

# Exporters and Shocks

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# Motivation: International Elasticity Puzzle

- ▶ Trade facts: need a high elasticity of substitution between goods of different countries, e.g. Yi (2003)
- ▶ Macro facts: need a low elasticity of substitution between goods of different countries, e.g. BKK (1994), Heathcote & Perri (2002)

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- ▶ This paper: Investigate origins of this puzzle using micro data

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- ▶ Estimate firm-level **intensive** and **extensive** margin responses to both macro shocks and trade liberalizations:
- ▶ Examples of shocks:
  - ▶ US experiences real appreciation relative to UK
  - ▶ US grows faster than UK
  - ▶ Tariff falls in US market, not in UK market
- ▶ How does an Irish firm change its participation/ export sales to US relative to UK in response to these shocks?

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- ▶ Bigger elasticities with respect to tariff reductions than with respect to real exchange rate movements
- ▶ Extensive margin (participation) more responsive to tariffs than to real exchange rates, but magnitudes small and entrants/ exiters are *tiny*
- ▶  $\Rightarrow$  International Elasticity Puzzle due to intensive margin: still a puzzle!

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- ▶ May face fixed & sunk costs of participation in each market  $k$
- ▶ Firm  $i$  faces demand in market  $k$  at time  $t$  given by:

$$Q_t^{ik} = \left[ \left( \frac{(1 + \tau_t^{ik}) P_t^{ik*}}{P_t^{k*}} \right)^{-\theta} Q_t^k \right] D_t^{ik} \exp(\eta_t^{ik})$$

- ▶  $\eta_t^{ik}$ : iid demand shock
- ▶  $D_t^{ik}$ : state variable - can link current demand to past actions (and hence to past shocks)

# Notation

- ▶  $X_t^{ik}$ : indicator for participation
- ▶  $\mathbf{Z}_t^{ik}$ : vector of exogenous shocks  $(P_t^H, P_t^{k*}, E_t^K, C_t^i, Q_t^k, \tau_t^{ik}, \eta_t^{ik})$

## Example 1

- ▶ Ruhl & Willis (2008):  $D_t^{ik}$  depends on past participation in market  $k$

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# Micro data

- ▶ Confidential micro data made available at the Central Statistics Office (CSO) in Ireland
- ▶ Plant census
- ▶ Prodcom survey of products sold
- ▶ Customs data on exports

## Micro data: Plant census

- ▶ Annual plant census, 2000-2009
- ▶ All plants in manufacturing with  $\geq 3$  employees
- ▶ Usual set of plant census variables: 4-digit NACE sector, revenue, employment, wage bill, investment, materials expenditures etc.
- ▶ Aggregate up to the firm level

## Micro data: Prodcum survey

- ▶ Value and volume of all 8-digit products manufactured by the firm and sold in the relevant year
- ▶ Available 2000-2009, matched to 95% of CIP by value
- ▶ Concordance between production classification (Prodcum) and trade classification (CN)
- ▶ Knowing products produced allows us to construct relevant tariff variable at the firm-market-year level using production weights

# Micro data: Customs data on exports

- ▶ Customs records, 2000-2009 (Intrastat and Extrastat)
  - ▶ Intrastat reporting threshold: Euro 635,000 annually
  - ▶ Extrastat reporting threshold: Euro 254 per transaction
- ▶ Records matched to *firms* using tax id number and where necessary, confidential info, by CSO
- ▶ ⇒ Euro value of exports at 6-digit HS level, by firm-destination-year
  - ▶ Allows us to attach the macro shocks for the appropriate destination
  - ▶ Allows us to construct a tariff variable at the firm-destination-year level using sales weights

# Summary statistics: Firms and exports

## Exporters and non-exporters

	# firms		Avg employees		Avg revenue		Avg export %
	All	Exporters	Nonex.	Exporters	Nonex.	Exporters	Exporters
2000	4826	2025	32	87	11808	29657	42
2001	4768	2072	33	84	13012	29227	42
2002	4944	2079	30	80	10281	33699	42
2003	4902	2063	28	78	10775	37748	42
2004	4585	2024	28	80	12020	40664	42
2005	4307	1916	30	82	14604	43993	44
2006	4476	1950	29	81	14796	43683	43
2007	5266	1974	25	78	13330	44762	40
2008	5337	1920	21	73	10353	44320	38
2009	4906	1860	19	72	9501	44660	39

Notes: Statistics are for our cleaned dataset of CIP firms. Exporters are firms who are matched with more than 500 Euro of exports from customs data. Avg revenue is in 1000 Euro. Export share is calculated as total exports from the customs match divided by sales reported in the CIP. Values greater than 100 are replaced by 100. Source: CSO and authors' calculations.

