Trade and Exchange Rate Effects: Evidence from Turkish Firm-Level Data

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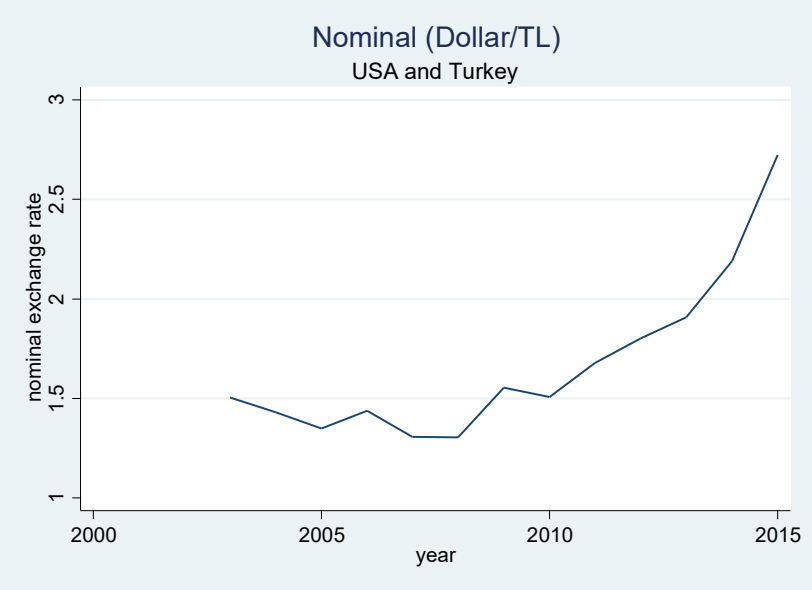
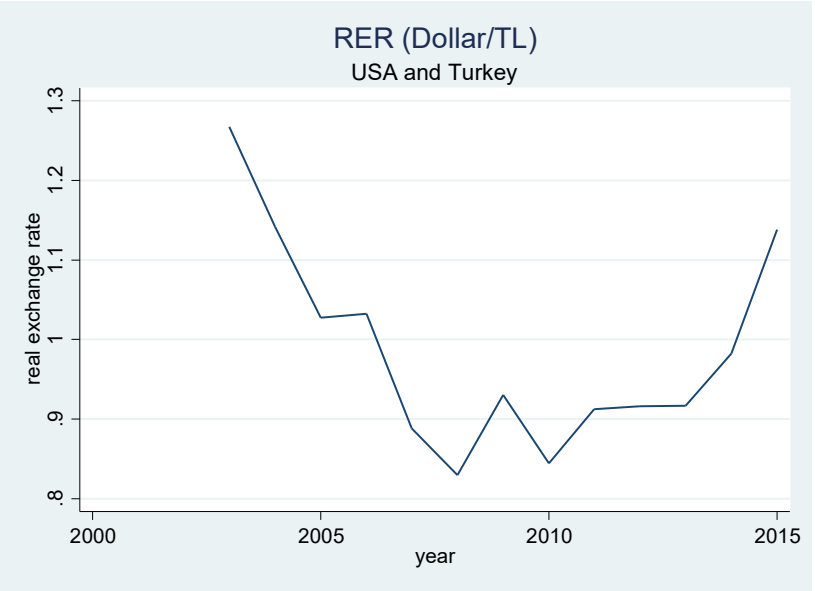
TL against USD





