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Decomposing Services Exports Adjustments along the Intensive and Extensive Margin at the Firm-Level

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WIFO

This seminar series is an activity in the framework of FIW ('Forschungsschwerpunkt Internationale Wirtschaft'), which is a project designed to build a center of excellence in research on International Economics, funded by the Austrian Ministry of Science, Research and Economy (BMWFW).

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Motivation

- Is service trade different from goods trade?
- Stylized features as recognized in the recent firm-level literature:

$\longrightarrow$ Primacy of large and productive service exporting firms, low service export participation, number of export markets served increases with firm productivity.

- Presence of zero trade flows:

$\longrightarrow$ Self-selection of more productive firms into export destination markets.

- Firm-level adjustments in trade flows occur along two margins:

$\longrightarrow$ Intensive and extensive margins of trade.

- Relative contribution to overall export growth seems relevant to economic policy:

$\longrightarrow$ Different policy instruments are required to promote firms to enter new markets and to deepen existing export relations.

Research questions and contribution

- Access to firm-level data on Austrian service exporting firms. 37 individual destination markets, service and manufacturing exporting firms.
- Analyze determinants of export market choice and of the volume of exports of Austrian service exporting firms.
- Distinguish between service sector and manufacturing sector firms.
- Decompose changes in exports into contributions from the intensive and extensive margin at the firm-level - incorporating self-selection of firms into particular export markets.
- Elaborate on the composition of export flows in counterfactual scenarios: to assess expected reaction of trade flows for specific groups of firms in response to changes in key exogenous determinants.

Related literature

- Adoption of gravity models to firm level data has not yet gained widespread attention.
- Heckman sample selection model for manufacturing firm level data:
  - Greenaway et al. (2009), Crozet and Koenig (2010).
- Firm level services trade - stylized facts:
  - Breinlich and Criscuolo (2011), Kelle and Kleinert (2010), Ariu (2011, 2012), Federico and Tosti (2012).
  - Analyze adjustment at the intensive and extensive margin at the aggregate level of destinations or industries.

$\longrightarrow$ Measures on intensive margin leave out variation across destinations and/or services types.

$\longrightarrow$ Measures on extensive margin fail to account for the heterogeneity of firms.

Econometric specification I

- Based on heterogenous firm models (Melitz 2003; Helpman et al. 2008), allowing for positive and zero bilateral trade flows.
  - $\longrightarrow$ Monopolistic competition model with CES-preferences in which firms face fixed and variable costs of exporting.
  - $\longrightarrow$ Productivity varies across firms and only the more productive firms find it profitable to export to specific destinations.
  - $\longrightarrow$ Profits a separable and vary by destination market.
- Econometric specification incorporates export decision of firms which results in an extensive and intensive margin of trade.
  - $\longrightarrow$ Self-selection of firms into export markets.
  - $\longrightarrow$ Impact on trade volumes, conditional on positive trade.
  - $\longrightarrow$ Heckman's sample selection model (Heckman 1979).
- Theory consistent comparative statics, which allows to disentangle the reaction of firms at both margins.

Econometric specification II

- Exports of firm i to country j will be observed if profits from serving this market are positive (zero-profit condition):

$$z_{ij}^{*} = -\ln\sigma + (1-\sigma)\ln(\tfrac{\sigma}{\sigma-1}) + (1-\sigma)\ln c_i + (1-\sigma)\ln\tau_j + \ln\frac{E_j}{P_j^{1-\sigma}} - \ln f_j > 0$$

- Value of exports of firm i to country j, if positive, amount to

$$x_{ij} = (1-\sigma)\ln\tfrac{\sigma}{\sigma-1} + (1-\sigma)\ln c_i + (1-\sigma)\ln\tau_j + \ln\left(\frac{E_j}{P_j^{1-\sigma}}\right) \text{ if } z_{ij}^{*} \geq 0.$$

- Firm characteristics: size, productivity
- Destination market characteristics: distance, time zones, GDP, GDP pc., gravity dummies

Econometric specification III

- Identification of the second stage: valid excluded variables (not only relying on the normality assumption for the unobserved trade costs).
- Theory suggests that trade barriers affecting fixed trade costs but do not variable (per-unit) trade costs satisfy the exclusion restriction.
- In line with Helpman et al. (2008), we use country-level data on the regulation costs of firm entry (number of days and number of procedures for an entrepreneur to legally start operating a business) and foreign control indicator variable.
- Surmise that these costs mainly affect the (firm-level) fixed costs faced by exporting firms.