▶ Match

## Summary statistics: Export destinations

**Percent of matched exports by destination**

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Australia	1	1	1	1	1	1	1	1	1	1
Canada	0	1	0	1	0	0	0	0	0	1
China	0	0	1	1	1	1	1	2	2	3
Denmark	1	0	1	1	0	0	1	1	1	0
Japan	4	4	4	3	3	3	3	2	2	2
Norway	0	0	0	0	0	0	0	0	0	0
Sweden	1	1	1	1	1	1	1	1	1	1
Switzerland	1	1	1	1	4	5	4	5	4	4
UK	17	15	15	15	15	15	16	16	16	15
US	22	20	22	23	21	16	16	18	19	22
Euro 9	42	43	45	44	43	47	44	42	41	42
E. Europe	1	1	1	1	1	1	1	1	2	1

Notes: Source: CSO and Authors' calculations. Euro 9 includes Austria, Belgium, Finland, France, Germany, Italy, Netherlands, Spain, Portugal

## Summary statistics: Export entry and exit

### Transitions of firms into and out of exporting

Year-t status	no exports			exports		
Year-t+1 status	no exports	exports	exit	no exports	exports	exit
2000-01	0.88	<b>0.06</b>	0.06	<b>0.04</b>	0.93	0.03
2001-02	0.86	<b>0.04</b>	0.10	<b>0.05</b>	0.90	0.04
2002-03	0.84	<b>0.06</b>	0.10	<b>0.07</b>	0.87	0.06
2003-04	0.77	<b>0.06</b>	0.17	<b>0.05</b>	0.87	0.08
2004-05	0.82	<b>0.05</b>	0.13	<b>0.06</b>	0.86	0.08
2005-06	0.85	<b>0.05</b>	0.10	<b>0.07</b>	0.85	0.08
2006-07	0.86	<b>0.03</b>	0.11	<b>0.07</b>	0.85	0.07
2007-08	0.78	<b>0.04</b>	0.18	<b>0.06</b>	0.84	0.10
2008-09	0.82	<b>0.04</b>	0.14	<b>0.06</b>	0.87	0.07

Notes: Share of firms of year-t status ending up in year-t+1 status



# Summary statistics: Size of entrants and exiters

## Size of entrants and exiters in important markets

year	US		Japan		Switzerland		Australia	
	Entrants	Exiters	Entrants	Exiters	Entrants	Exiters	Entrants	Exiters
2000		0.01		0.07		0.31		0.05
2001	0.01	0.02	0.01	0.02	3.23	0.17	0.23	0.26
2002	0.01	0.07	0.05	0.06	0.05	0.03	0.02	0.02
2003	0.01	0.07	0.04	0.03	0.03	0.02	0.05	0.05
2004	0.04	0.52	0.10	0.02	0.00	0.01	0.01	0.03
2005	0.02	0.02	0.05	0.02	0.01	0.01	0.04	0.02
2006	0.04	0.02	0.05	0.17	0.00	0.02	0.01	0.06
2007	0.51	0.01	0.03	0.05	0.01	0.01	0.04	0.03
2008	0.09	0.04	0.03	0.92	0.01	0.12	0.02	0.50
2009	0.35		0.45		0.03		0.54	

Notes: Ratio of mean sales of entrants to mean sales of incumbents and ratio of mean sales of exiters to mean sales of continuing firms.

