NBER Conference on Risks in Agricultural Supply Chains

Exchange Rate Volatility and Global Food Supply Chains

Sandro Steinbach

Agricultural and Resource Economics
University of Connecticut

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- Most countries moved to a floating or soft-pegged currency system since the collapse of the Bretton Woods system in the early 1970s (Clark et al., 2004 IMF)
- Higher **volatility of foreign exchange** associated with **uncertainty regarding the terms of trade** (Mc Kenzie, 1999 JES)
- Implications for international trade **poorly understood** and literature is largely inconclusive (Auboin and Ruta, 2013 WTR)
- **Theoretical literature ambiguous** regarding the sign of the relationship:
  - Exchange rate uncertainty causes increase in **revenue uncertainty** which can hamper international trade (Ethier, 1973 AER; Demers, 1991 RES)
  - **Arbitrage** between spot and forward markets (Johnson, 1969 JSLR) and **market power** (Franke, 1991 JIMF) can lead to more international trade

- Substantial **uncertainty regarding the impact of exchange rate volatility** echoed in the empirical literature (Auboin and Ruta, 2013 WTR)

- Earlier studies provide evidence for an **adverse effect** of exchange rate volatility on manufacturing (Thursby and Thursby, 1987 RES; Koray and Lastrapes, 1989 RES; Rose, 2000 EP) and food trade (Pick, 1990 AJAE; Cho et al., 2002 AJAE; Kandilov, 2008 AJAE)

- Tenreyro (2007 JDE) challenged this view arguing that the negative and significant effect estimates are the result of **endogeneity and heteroskedasticity biases** $\longrightarrow$ no significant relationship between short-run volatility and international trade

- Broda et al. (2011 NBER) argue that insignificant volatility estimates are due to **aggregation bias**

- Analyze the **impact of exchange rate volatility on international food trade** at the product level (781 products) using detailed retrospective trade and exchange rate data for 159 countries over the period from 2001 to 2017
- Use sectoral gravity-type regression specification to measure the impact of **short-run** and **long-run exchange rate volatility**
- Investigate differences according to supply chain position and industry/product characteristics
- Find **some evidence** for association between exchange rate volatility and food trade according to **supply chain position** and **strong evidence** for differences according to **industry/product characteristics**

- Exploit variation in global food trade between countries at the product level and over time with the following product-specific gravity model:

$$X_{ij,t}^{s} = \exp(e_{i,t}^{s} + m_{j,t}^{s} + t_{ij}^{s} - \theta \log \tau_{ij,t}^{s})\eta_{ij,t} \quad (1)$$

- $X_{ij,t}^{s}$ is bilateral export flows of product s from country i to country j in year t
  - Time-variant multilateral resistance terms for exporters are denoted by $e_{i,t}^{s}$ and for importers by $m_{j,t}^{s}$, while country-pair fixed effects are denoted by t_{ij}^{s}
  - Trade cost function denoted by $\tau_{ij,t}^{s}$ (symmetric and of the iceberg form) includes measures of exchange rate volatility and common gravity-type control variables
  - Used Poisson PML with multiple high-dimensional fixed effects (Silva and Tenreyro, 2007 RES; Correia et al., 2020 SJ) and clustering at product-country-pair level (Cameron and Trivedi, 2015 JHR)

