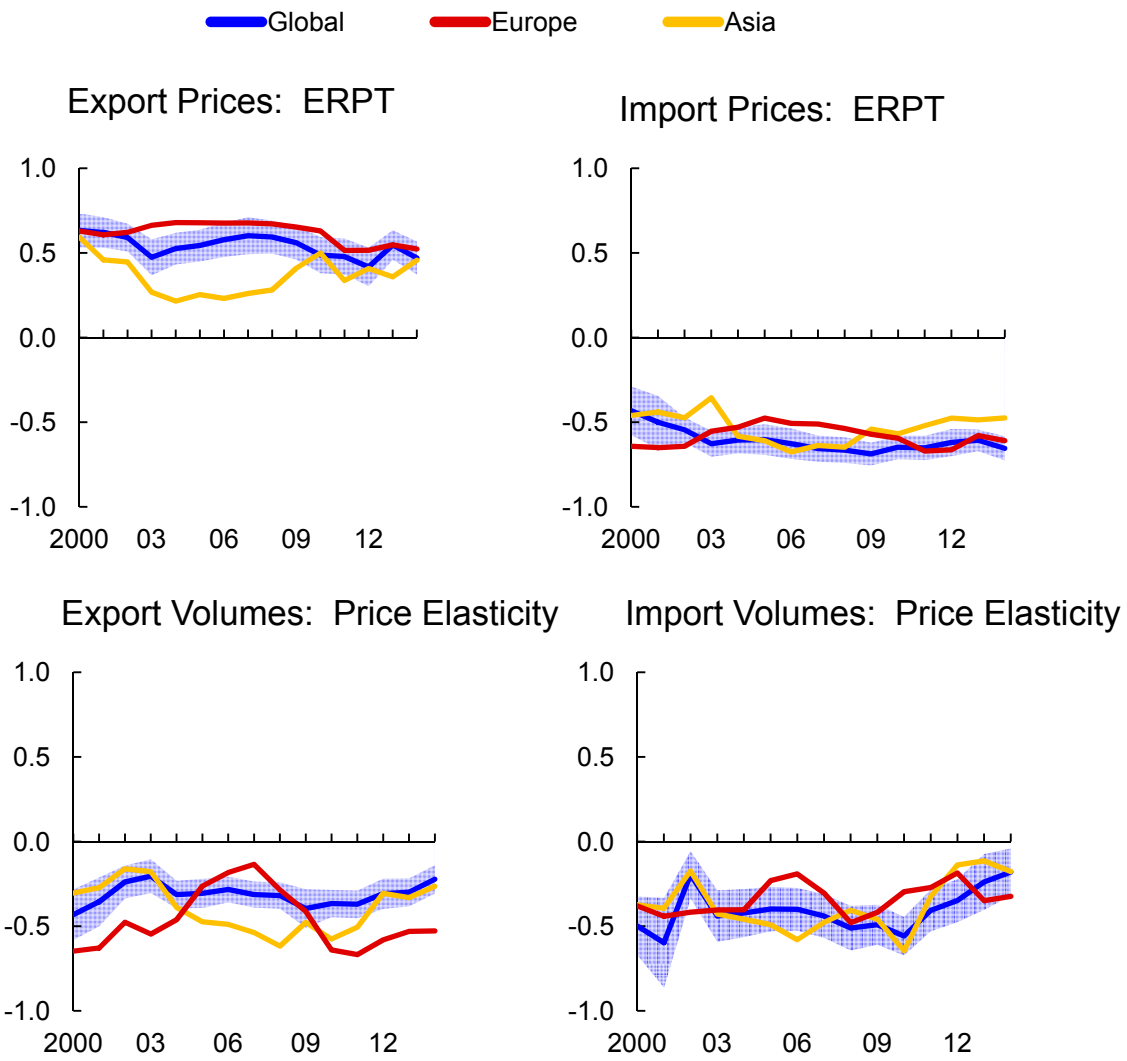
Results: Averages Estimates Across Countries

	Exchange Rate Pass-Through		Price Elasticity of Volumes		Marshall-Lerner
	Export prices	Import prices	Exports	Imports	Condition Satisfied?
Based on Producer Price Index					
Long-Term Elasticity	0.552	–0.605	–0.321	–0.298	Yes
One-Year Elasticity	0.625	–0.580	–0.260	–0.258	Yes
Memorandum					
Non-Commodity Exporters					
Long-Term Elasticity	0.571	–0.582	–0.461	–0.272	Yes

Note: Table reports simple average of individual economy estimates for 60 economies during 1980–2014.