# Data: Shocks

## Macro shocks

- ▶ Real consumption exchange rates (Source: IFS)
- ▶ Aggregate real expenditure (Source: IFS/OECD/WDI)
  - ▶ Nominal destination currency expenditure (GDP - Exports + Imports) deflated by destination market CPI

▶ RER

▶ Demand

## Tariff shock

- ▶ 2000-04: Tariff reductions associated with the Uruguay Round
- ▶ WTO: ad valorem MFN tariffs aggregated to HS6
- ▶ Construct firm-market-year-specific tariff variables for most important tariff-subject markets (20-25% of Irish exports)
  - ▶ Australia, Brazil, Canada, China, India, Japan, Malaysia, Mexico, New Zealand, Saudi Arabia, South Africa, Thailand, Turkey, UAE, USA

▶ Tariff shock

▶ Tariffs

## Empirical strategy: Intensive margin

- ▶ Real revenue in home currency:

$$R_t^{ik} = \tilde{\theta} \left( \tilde{C}_t^i \right)^{1-\theta} \left( \frac{RER_t^k}{1 + \tau_t^{ik}} \right)^\theta Q_t^k D_t^{ik} \exp \left( \eta_t^{ik} \right)$$

## Empirical strategy: Intensive margin

- ▶  $\Delta r_t^{ik}$ : log change in real revenue of firm  $i$  from market  $k$  at  $t$

$$\Delta r_t^{ik} = \alpha^k + c_t^i + \sum_{s=0}^S \beta_s' \Delta \mathbf{z}_{t-s}^{ik} + \varepsilon_t^{ik}$$

- ▶  $\alpha^k$ : market fixed effect
- ▶  $c_t^i$ : firm-year fixed effect to control for costs
- ▶  $\Delta \mathbf{z}_t^{ik}$ : vector of shocks: log changes in real exchange rate, real demand, tariff variable
- ▶ May also control for  $D$  by including log lag real revenue  $r_{t-1}^{ik}$
- ▶ Use Intrastat and Extrastat destinations

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- ▶ Selection bias: Focus on observations likely to be far from entry/exit thresholds: firm-market pairs with positive sales in all sample years

# Results: Intensive margin

## Revenue and shocks

	coeff	s.e.	coeff	s.e.
$\Delta rer_t^k$	0.97	(0.31)**	0.78	(0.29)**
$\Delta rer_{t-1}^k$	-0.07	(0.33)	0.02	(0.31)
$\Delta dem_t^k$	1.03	(0.71)	1.11	(0.68)
$\Delta dem_{t-1}^k$	0.20	(0.81)	0.34	(0.77)
$\Delta tau_t^{ik}$	-7.06	(9.93)	-5.76	(9.12)
$\Delta tau_{t-1}^{ik}$	-19.65	(8.42)**	-17.63	(7.91)**
$r_{t-1}^{ik}$			-0.16	(0.01)**
Market f.e.	yes		yes	
Firm-year f.e.	yes		yes	
# firm-mkt-years	12772		12772	
# firm-years	3171		3171	
R <sup>2</sup>	0.32		0.37	
R <sup>2</sup> -adj	0.09		0.16	

Notes: Estimation method is OLS. Dependent variable is log euro sales deflated by Irish CPI. Sample consists of firm-market pairs with continuous participation 2000-2009, where included markets are Euro 9, UK, Sweden, Denmark and Extrastat markets. Robust standard errors are calculated. \*\* indicates significance at the 5% level. \* indicates significance at the 10% level.

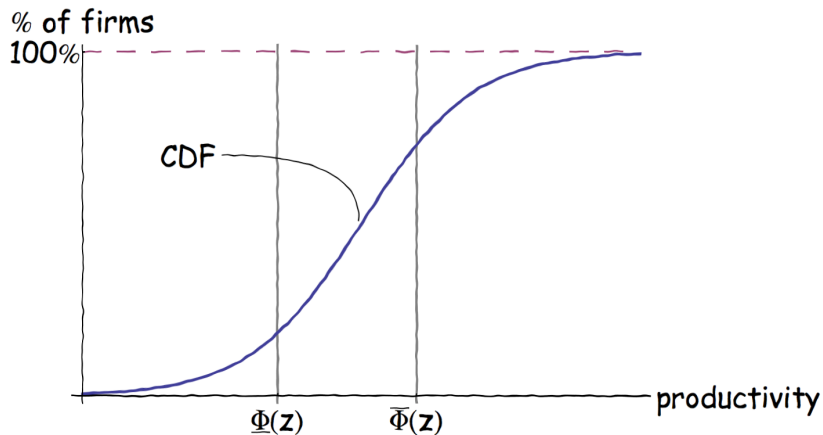
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- ▶ Participation decision:

$$X_t^{ik} = X \left( X_{t-1}^{ik}, D_t^{ik}, \mathbf{z}_t^{ik}, \mathbb{E} \left( \mathbf{z}_{t+1}^{ik}, \dots \right) \right)$$

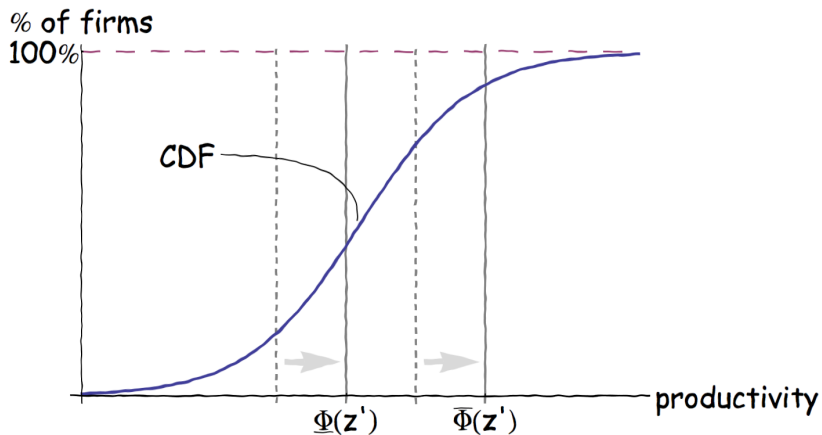
- ▶ Effect of shocks may vary across firms

## Empirical strategy: Extensive margin





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## Empirical strategy: Extensive margin

- ▶  $X_t^{ik}$ : indicator for participation of firm  $i$  in market  $k$  at  $t$

$$\Pr[X_t^{ik} = 1] = \left[ \begin{array}{l} \alpha^k + c_t^i + \phi X_{t-1}^{ik} + \beta' \mathbf{z}_t^{ik} + \delta' \mathbf{z}_t^{ik} X_{t-1}^{ik} \\ + \gamma' (\mathbf{s}_{t-1}^i \otimes \mathbf{z}_t^{ik}) + \theta' (\mathbf{s}_{t-1}^i \otimes \mathbf{z}_t^{ik}) X_{t-1}^{ik} \\ + \lambda' r_{t-1}^{ik} X_{t-1}^{ik} + \rho' (r_{t-1}^{ik} \otimes \mathbf{z}_t^{ik}) X_{t-1}^{ik} + \varepsilon_t^{ik} \end{array} \right]$$

- ▶  $\alpha^k$ : market fixed effect
- ▶  $c_t^i$ : firm-year fixed effect
- ▶  $X_{t-1}^{ik}$ : indicator for lagged participation
- ▶  $\mathbf{z}_t^{ik}$ : “shock” variables: log real xrate, real demand, tariff
- ▶  $\mathbf{s}_{t-1}^i$ : “cost” variables: indicators for employment
- ▶  $r_{t-1}^{ik}$ : log of lag real revenue from market  $k$
- ▶ Use Extrastat destinations only

# Results: Extensive margin

## Marginal effects from participation equation

Status	Employees	rer		demand		tariff	
		coeff	se	coeff	se	coeff	se
Potential entrants	1-14	0.00	(0.00)	0.01	(0.00)**	0.02	(0.00)**
	15-99	0.01	(0.00)**	0.02	(0.00)**	-0.00	(0.01)
	100+	0.02	(0.00)**	0.02	(0.00)**	-0.03	(0.02)**
Incumbents	1-14	0.02	(0.01)**	0.01	(0.00)**	0.54	(0.18)**
	15-99	0.01	(0.00)**	0.01	(0.00)**	-0.12	(0.14)
	100+	0.01	(0.01)*	0.00	(0.00)	-0.34	(0.14)**

Notes: Omitted category is firms with fewer than 15 employees in the last period, who did not participate in the last period.  $emp2_{t-1}^i$  is an indicator variable for having 15-99 employees in the last period.  $emp3_{t-1}^i$  is an indicator variable for having 100+ employees in the last period. For incumbents, evaluated at log of mean revenue for the relevant size category.