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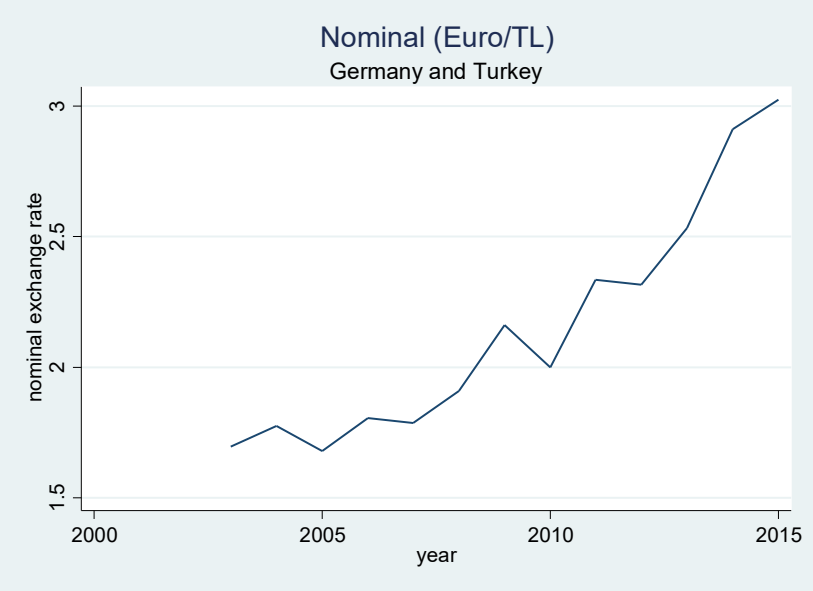
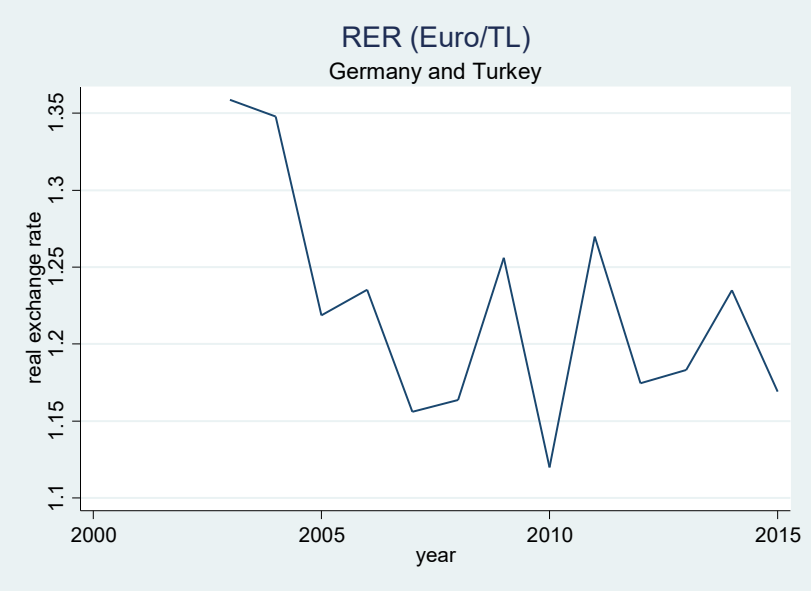
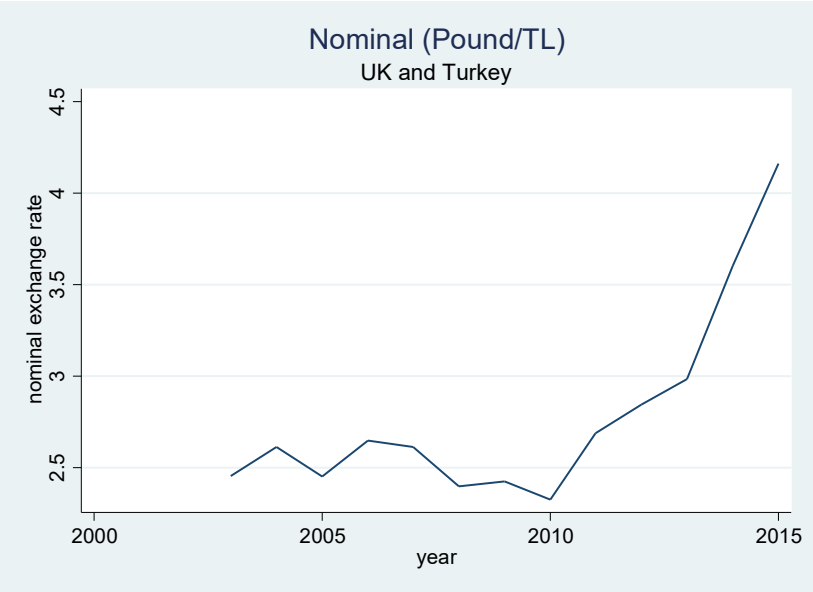
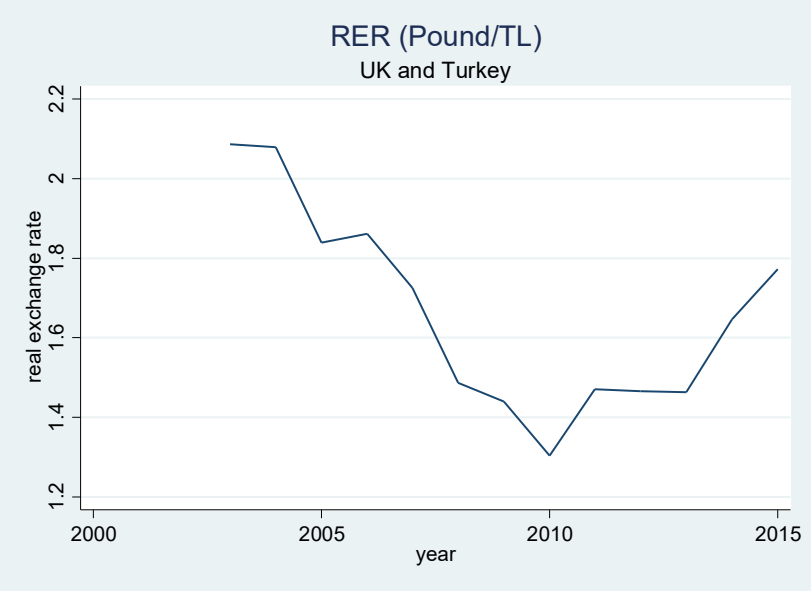
TL against Euro