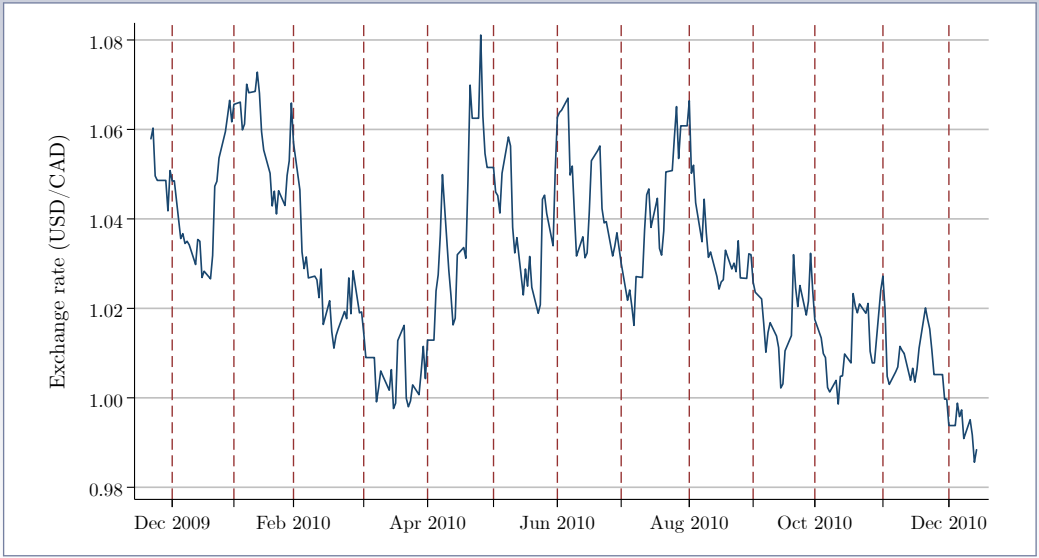
- **Nominal exchange rate volatility** ($\delta_{ij,t}$) defined by the standard deviation (σ) of the first difference of the logarithmized bilateral exchange rate ($e_{ij,k}$) as follows:

$$\delta_{ij,t} = \sigma\Big[\ln(e_{ij,k}) - \ln(e_{ij,k-1})\Big] \tag{2}$$

- Used **daily exchange rate data** for 18,632 currency pairs and 21 years from Refinitiv Financial Solutions (2019)

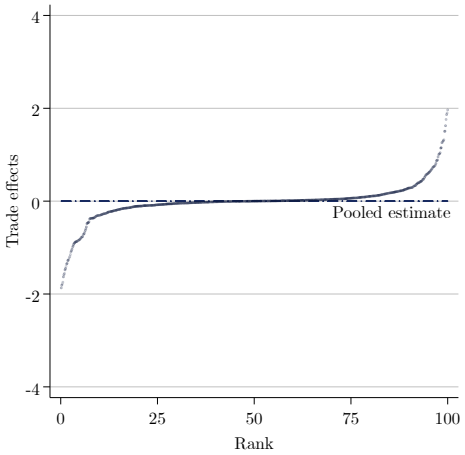
- Calculated **daily** and **end-month exchange rate** measures

- Measured **short-run volatility** α_{δ}^{S} based on preceding year (Tenreyro, 2007 JDE) and **long-run volatility** α_{δ}^{L} based on the five preceding years (Rose, 2000 EP)

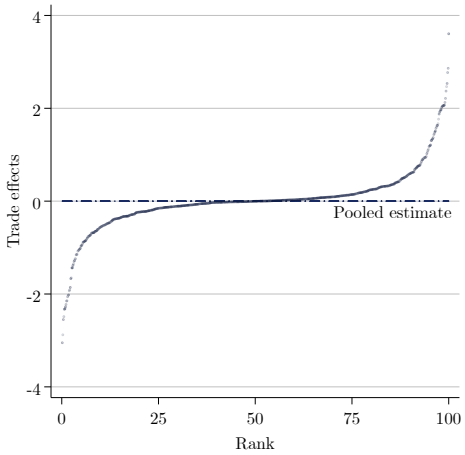

Exchange rate (USD/CAD)
1.08
1.06
1.04
1.02
1.00
0.98
Dec 2009
Feb 2010
Apr 2010
Jun 2010
Aug 2010
Oct 2010
Dec 2010

	Agriculture and food		All other products	
	α_δ^S	α_δ^L	α_δ^S	α_δ^L
Panel A: Sign of parameter estimates				
Positive estimates	51.54	52.27	51.50	53.89
Negative estimates	48.46	47.73	48.50	46.11
Panel B: Significance of parameter estimates				
Significant at 1% level	15.90	13.33	12.83	14.34
Significant at 5% level	24.87	29.60	24.12	26.86
Significant at 10% level	34.36	37.87	33.25	35.52
Panel C: Magnitude of parameter estimates				
Mean estimate	0.008	0.115	0.002	−0.068
Median estimate	−0.050	−0.105	−0.033	−0.167
25% percentile estimate	−0.800	−1.554	−0.659	−1.343
75% percentile estimate	0.767	1.631	0.623	1.147