Data

- Austrian Trade in Services Survey (OeNB), 2006-2009 averages,
- reports firm-level exports of services by 37 destination countries,
- covers 5554 service trading firms, excluding financial and insurance companies and tourism sector.
- Additional firm characteristics: Structural Business Survey (Statistics Austria) & OeNB's company database
  $\longrightarrow$ industry affiliation, employment, sales revenues, foreign control
- Destination market characteristics: CEPII, WDI
  $\longrightarrow$ geographical and cultural ties (distance, contiguity, language familiarities, ...), real GDP, real GDP p.c., starting business indicators

Descriptive statistics

	Service Sector				Manufacturing Sector			
	Zero Export flows		Positive Exports: 23%		Zero Export flows		Positive Exports: 17%	
Variables	Obs	Mean	Obs	Mean	Obs	Mean	Obs	Mean
Exports	123463	0	36007	2268.77	38100	0	7928	3193.97
Foreign control	123463	0.37	36007	0.36	38100	0.34	7928	0.41
Outward FDI	123463	0.07	36007	0.09	38100	0.17	7928	0.34
Sales	123463	37688.80	36007	88856.97	38100	113506.50	7928	243417.00
Employees	119408	84.44	35474	176.96	37457	258.93	7868	517.47
Sales/Employee	119408	1934.74	35474	3241.40	37457	637.33	7868	537.59
real GDP	123463	735.30	36007	911.80	38100	730.49	7928	989.79
real GDP p.c.	123463	19148.08	36007	19894.98	38100	19273.23	7928	19525.73
real GDP 2017	123463	884.74	46235	1061.40	38100	877.41	7928	1133.25
Distance	123463	2813.04	36007	1459.62	38100	2701.77	7928	1573.60
Contiguity	123463	0.17	36007	0.38	38100	0.18	7928	0.40
Historical Ties	123463	0.07	36007	0.11	38100	0.07	7928	0.11
Com. language	123463	0.11	36007	0.21	38100	0.12	7928	0.21
Landlocked	123463	0.14	36007	0.23	38100	0.15	7928	0.22
Time zone diff.	123463	1.66	36007	0.77	38100	1.59	7928	0.83
Start Business	115755	21.79	35095	19.13	35730	21.47	7810	19.82

Export propensity and export volume: Heckman sample selection model

Variable	Service Sector Selection	Service Sector Outcome	Manufacturing Sector Selection	Manufacturing Sector Outcome
Ln Size	0.185^{***}	0.600^{***}	0.207^{***}	0.596^{***}
	(0.002)	(0.014)	(0.005)	(0.048)
Ln Productivity	0.147^{***}	0.625^{***}	0.086^{***}	0.687^{***}
	(0.003)	(0.014)	(0.010)	(0.047)
Ln Distance	-0.245^{***}	-0.561^{***}	-0.202^{***}	-0.305^{***}
	(0.009)	(0.039)	(0.018)	(0.085)
Time zone diff.	-0.040^{***}	-0.026^{*}	-0.033^{***}	-0.048^{*}
	(0.003)	(0.014)	(0.007)	(0.028)
Ln GDP	0.193^{***}	0.646^{***}	0.207^{***}	0.627^{***}
	(0.003)	(0.018)	(0.006)	(0.053)
Ln GDP pc.	-0.072^{***}	-0.347^{***}	-0.085^{***}	-0.441^{***}
	(0.006)	(0.023)	(0.011)	(0.049)
Contiguity	0.381^{***}	0.970^{***}	0.432^{***}	0.928^{***}
	(0.014)	(0.054)	(0.027)	(0.132)
Historical ties	0.141^{***}	0.329^{***}	0.133^{***}	0.235^{**}
	(0.016)	(0.056)	(0.030)	(0.118)
Com. language	0.431^{***}	1.435^{***}	0.347^{***}	1.082^{***}
	(0.014)	(0.053)	(0.027)	(0.116)
Landlocked	-0.161^{***}	-0.475^{***}	-0.183^{***}	-0.268^{**}
	(0.016)	(0.055)	(0.031)	(0.116)
Foreign control	-0.025^{***}		0.059^{***}	
	(0.009)		(0.017)	
Ln Start Business	-0.084^{***}		-0.043^{***}	
	(0.006)		(0.012)	
Mills' ratio		0.803^{***}		0.510^{*}
		(0.087)		(0.279)
Industry dummies (χ^2)		5394.783^{***}		307.579^{***}
Observations	146510	34576	42875	7750