TL against Pound





Motivation

- The Turkish Lira has witnessed both real appreciation and depreciation against its major partner currencies (€, $, £) over the course of last two decades.

- The TurkStat product- and firm-level database has several unique attributes that enable multiple layers of analysis, thereby making significant contributions to the literature.

Objective

- A rigorous analysis of exchange rate effects on export performance that takes into account the import-dependency
  - at product and firm level detail
  - for a span of 13 years (2003-2015)
  - while employing monthly and quarterly data

Broad Literature

- "natural hedging"
  - Greenaway et al. (2010)
  - Fauceglia et al. (2014, 2018)

- "export hysteresis"
  - Baldwin and Krugman, (1989)
  - Fauceglia et al. (2018)

- trade-exchange rate relationship (Turkey)
  - Cosar (2002)
  - Saygili (2010)
  - Berument, Dincer & Mustafaoglu (2014)

Related Literature

- Greenaway et al. (2010) examine a panel of UK manufacturing firms to show that the adverse effect of an exchange rate appreciation on export probability is lower in industries that import a greater share of inputs; however, a similar effect is not observed at the intensive margin.

- Berman et al. (2009) use French firm-level data to show that export volume reacts less to exchange rate movements for firms that employ a larger fraction of imported inputs.

- Fauceglia et al. (2018) use both product- and firm-level data in complementary analysis to examine the role of international integration in GVCs in mitigating the adverse trade effects of currency appreciation in the context of Switzerland.