**Note*: Panels *A* and *B* based on all parameter estimates and Panel *C* on statistically significant estimates.



(a) Short-run volatility



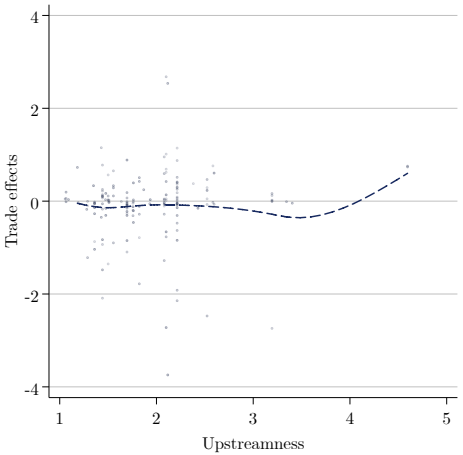
(b) Long-run volatility

Note: Product-level trade effects are calculated by the formula $\beta^* = sd_x/sd_y * \hat{\beta}$ based on statistically significant estimates.

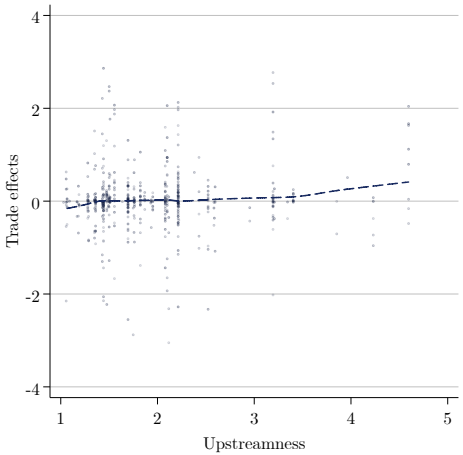
- Global value chain integration implies that exchange rate movements among upstream suppliers and downstream buyers can affect a country's trade flows through **backward and forward linkages** (Amiti et al., 2014 AER)

- Upstream (backward) global value chain integration can lower the sensitivity of export flows to exchange rate movements because it causes trade and marginal costs to move in paralell (Gopinath et al., 2020 AER)
  - Upstreamness measured according to Antrás et al. (2012 AER) as distance between production stage and final demand
  - Downstreamness defined as average position in the value chain at which an industry's output is used (Antrás and Chor, 2013 ECTA)

- Used crosswalk between NAICS and HS-6 level to classify trade products according to the supply chain position

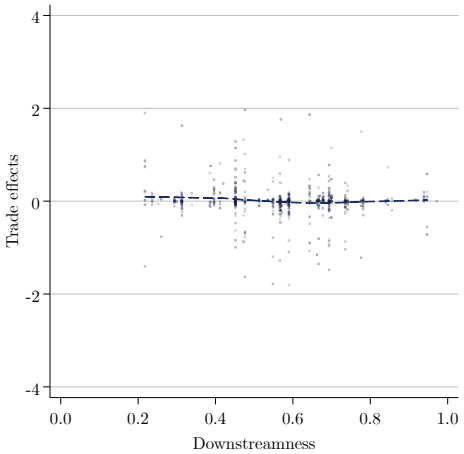


(a) Short-run volatility



(b) Long-run volatility

Note: Cubic spline interpolation indicated with dashed lines.