- Average (pass-through) elasticities in line with the literature.
- Marshall-Lerner conditions satisfied under incomplete pass-through.
- Most of the long-term effects of trade materializes in the first year.

Little Sign of Disconnect: Rolling Regressions



Note: Shaded area denotes 90 percent confidence intervals.

Little Sign of Disconnect: Structural Break Tests

Table 5. Trade Elasticities over Time

	Full	1990–2002	2003–2014	Statistical significance of difference between two periods 1/
	I. Pass-through into export prices			
All countries	0.569***	0.557***	0.457***	
By Integration into Global Value Chains				
Countries with larger increase	0.572***	0.560***	0.548***	
Countries with smaller increase	0.684***	0.608***	0.609***	
	II. Pass-through into import prices			
All countries	-0.612***	-0.549***	-0.632***	
By Integration into Global Value Chains				
Countries with larger increase	-0.621***	-0.545***	-0.618***	
Countries with smaller increase	-0.650***	-0.511***	-0.720***	**
	III. Price elasticities of exports			
All countries	-0.241***	-0.279***	-0.170**	
By Integration into Global Value Chains				
Countries with larger increase	-0.286***	-0.344**	-0.362***	
Countries with smaller increase	-0.439***	-0.357**	-0.629***	
	IV. Price elasticities of imports			
All countries	-0.399***	-0.471***	-0.242**	*
By Integration into Global Value Chains				
Countries with larger increase	-0.574***	-0.661***	-0.269**	*
Countries with smaller increase	-0.460***	-0.464***	-0.365**	

*p < 0.1; ** p < 0.05; *** p < 0.01.

1/ Blank indicates no statistically significant difference.

Large Currency Depreciations Episodes

More Insights: Large Depreciation Episodes

- Contain a large exogenous component:
  - Foreign demand is relatively stable compared to domestic fundamentals.
  - Agents are likely to respond quicker if the relative prices change by a lot.
  - Minimize the bias of price elasticities as a measure for the demand slope.
- Effect on exports goes primarily through exchange rate.
  - Imports: various domestic developments that affect imports coincide with large exchange rate depreciations.
- Large depreciations *not* associated with banking crises
  - Confounding factor (Dell'Ariccia et al., 2005; Iacovone and Zavacka, 2009).
- Question: Are the effects in line with elasticities already estimated?
- Event: 90th percentile depreciation vs. USD (separately for AE and EMDEs), 90 percentile more than in previous year.

Estimation Strategy

- Follows Cerra and Saxena (2008) and Romer and Romer (2010):
  - The average responses of export prices and export volumes to a large depreciation are estimated separately using panel data analysis.
  - ARDL model in first differences.
  - The estimated impacts of an episode are cumulated.

  - REER equation

$$\Delta \ln\left(\frac{eP}{P^*}\right)_{it} = \mu_i + \tau_t + \rho\Delta \ln\left(\frac{eP}{P^*}\right)_{i,t-1} + \sum_{j=0}^{2}\beta_j shock_{i,t-j} + \varepsilon_{it},$$