Estimation Strategy: Baseline Equation

$$X_{fjt} = \exp\left(\beta_1 \ln\left(E_{jt-1}\right) + \beta_2 \alpha_{ft-1} + \beta_3 \ln\left(E_{jt-1}\right) \times \alpha_{ft-1} + \beta_4 Evol_{jt-1} + \beta_5 Evol_{jt-1} \times \alpha_{ft-1} + \gamma_1 ln(y_{jt-1}) + \mu_1 \chi_{ft-1} + \mu_2 \emptyset_{ft} + \lambda_{fj} + \lambda_t\right) + \varepsilon_{fjt}$$

where f denotes firm, t denotes time (year-quarter) and j denotes destination country.

Data

- Foreign Trade Statistics database (FTS)
  - Monthly data for the period 2003-2015
  - Data source is the customs declarations covering the entire universe of goods traders in Turkey.
  - Information on statistical value (export f.o.b./import c.i.f.), quantity of exports and imports in kilograms, the reference period, product code, partner country, nature of transaction and type of payment.
  - GTIP 12-digit, a variant of Harmonized System

- Annual Industry and Service Statistics database (AISS)
  - TurkStat surveys covering firms in manufacturing and services sectors
  - All firms with 20+ employees in Turkey
  - Subsample of firms with less than 20 employees
  - Information on a wide variety of firm characteristics such as employment, wages, investment, value added, sales, foreign ownership and the number of domestic plants of the firms.

- The data for nominal exchange rates, consumer price indices and gross domestic products of export partners of Turkey are obtained from the IMF-IFS database.

Dependent Variable

Quantity of Exports: x_{fjt}

- *f:* all exporting firms of Turkey
- j: Exporting partners of Turkey
  - countries with a share lower than 0.5 percent in exports and Northern Cyprus are excluded.
- 41 export partners of Turkey
  - accounting 84.33 percent and 85.25 percent of exports of Turkey in 2003 and 2015, respectively.
- *t:* time span of the 2003-2015 period (quarterly).

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Core Variables – RER

$$rer_{jt} = er_{ct} \frac{cpi_{ct}}{cpi_{TUR,t}}$$

- er_{jt}: nominal exchange rate for each export partner at time t (denoted as TL/export partner's currency)
- $cpi_{TUR,t}$: consumer price index of Turkey at time t
- cpi_{jt} : consumer price index of the export partner at time t

An increase in the real exchange rate signifies depreciation of TL.

Core Variables – RER Volatility

Exchange rate volatility for short-term and medium-term:

- $SRvol_{jt}$: the standard deviation of the real exchange rate for the months of the current quarter (t) and the last quarter (t-1) (for 6 months)

- $MRvol_{jt}$: the standard deviation of the real exchange rate for the months of the current quarter (t) and the last 3 quarters (t-1, t-2, t-3) (for 12 months)

Core Variables – Import dependency

$$\alpha_{ft} = m_{ft}/sales_{ft}$$

- m_{ft}: value of imported intermediate inputs in Turkish Liras for firm f across exporting partners (41 countries) at time t

Firm-level controls

- χ_{ft}
  - Employment
  - Capital-Intensity
  - Foreign share

- $\emptyset_{ft}$
  - Labor Productivity (value added to labor ratio)
  - TFP as calculated in Ackerberg, Caves and Frazer (2015)

Variable definitions and sources of data

Variable	Definition	Data Source
x_{fjt}	Export quantity, kg	FTS
m_{ft}	Value of imported intermediate inputs in Turkish Liras	FTS
rer_{jt}	Real exchange rate	IMF-IFS
er_{jt}	nominal exchange rate (denoted as currency of c/TL)	IMF-IFS
cpi_{jt}	Consumer price index of country c	IMF-IFS
$SRvol_{jt}$	Standard deviation of exchange rate volatility in months of quarter t and t-1.	Authors' calculations
$MRvol_{jt}$	Standard deviation of exchange rate volatility in months of quarter t, t-1, t-2 and t-3.	Authors' calculations
y_{jt}	Log of real GDP of Turkey's export destinations	IMF-IFS
α_{ft}	As defined in equation (3)	Authors' calculations
$\emptyset_{ft}$	TFP calculated using ACF (2015)	Authors' calculations
χ_{ft}	Employment Capital-Labor Ratio (K/L) Foreign Share	AISS

Notes: f, j, and t denote firm, partner country and time.