► Equation

# Economic significance

- ▶ Response to shocks small relative to steady state entry/ exit
- ▶ Entrants and exiters usually tiny relative to incumbents
- ▶  $\implies$  Impact of shocks on aggregate exports comes mainly through intensive margin

# Conclusions

- ▶ Elasticities of firm-level intensive margin with respect to shocks close to aggregate elasticities

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# Conclusions

- ▶ Elasticities of firm-level intensive margin with respect to shocks close to aggregate elasticities
- ▶ Firm-level extensive margin more responsive to tariffs than to real exchange rates, but entrants/ exiters are small
- ▶  $\Rightarrow$  Understanding the International Elasticity Puzzle requires us to understand the intensive margin

## Work in progress

- ▶ Quantitative analysis: Can costs of adjustment on the intensive margin interact with volatility of shocks to help match the facts?



# Summary statistics: Customs match

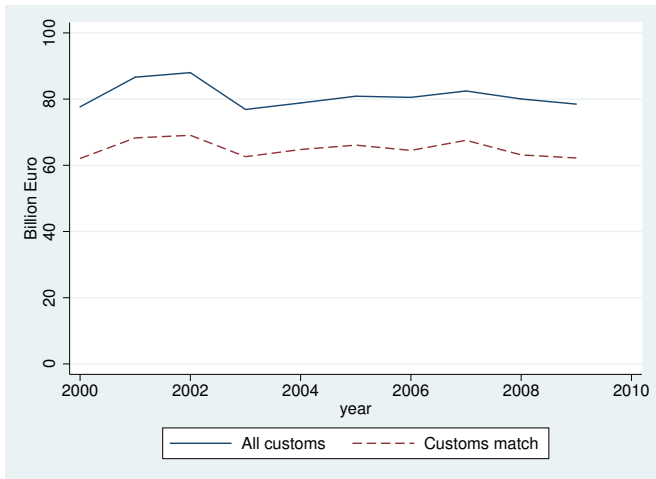


Figure: Total exports

Notes: All customs refers to total industrial exports according to published Customs data. Customs match refers to total customs exports of CIP firms matched to customs data. Source: CSO and authors' calculations

# Summary statistics: HS6 tariffs

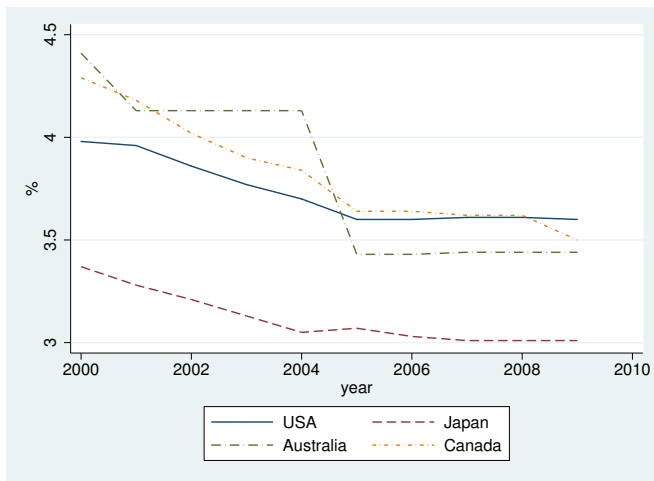


Figure: Average tariffs

Notes: Figure graphs coefficient on year dummies in regression of unweighted ad valorem tariffs at the HS6 level on HS6 fixed effects and year dummies.