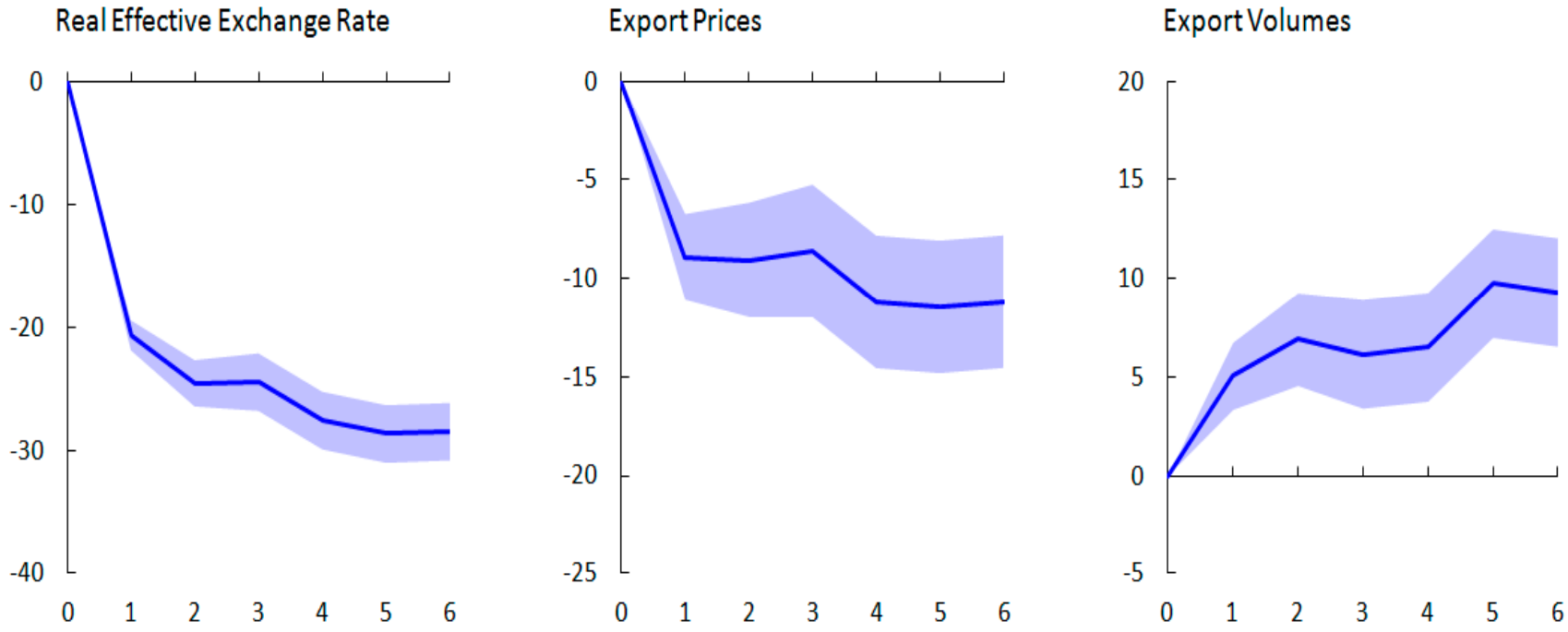
  - Export price equation:

$$\Delta \ln\left(\frac{eP^X}{P^*}\right)_{it} = \mu_i + \tau_t + \rho\Delta \ln\left(\frac{eP^X}{P^*}\right)_{i,t-1} + \sum_{j=0}^{2}\beta_j shock_{i,t-j} + \sum_{j=0}^{2}\gamma_j \Delta \ln\left(\frac{ULC}{P}\right)_{i,t-j} + \varepsilon_{it},$$

  - Export volume equation:

$$\Delta \ln X_{it} = \mu_i + \tau_t + \rho\Delta \ln X_{i,t-1} + \sum_{j=0}^{2}\beta_j shock_{i,t-j} + \gamma\Delta \ln Y_{it}^* + \varepsilon_{it},$$