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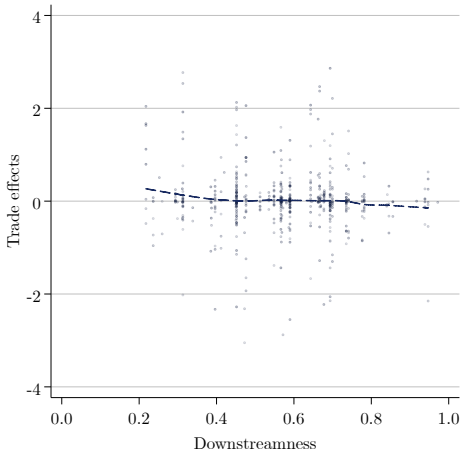
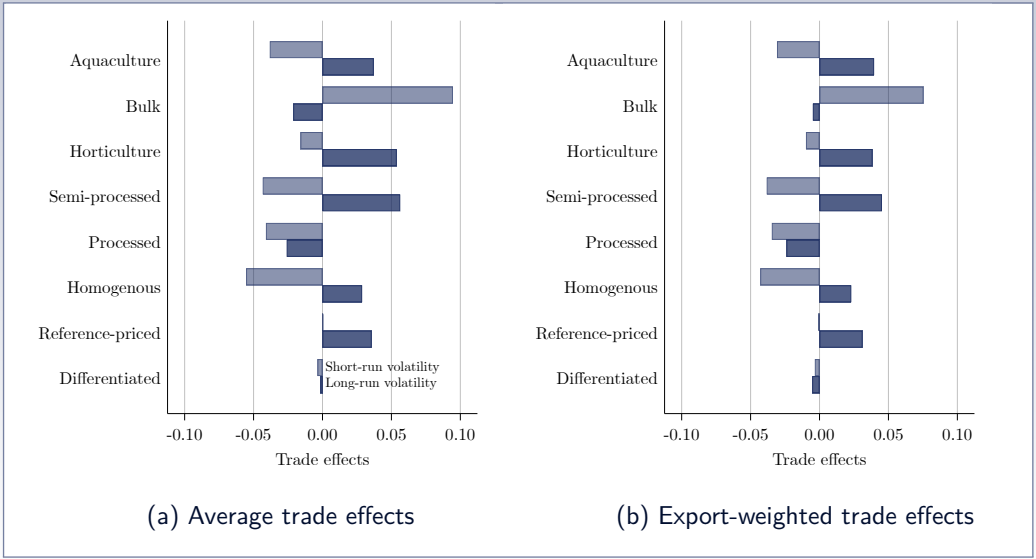
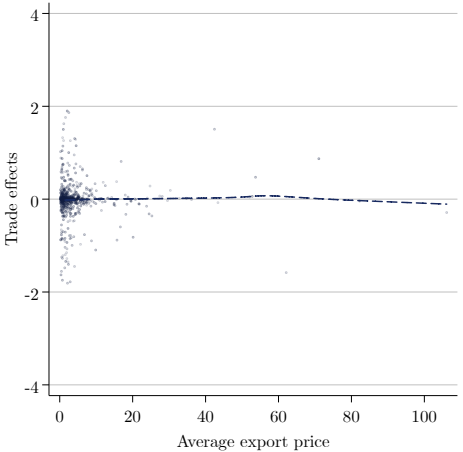


(b) Long-run volatility

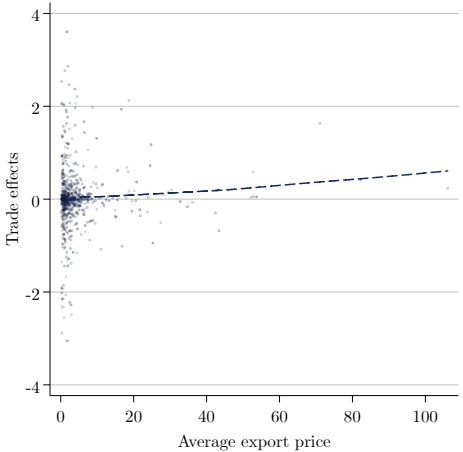


Note: Trade products categorized according to Rauch (1999 JIE) and Regmi et al. (2015 ERS).