Counterfactual analysis

- To quantify the impact of a change in exogenous determinants on the extensive and intensive margin of service trade, we compare expected export flows in the baseline and counterfactual scenario.
- Aggregate the implied percentage changes of each firm to weighted averages of groups of firms and report aggregate group specific figures.
- We follow Yen and Rosinski (2008): log-transformed dependent variable

$$E[e^{x_{ij}}] = E[e^{x_{ij}}|z_{ij}^* \geq 0]P(z_{ij}^* \geq 0) = e^{x_{ij}\beta+\sigma_\epsilon^2/2}\Phi(v_{ij}\gamma + \rho\sigma_\epsilon).$$

Decomposition:

- Calculate firm-specific probability of exporting to a specific destination and the expected trade volume conditional on exporting for each firm.
- Intensive margin: contribution of continuing exporters holding probability of exporting constant.
- Extensive margin: changes in the probability of exporting at given conditional expectations of positive exports.

Decomposition

Expected percent change for firm i exporting to country j:

$$
\begin{aligned}
G_{ij} &= \frac{E[e^{x_{ij}^C}] - E[e^{x_{ij}}]}{E[e^{x_{ij}}]} \\
&= \frac{E[e^{x_{ij}^C} | z_{ij}^{*C} \geq 0] P(z_{ij}^{*C} \geq 0) - E[e^{x_{ij}} | z_{ij}^{*C} \geq 0] P(z_{ij}^{*C} \geq 0)}{E[e^{x_{ij}} | z_{ij}^{*} \geq 0] P(z_{ij}^{*} \geq 0)} \\
&\quad \text{(intensive margin at constant probability to export)} \\
&+ \frac{E[e^{x_{ij}} | z_{ij}^{*C} \geq 0] P(z_{ij}^{*C} \geq 0) - E[e^{x_{ij}} | z_{ij}^{*} \geq 0] P(z_{ij}^{*} \geq 0)}{E[e^{x_{ij}} | z_{ij}^{*} \geq 0] P(z_{ij}^{*} \geq 0)} \\
&\quad \text{(extensive margin at constant positive export flows)} \\
&= \frac{\Phi(v_{ij}^C \gamma + \rho\sigma_\epsilon)}{\Phi(v_{ij}\gamma + \rho\sigma_\epsilon)} \left[e^{(x_{ij}^C - x_{ij})\beta} - 1 \right] + \left(\frac{\Phi(v_{ij}^C \gamma + \rho\sigma_\epsilon)}{\Phi(v_{ij}\gamma + \rho\sigma_\epsilon)} - 1 \right).
\end{aligned}
$$

Robustness analysis I

- Re-estimate the first stage Probit model using the semiparametric SNP estimator (De Luca, 2008):

  $\longrightarrow$ Only slight deviations from the normal distribution, parameters remain robust.

- Re-estimate the outcome equation using alternative two-step estimators (parametric and semiparametric series) (Heckman two step; Newey, 2009):

  $\longrightarrow$ Predictions of ML and two-step models are highly correlated (>0.95).

- Introduce destination country dummies and re-estimated all specifications:

  $\longrightarrow$ Firm specific variables very similar to baseline model.

Robustness analysis II

- Robustness analysis suggests that ML estimates are preferable and reasonably robust.
- Normality assumption provides a reasonable approximation of the data generating process.
- Main advantage: possibility to derive counterfactual predictions based on the estimated probabilities of firms export status in a specific destination market and conditional expectations of positive export flows.