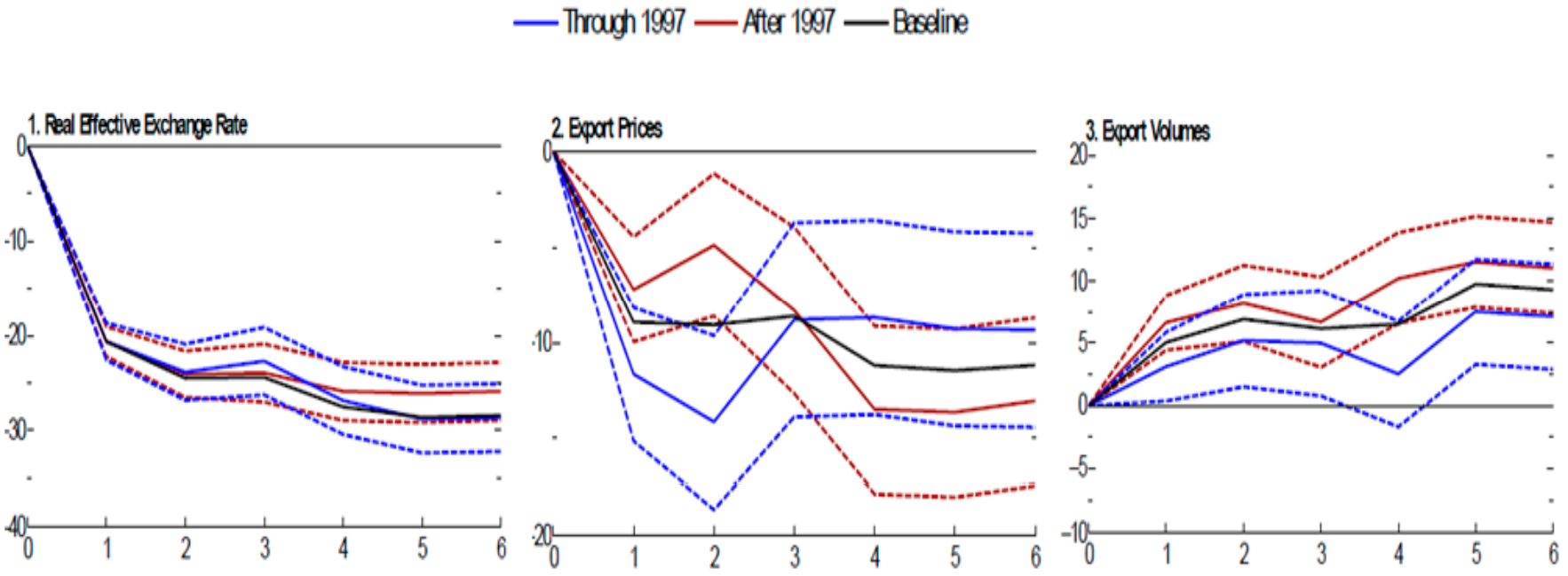
Results: Large Currency Depreciations Episodes



Note: Years on x-axis. Shaded areas denote 90 percent confidence bands. Initial slack based on low growth in year prior to episode.

- During the 66 episodes REER declines on average 25 percent over 5 years.
- Export prices in foreign currency fall by close to 10 percent after 1 year.
- Export volumes rise more gradually and reach 10 percent after 5 years.

Little Sign of Disconnect: Large Depreciations



Source: IMF staff estimates.
Note: Dashed lines denote 90 percent confidence intervals.

- "Balanced sample": half of the episodes occurred up to 1997.
- Export prices and volumes responded similarly during the two period samples.
- No evidence of disconnect or lengthening of lagged responses.

Sectoral Level Analysis

Sector level analysis

- Estimate exchange rate pass-through and exchange rate movements' effects on trade volume (reduced form).
  - Price elasticity of trade volume not estimated as trade prices measurement error shows up in both sides of the estimated equation.

- Follow Campa and Goldberg (2005) in using macro-level variables
  - Those may influence exchange rate pass-through and the effects of exchange rate movements on trade volumes.

- Construct country-sector level export and import price indexes for 18 tradable sectors using UN Comtrade data at annual frequency.
  - Adopt an adapted version of the multilateral GEKS approach (Ivancic et al., 2011).
  - The GEKS index has two properties: (1) it makes maximum use of all possible matches between any two periods, and (2) it has no chain drift.