Baseline PPML estimates

Variables	All (1)	All (2)	Manuf. (3)	Serv. (4)
rer_{jt-1}	1.225***	1.381***	1.251***	1.091**
	(0.256)	(0.256)	(0.297)	(0.494)
α_{ft-1}		-0.245		
		(0.263)		
$rer_{jt-1} \times \alpha_{ft-1}$	-0.850*	0.164	-0.874*	0.320
	(0.463)	(0.424)	(0.513)	(1.203)
$MRvol_{jt-1}$	-2.286***	-1.348*	-1.652*	-3.620***
	(0.749)	(0.727)	(0.965)	(1.104)
$MRvol_{jt-1} \times \alpha_{ft-1}$	3.931*	-1.003	2.343	7.985
	(2.357)	(2.614)	(2.823)	(11.696)
TFP_{ft-1}		0.098***		
		(0.018)		
K/L_{ft-1}		-0.124***		
		(0.026)		
$Foreign$		-0.092*		
		(0.051)		
$Medium$		0.117***		
		(0.033)		
$Large$		0.154**		
		(0.065)		
y_{jt-1}	0.562***	0.552***	0.562***	0.557***
	(0.033)	(0.030)	(0.039)	(0.056)
$Constant$	1.146	2.057***	1.038	1.549
	(0.834)	(0.782)	(0.983)	(1.411)
Observations	695256	697524	577,957	116148
Firm FE	NO	YES	NO	NO
Firm-Time FE	YES	NO	YES	YES
Firm-Country	YES	YES	YES	YES
Country-Time FE	NO	NO	NO	NO
Sector FE	YES	YES	YES	YES
Time FE	YES	YES	YES	YES
Pseudo R^2	0.953	0.929	0.953	0.950

Note: Standard errors are clustered by firm*destination*time. Levels of significance: *10%, **5%, ***1%.

PPML estimates (before and after 2011)

Variables	All Sample		Manufacturing		Services	
	App. (1)	Dep. (2)	App. (3)	Dep. (4)	App. (5)	Dep. (6)
rer_{jt-1}	1.025***	2.013***	1.151***	2.178***	0.459	0.933
	(0.302)	(0.613)	(0.353)	(0.754)	(0.606)	(0.684)
$rer_{jt-1} \times \alpha_{ft-1}$	-1.083*	-0.690	-1.030	-0.354	-2.183	-1.240
	(0.631)	(0.544)	(0.694)	(0.593)	(1.827)	(1.225)
$MRvol_{jt-1}$	-2.717***	-1.440	-2.130*	-0.226	-4.335***	-3.334**
	(0.971)	(0.890)	(1.199)	(1.097)	(1.599)	(1.410)
$MRvol_{jt-1} \times \alpha_{ft-1}$	5.372**	-2.974	3.693	-8.230*	22.169	11.931
	(2.270)	(4.255)	(2.713)	(4.766)	(15.931)	(8.812)
y_{jt-1}	0.412***	0.210***	0.377***	0.235***	0.522***	0.084
	(0.044)	(0.045)	(0.054)	(0.052)	(0.068)	(0.074)
Constant	5.227***	9.472***	5.882***	8.699***	3.087*	13.226***
	(1.127)	(1.172)	(1.368)	(1.361)	(1.712)	(1.862)
Observations	329957	355664	279359	290696	50131	64334
Firm FE	NO	NO	NO	NO	NO	NO
Firm-Time FE	YES	YES	YES	YES	YES	YES
Firm-Country	YES	YES	YES	YES	YES	YES
Country-Time FE	NO	NO	NO	NO	NO	NO
Sector FE	YES	YES	YES	YES	YES	YES
Time FE	YES	YES	YES	YES	YES	YES
Pseudo R^2	0.959	0.967	0.960	0.967	0.952	0.968

Note: Standard errors are clustered by firm*destination*time. Levels of significance: *10%, *5%, ***1%.