## Summary statistics: HS6 tariffs

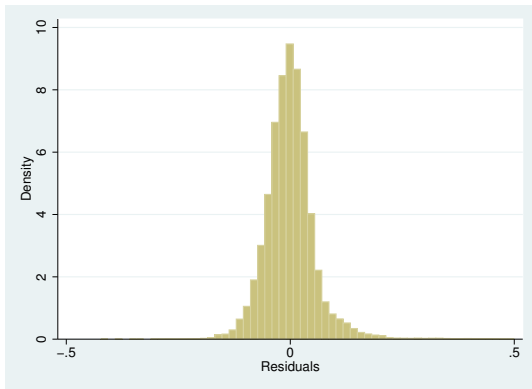
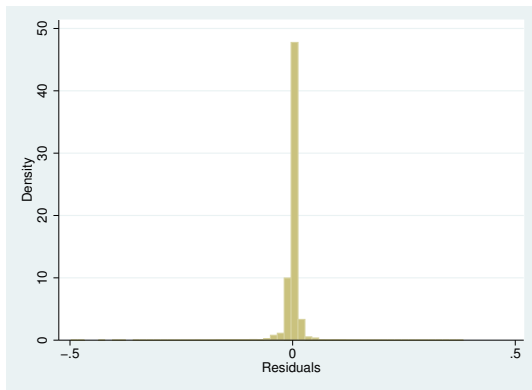


Figure: Residual variation in tariff levels

Notes: Residuals from regressing  $\ln(1 + \tau)$  on country fixed effects and HS6-year fixed effects

▶ Back

## Summary statistics: HS6 tariffs



**Figure:** Residual variation in tariff changes

Notes: Residuals from regressing  $\Delta \ln(1 + \tau)$  on country fixed effects and HS6-year fixed effects

▶ Back

# Data: Tariff shock

- ▶ Two baseline tariff variables:

- ▶ Intensive:

$$\Delta rtariff_t^{ik} = \sum_j \left( \frac{rsh_t^{ijk} + rsh_{t-1}^{ijk}}{2} \right) \Delta \ln (1 + \tau_t^{jk})$$

- ▶ Extensive:

$$ptariff_t^{ik} = \sum_j \left( \frac{psh_t^{ij} + psh_{t-1}^{ij}}{2} \right) \ln (1 + \tau_t^{jk})$$

- ▶  $rsh_t^{ijk}$ : share of good  $j$  in  $i$ 's exports to  $k$  at  $t$
- ▶  $psh_t^{ij}$ : share of good  $j$  in  $i$ 's production at  $t$