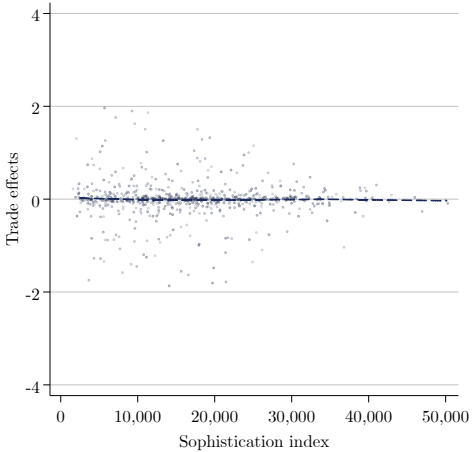
- Exchange rate volatility positively associated with **product price** (Campa and Goldberg, 2005 RES)
  - Use average export price to compare trade effects
- Exported products differ in **technological sophistication** (Hidalgo et al., 2007 Science)
  - Sophisticated products less prone to trade shocks (Weldemicael, 2013 WE)
  - Quantify the productivity level by weighted average of the per capita GDPs of countries exporting a given product (Hausmann et al., 2007 JEG)
- **Product complexity** correlates with income inequality which in turn is strongly associated with **exchange rate volatility** (Galí & Monacelli, 2005 RES)
  - Measure the relative knowledge intensity of a product (Hartmann et al., 2017 WD)



(a) Short-run volatility



(b) Long-run volatility



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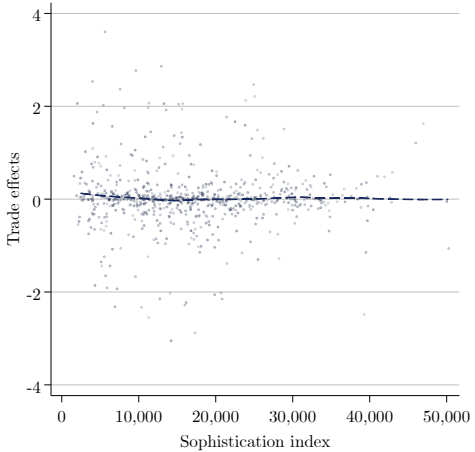
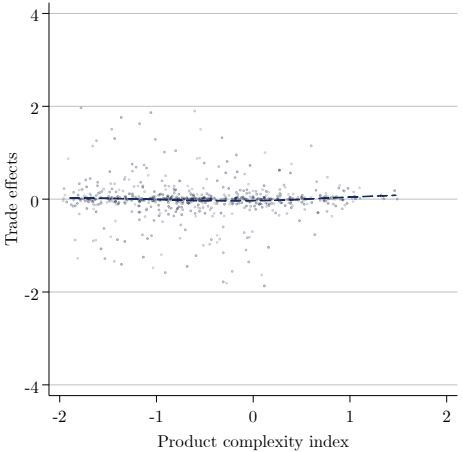
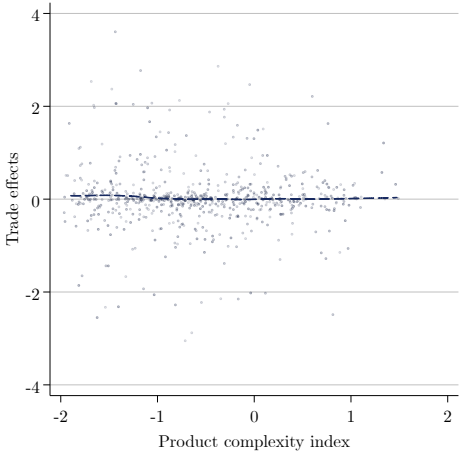