PPML estimates by firm ownership

Variables	Domestic firms			Foreign firms		
	All	Manuf.	Serv.	All	Manuf.	Serv.
	(1)	(2)	(3)	(4)	(5)	(6)
rer_{jt-1}	1.420***	1.514***	1.099*	1.125***	0.908***	2.171*
	(0.409)	(0.509)	(0.588)	(0.344)	(0.332)	(1.300)
$rer_{jt-1} \times \alpha_{ft-1}$	0.179	0.451	-4.577	-0.533	-0.322	-0.835
	(0.773)	(0.826)	(2.912)	(0.442)	(0.462)	(1.531)
$MRvol_{jt-1}$	-1.506	-1.265	-2.247*	-4.124***	-2.023*	-11.031***
	(0.917)	(1.292)	(1.169)	(1.139)	(1.136)	(2.835)
$MRvol_{jt-1} \times \alpha_{ft-1}$	-14.262**	-17.996**	50.717	10.274***	5.780**	31.486*
	(6.801)	(7.210)	(31.051)	(2.691)	(2.695)	(16.136)
y_{jt-1}	0.472***	0.463***	0.504***	0.360***	0.381***	0.265**
	(0.041)	(0.049)	(0.065)	(0.046)	(0.050)	(0.107)
Constant	3.443***	3.590***	2.839*	6.057***	5.359***	8.730***
	(1.015)	(1.198)	(1.630)	(1.171)	(1.280)	(2.796)
Observations	513231	424032	88256	173836	146976	26670
Firm FE	NO	NO	NO	NO	NO	NO
Firm-Time FE	YES	YES	YES	YES	YES	YES
Firm-Country	YES	YES	YES	YES	YES	YES
Country-Time FE	NO	NO	NO	NO	NO	NO
Sector FE	YES	YES	YES	YES	YES	YES
Time FE	YES	YES	YES	YES	YES	YES
Pseudo R2	0.958	0.959	0.956	0.953	0.954	0.950

Note: Standard errors are clustered by firm*destination*time. Levels of significance: *10%, **5%, ***1%.

PPML estimates by technology class of sectors

Variables	Low Tech (1)	Med-Low Tech (2)	Med-High Tech (3)	High Tech (4)
rer_{jt-1}	0.333	1.965***	0.691***	-0.534
	(0.237)	(0.594)	(0.248)	(0.888)
$rer_{jt-1} \times \alpha_{ft-1}$	0.300	0.872	-1.197***	5.166***
	(0.379)	(1.346)	(0.355)	(1.326)
$MRvol_{jt-1}$	-0.284	-1.085	-1.606**	7.948***
	(0.466)	(1.465)	(0.660)	(2.250)
$MRvol_{jt-1} \times \alpha_{ft-1}$	-6.076*	-13.266	4.315***	-62.316***
	(3.565)	(11.298)	(1.651)	(14.789)
y_{jt-1}	0.488***	0.565***	0.510***	0.743***
	(0.025)	(0.049)	(0.045)	(0.063)
Constant	1.187*	1.523	1.083	-6.714***
	(0.610)	(1.246)	(1.168)	(1.625)
Observations	230945	172899	163423	10068
Firm FE	NO	NO	NO	NO
Firm-Time FE	YES	YES	YES	YES
Firm-Country	YES	YES	YES	YES
Country-Time FE	NO	NO	NO	NO
Sector FE	YES	YES	YES	YES
Time FE	YES	YES	YES	YES
Pseudo R2	0.939	0.952	0.938	0.933

Note: Standard errors are clustered by firm*destination*time. Levels of significance: *10%, **5%, ***1%.