Counterfactual scenarios

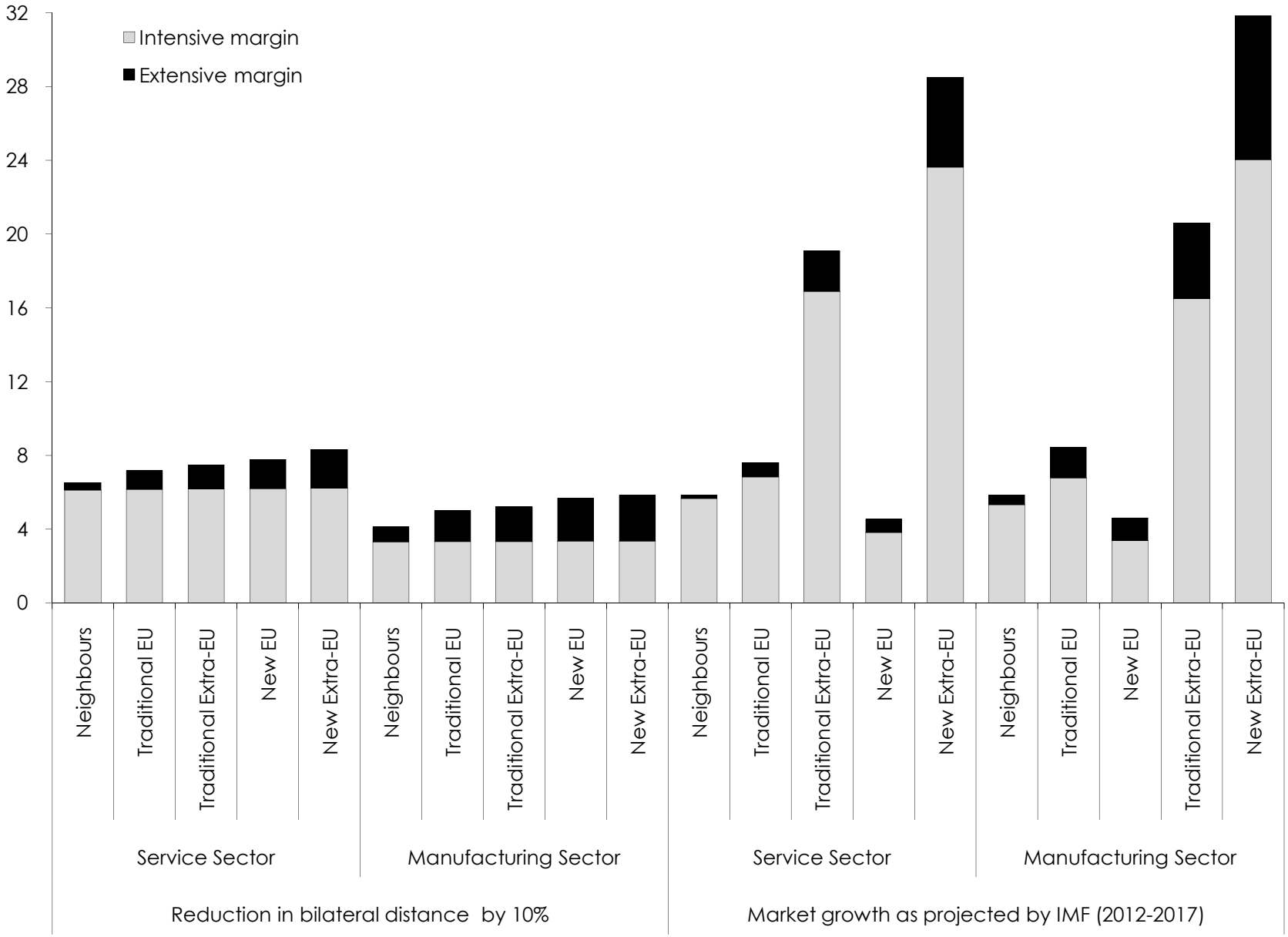
- (Hypothetical) reduction of trade costs (distance) by 10%
- Projected export market potentials (IMF GDP projections for 2017)
- Promotion of least productive firms (increase in productivity by 5%)
- Promotion of most productive firms (increase in productivity by 5%)