# Summary statistics: Real exchange rates

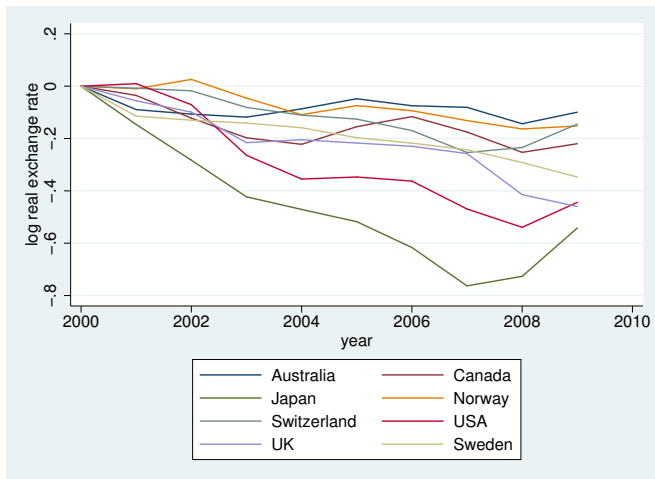


Figure: Annual average real exchange rates: Non-Euro destinations

# Summary statistics: Real exchange rates

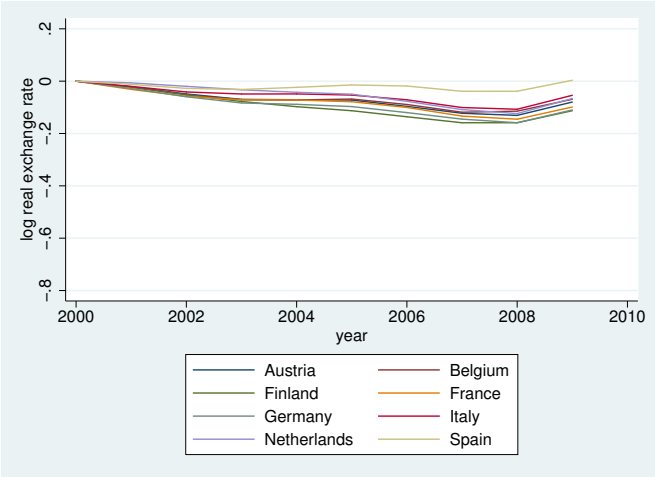


Figure: Annual average real exchange rates: Euro destinations

# Summary statistics: Real aggregate demand

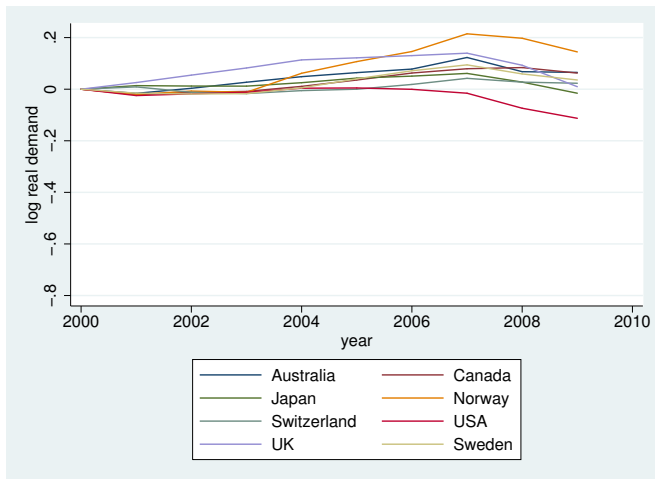


Figure: Real aggregate demand: Non-Euro destinations





# Results: Extensive margin

## Participation: Linear probability

	coeff	s.e.
$X_{t-1}^{ik}$	-0.03	(0.08)
$X_{t-1}^{ik} * rev_{t-1}^{ik}$	0.18	(0.01)**
$rer_t^k$	0.00	(0.00)
$emp2_{t-1}^i * rer_t^k$	0.01	(0.00)**
$emp3_{t-1}^i * rer_t^k$	0.02	(0.00)**
$X_{t-1}^{ik} * rer_t^k$	0.04	(0.01)**
$X_{t-1}^{ik} * emp2_{t-1}^i * rer_t^k$	-0.01	(0.01)*
$X_{t-1}^{ik} * emp3_{t-1}^i * rer_t^k$	-0.01	(0.01)*
$X_{t-1}^{ik} * rev_{t-1}^{ik} * rer_t^k$	-0.01	(0.00)**
$dem_t^k$	0.01	(0.00)**
$emp2_{t-1}^i * dem_t^k$	0.00	(0.00)**
$emp3_{t-1}^i * dem_t^k$	0.01	(0.00)**
$X_{t-1}^{ik} * dem_t^k$	0.02	(0.00)**
$X_{t-1}^{ik} * emp2_{t-1}^i * dem_t^k$	0.00	(0.00)
$X_{t-1}^{ik} * emp3_{t-1}^i * dem_t^k$	-0.00	(0.00)**
$X_{t-1}^{ik} * rev_{t-1}^{ik} * dem_t^k$	-0.01	(0.00)**
$tau_t^{ik}$	0.02	(0.00)**
$emp2_{t-1}^i * tau_t^{ik}$	-0.03	(0.01)**
$emp3_{t-1}^i * tau_t^{ik}$	-0.06	(0.02)**
$X_{t-1}^{ik} * tau_t^{ik}$	0.32	(0.20)
$X_{t-1}^{ik} * emp2_{t-1}^i * tau_t^{ik}$	-0.65	(0.23)**
$X_{t-1}^{ik} * emp3_{t-1}^i * tau_t^{ik}$	-0.88	(0.23)**
$X_{t-1}^{ik} * rev_{t-1}^{ik} * tau_t^{ik}$	0.08	(0.04)**
# firm-mkt-years		299549
R <sup>2</sup> -adj		0.62