PPML estimates by firm size

Variables	All Sample			Manufacturing			Services		
	Small (1)	Medium (2)	Large (3)	Small (4)	Medium (5)	Large (6)	Small (7)	Medium (8)	Large (9)
rer_{jt-1}	1.319***	1.841***	1.213**	0.712***	1.393***	1.292***	2.772***	0.383	-1.659
	(0.344)	(0.300)	(0.474)	(0.245)	(0.295)	(0.489)	(0.909)	(0.874)	(2.003)
$rer_{jt-1} \times \alpha_{ft-1}$	-0.272	0.464	-1.274	-1.300***	0.554	-1.255	2.583**	2.476*	-5.975
	(0.520)	(0.512)	(0.879)	(0.372)	(0.504)	(0.890)	(1.133)	(1.316)	(6.537)
$MRvol_{jt-1}$	-1.339*	-1.197	-1.635	-1.809***	-1.423	-1.414	-0.856	1.352	-7.970
	(0.688)	(0.891)	(2.064)	(0.492)	(0.913)	(2.130)	(1.778)	(2.017)	(5.174)
$MRvol_{jt-1} \times \alpha_{ft-1}$	4.921	-5.174	2.961	9.109**	-6.450	2.452	2.670	-13.920	24.913
	(5.123)	(5.184)	(5.054)	(3.681)	(5.322)	(5.208)	(9.143)	(10.568)	(50.614)
y_{jt-1}	0.379***		0.559***	0.355***	0.580***	0.560***	0.394***	0.580***	0.370
	(0.047)		(0.068)	(0.027)	(0.037)	(0.068)	(0.122)	(0.074)	(0.378)
Constant	4.255***	14.346***	2.190	4.404***	0.106	2.109	4.622	0.527	8.427
	(1.159)	(0.130)	(1.717)	(0.650)	(0.927)	(1.734)	(3.067)	(1.932)	(9.118)
Observations	183568	213058	57439	164611	197906	53502	18770	15026	3914
Firm FE	NO	NO	NO	NO	NO	NO	NO	NO	NO
Firm-Time FE	YES	YES	YES	YES	YES	YES	YES	YES	YES
Firm-Country	YES	YES	YES	YES	YES	YES	YES	YES	YES
Country-Time FE	NO	NO	NO	NO	NO	NO	NO	NO	NO
Sector FE	YES	YES	YES	YES	YES	YES	YES	YES	YES
Time FE	YES	YES	YES	YES	YES	YES	YES	YES	YES
Pseudo R2	0.954	0.946	0.938	0.950	0.949	0.939	0.949	0.951	0.926

Note: Standard errors are clustered by firm*destination*time. Levels of significance: *10%, **5%, ***1%.