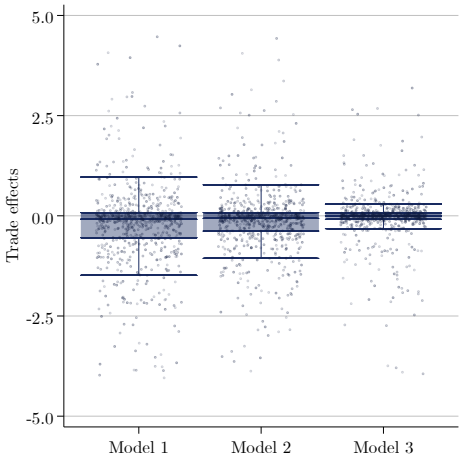
(b) Long-run volatility



(a) Short-run volatility



(b) Long-run volatility



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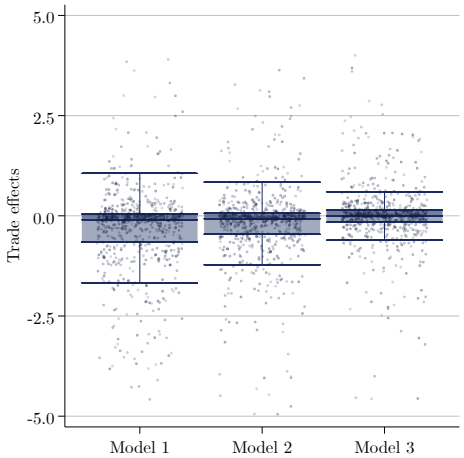
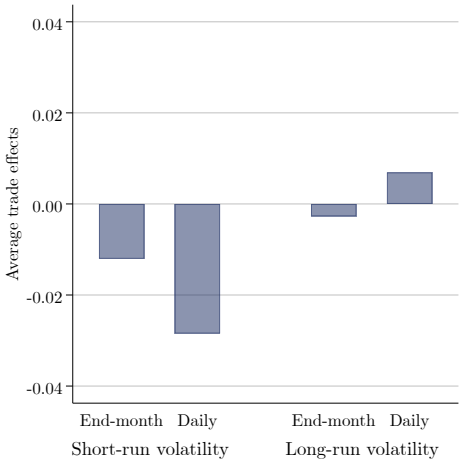
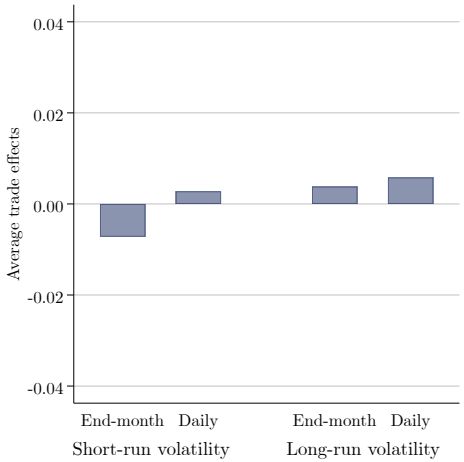


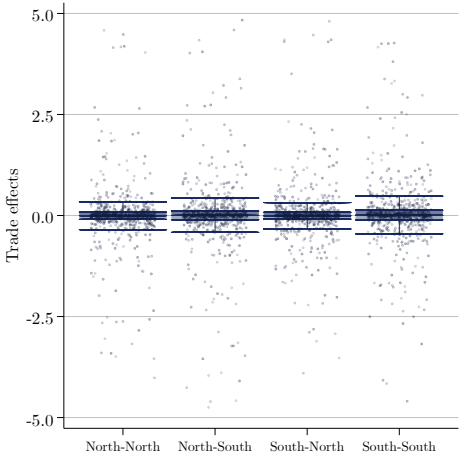
(b) Long-run volatility



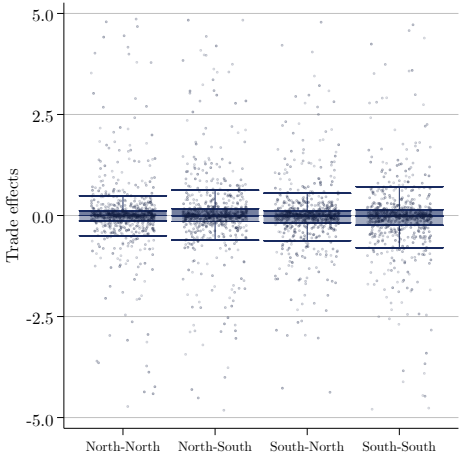
(a) Agricultural and food products



(b) All other products



(a) Short-run volatility



(b) Long-run volatility

- Theoretical literature ambivalent regarding the sign and magnitude of the exchange rate volatility effect, while most empirical studies indicate a negative association
- Study contributes by investigating the relationship at the product-level based on detailed retrospective trade and exchange rate data
- **Limited evidence for a significant (and systematic) relationship** between exchange rate volatility and international food trade
- Positive trade effects of exchange rate volatility for upstream but **no evidence for downstream products**
- Endogeneity and aggregation bias drive earlier negative (and statistically significant) findings