Estimation Strategy

- Exchange-rate pass-through to export prices:

$$\Delta \ln\left(\frac{eP^X}{P^*}\right)_{ikt} = \alpha_{ik} + \eta_t + \gamma_k \Delta \ln\left(\frac{eP}{P^*}\right)_{ikt} + \vec{\phi}\ \Delta \ln\left(\frac{eP}{P^*}\right)_{ikt} \times \vec{Z}_{ikt} + \beta\ \Delta \ln\left(\frac{ULC}{P^*}\right)_{it} + \nu_{ikt},$$

- The REER elasticity of export volumes:

$$\Delta \ln X_{ikt} = \alpha_{ik} + \eta_t + \gamma_k \Delta \ln\left(\frac{eP}{P^*}\right)_{ikt} + \vec{\phi}\ \Delta \ln\left(\frac{eP}{P^*}\right)_{ikt} \times \vec{Z}_{ikt} + \beta\ \Delta \ln Y^*_{it} + \nu_{ikt},$$

- REER computed using trade weights at the industry level.
- $\vec{Z}$ includes a period dummy to test disconnect over time.
- $\vec{Z}$ also includes macro variables (Campa and Goldberg, 2005) and GVC measures (foreign value added share in exports) both at the country-industry level, and at the industry level.
- $\vec{Z}$ variables are demeaned and normalized to a standard deviation equal to one.

Results: Exchange Rate Pass-Through

Variable	Export prices			Import prices		
	Model (1)	Model (2)	Model (3)	Model (1)	Model (2)	Model (3)
Exchange rate 1/	0.360***	0.297***	0.402***	-0.717***	-0.633***	-0.685***
	(0.04)	(0.05)	(0.066)	(0.026)	(0.048)	(0.062)
Exchange rate*period	0.079	0.279***	0.027	-0.109***	-0.018	-0.060
	(0.042)	(0.075)	(0.104)	(0.03)	(0.071)	(0.098)
Exchange rate*money growth			-0.077			0.005
			(0.08)			(0.004)
Exchange rate*real GDP			0.006			0.014***
			(0.015)			(0.005)
Exchange rate*inflation			-0.435***			0.023*
			(0.079)			(0.013)
Exchange rate*country-industry FVA share in gross exports		-0.020	-0.027		0.012***	0.013***
		(0.035)	(0.042)		(0.005)	(0.006)
Exchange rate*world industry FVA share in gross exports		-0.274***	0.043		0.030***	0.035***
		(0.099)	(0.13)		(0.009)	(0.01)
Exchange rate*industry share in exports		0.038	0.038		0.009	0.006
		(0.03)	(0.031)		(0.004)	(0.005)

Significance at *** p<0.01, ** p<0.05, * p<0.1; standard errors in parenthesis.

- Little evidence on declining pass-through over time.
- GVC measures are not economically significant.