PPML estimates by broad sectors

Variables	Food Beverage Tobacco (1)	Textiles & Apparel (2)	Leather (3)	Chemicals Rubber & Plastic (4)	Basic Fabricated Metals (5)	Machinery (6)	Transport Equipment (7)	Furniture (8)	Computer & Electronics (9)
rer_{jt-1}	-0.035	-0.262	-0.020	0.948***	1.044*	0.256	1.051***	2.641***	-0.754***
	(0.354)	(0.265)	(1.373)	(0.293)	(0.543)	(0.360)	(0.350)	(0.400)	(0.210)
$rer_{jt-1} \times \alpha_{ft-1}$	-0.066	-0.082	8.484**	-0.997	2.775**	2.457***	-1.517***	-4.777***	1.429**
	(0.816)	(0.447)	(4.071)	(0.660)	(1.161)	(0.516)	(0.415)	(1.575)	(0.564)
$MRvol_{jt-1}$	1.034*	0.258	-1.152	0.120	-0.043	0.793	0.280	0.560	-3.191***
	(0.603)	(0.665)	(3.848)	(1.067)	(1.420)	(1.006)	(0.592)	(0.768)	(0.963)
$MRvol_{jt-1} \times \alpha_{ft-1}$	-18.815***	-2.508	-81.231*	-6.136	-30.271**	-8.086*	1.053	49.108***	0.111
	(7.164)	(3.811)	(42.969)	(5.827)	(11.835)	(4.501)	(1.524)	(15.807)	(5.431)
y_{jt-1}	0.281***	0.705***	0.334***	0.419***	0.550***	0.547***	1.125***	0.608***	0.559***
	(0.035)	(0.026)	(0.098)	(0.055)	(0.057)	(0.038)	(0.071)	(0.031)	(0.035)
Constant	6.956***	-5.850***	2.745	3.141**	1.473	-2.014**	-15.249***	-5.128***	0.026
	(0.859)	(0.668)	(2.593)	(1.368)	(1.431)	(0.952)	(1.866)	(0.765)	(0.896)
Observations	43204	125455	4742	94349	77930	44858	46491	14198	44836
Firm FE	NO	NO	NO	NO	NO	NO	NO	NO	NO
Firm-Time FE	YES	YES	YES	YES	YES	YES	YES	YES	YES
Firm-Country	YES	YES	YES	YES	YES	YES	YES	YES	YES
Country-Time FE	NO	NO	NO	NO	NO	NO	NO	NO	NO
Sector FE	YES	YES	YES	YES	YES	YES	YES	YES	YES
Time FE	YES	YES	YES	YES	YES	YES	YES	YES	YES
Pseudo R2	0.924	0.921	0.923	0.933	0.943	0.908	0.938	0.915	0.943

Note: Standard errors are clustered by firm*destination*time. Levels of significance: *10%, **5%, ***1%.

PPML estimates by geographical regions

Variables	Marmara (1)	Aegean (2)	Central Anatolia (3)	Mediterranean (4)	Eastern and SE Anatolia (5)	Black Sea (6)
rer_{jt-1}	1.279***	2.627***	1.426**	-1.485**	0.685	-0.556
	(0.331)	(0.482)	(0.600)	(0.595)	(0.737)	(1.172)
$rer_{jt-1} \times \alpha_{ft-1}$	-1.216*	-0.344	-1.213	-0.253	-0.445	6.486
	(0.676)	(0.923)	(0.907)	(1.469)	(1.140)	(6.017)
$MRvol_{jt-1}$	-2.975***	-2.989**	-6.076***	0.816	-2.118	-4.083
	(1.134)	(1.325)	(1.457)	(1.827)	(1.855)	(2.493)
$MRvol_{jt-1} \times \alpha_{ft-1}$	4.842*	10.498	26.344***	-12.536	3.799	-61.243
	(2.926)	(8.801)	(6.463)	(14.096)	(9.765)	(51.603)
y_{jt-1}	0.588***	0.515***	0.385***	0.162**	0.717***	0.256***
	(0.049)	(0.056)	(0.055)	(0.067)	(0.079)	(0.091)
Constant	0.642	1.291	5.012***	11.946***	-2.049	9.344***
	(1.248)	(1.433)	(1.265)	(1.630)	(1.930)	(2.333)
Observations	417716	78970	46645	27752	15047	9934
Firm FE	NO	NO	NO	NO	NO	NO
Firm-Time FE	YES	YES	YES	YES	YES	YES
Firm-Country	YES	YES	YES	YES	YES	YES
Country-Time FE	NO	NO	NO	NO	NO	NO
Sector FE	YES	YES	YES	YES	YES	YES
Time FE	YES	YES	YES	YES	YES	YES
Pseudo R2	0.957	0.953	0.940	0.944	0.959	0.953

Note: Standard errors are clustered by firm*destination*time. Levels of significance: *10%, **5%, ***1%.

What is Next?

- Asymmetry exploration: separate analysis of appreciation and depreciation periods
- Quantile and regional distributions of the trade-exchange rate effects

Your Comments are more than welcome!

THANK YOU…