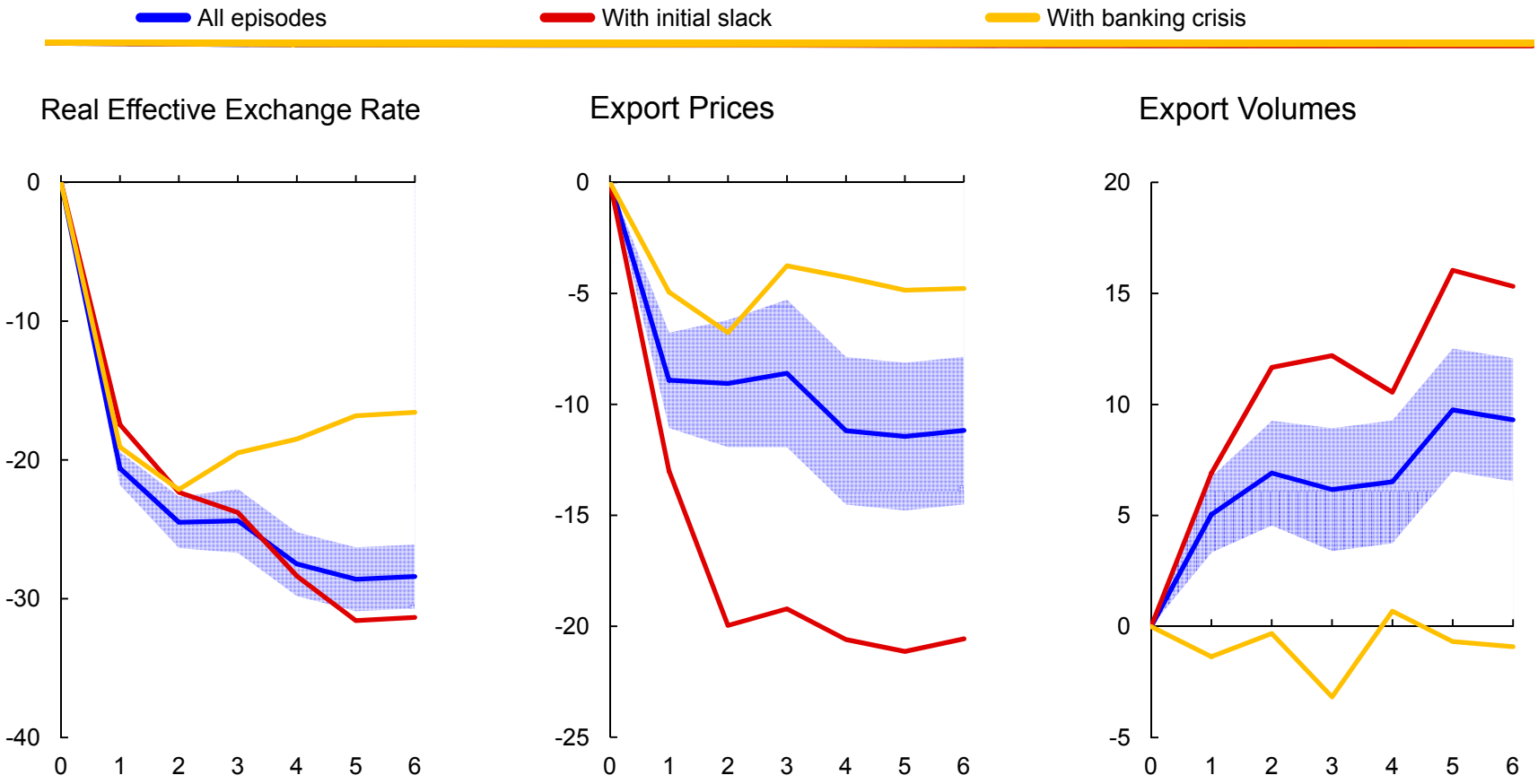
Results: REER Effects on Trade Volumes

Variable	Export volume			Import volume		
	Model (1)	Model (2)	Model (3)	Model (1)	Model (2)	Model (3)
Exchange rate 1/	-0.244***	0.217	0.221	1.147***	1.423***	1.829***
	(0.124)	(0.152)	(0.184)	(0.107)	(0.147)	(0.178)
Exchange rate*period	-0.552***	-0.949***	-0.786***	-0.826***	-1.634***	-1.604***
	(0.133)	(0.227)	(0.277)	(0.111)	(0.226)	(0.276)
Exchange rate*money growth			-1.246***			0.289
			(0.253)			(0.245)
Exchange rate*real GDP			-0.098			-0.183***
			(0.051)			(0.048)
Exchange rate*inflation			1.552***			1.777***
			(0.389)			(0.305)
Exchange rate*country-industry FVA share in gross exports		0.320***	0.197**		0.026	0.143
		(0.094)	(0.104)		(0.081)	(0.091)
Exchange rate*world industry FVA share in gross exports		0.379	0.368		1.427***	1.286***
		(0.298)	(0.377)		(0.281)	(0.328)
Exchange rate*industry share in exports		0.051	-0.013		0.090	0.191**
		(0.096)	(0.103)		(0.097)	(0.104)

Significance at *** p<0.01, ** p<0.05, * p<0.1; standard errors in parenthesis.

- Little evidence on declining REER effects on *X* over time, albeit significant for *M* .
- Some evidence that GVCs weakened exchange rate effects on trade volume.

Role for Initial Conditions?
Evidence from Large Currency Depreciations Episodes



Note: Years on x-axis. Shaded areas denote 90 percent confidence bands. Initial slack based on low growth in year prior to episode.

•In general, demand is an important factor for trade.

Conclusion: Exchange Rates Still Matter

- No generalized disconnect. (Some products, some economies).
- Broad pattern of stability holds across different samples. Rising share of X, M.
- Recent exchange rate changes imply sizable redistribution of real NX.
- No need to downgrade effects of exchange rates in forecasting models ...

  Relevance: Inflation dynamics. Resolution of trade imbalances.

Appendix