Counterfactual results I - Change in overall services exports

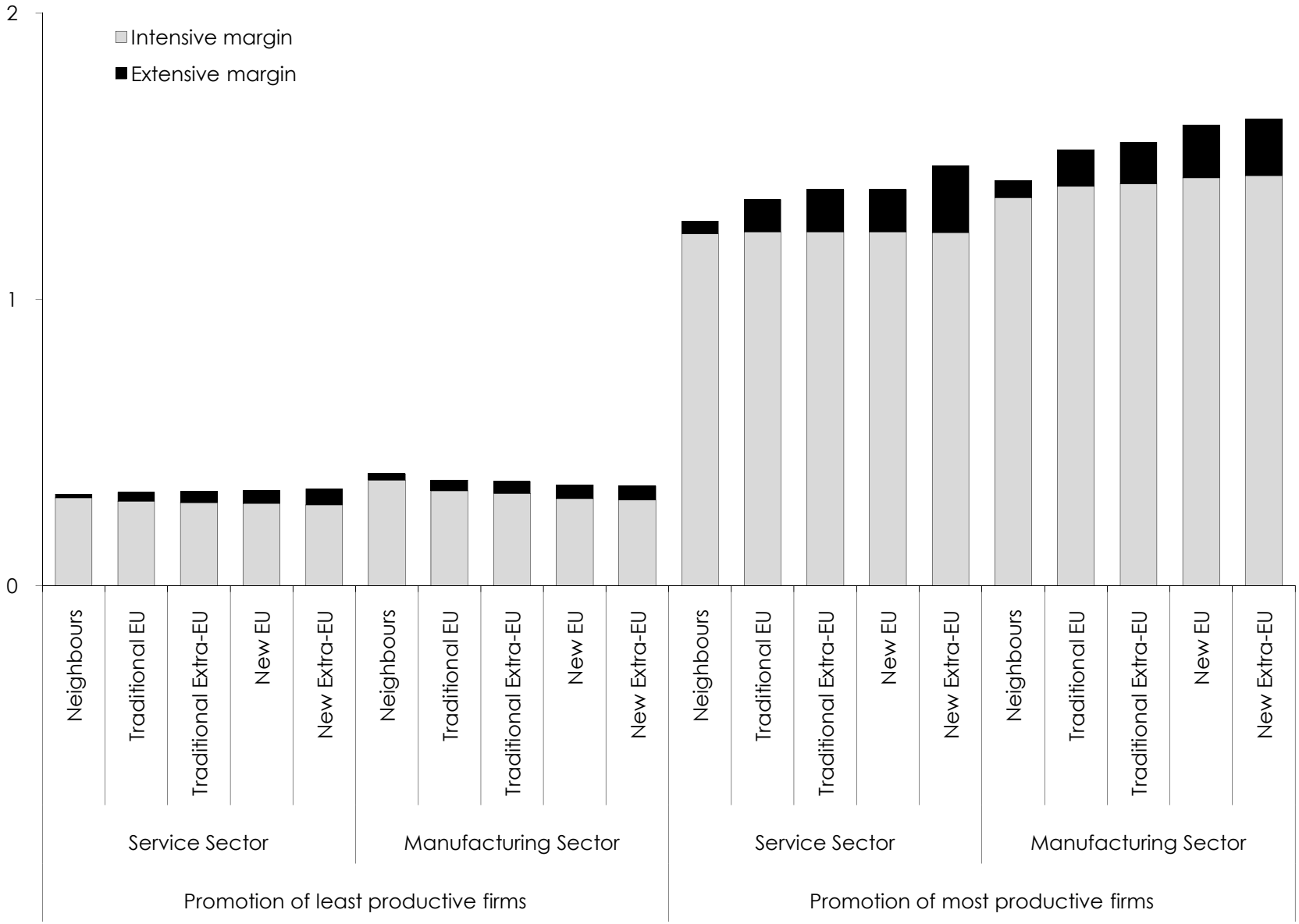
	Reduction in distance by 10 %	Market growth projections by IMF	Promotion of least productive firms	Promotion of most productive firms
		Services sector Changes in percent		
Neighbours	6.51	5.84	0.32	1.27
Traditional EU	7.17	7.60	0.32	1.35
Traditional Extra-EU	7.49	19.07	0.33	1.38
New EU	7.78	4.53	0.33	1.41
New Extra-EU	8.31	28.49	0.34	1.47
Total	6.73	7.14	0.32	1.30
		Manufacturing sector Changes in percent		
Neighbours	4.10	5.84	0.39	1.41
Traditional EU	4.99	8.42	0.37	1.52
Traditional Extra-EU	5.20	20.60	0.36	1.55
New EU	5.68	4.60	0.35	1.61
New Extra-EU	5.84	31.83	0.35	1.63
Total	4.42	7.98	0.38	1.45

Notes: Neighbouring countries: Czech Republic, Germany, Hungary, Italy, Liechtenstein, Slovakia, Slovenia and Switzerland; Traditional export markets in the EU: Belgium, Croatia, Finland, France, Great Britain, Netherlands, Poland, Romania, Spain and Sweden; Traditional export markets Extra-EU: Japan, Russia, Turkey, Ukraine and USA; New export markets in the EU: Bulgaria, Cyprus, Denmark, Estonia, Greece, Ireland, Latvia, Lithuania, Luxembourg, Malta and Portugal; New export markets Extra-EU: Australia, Brazil and New Zealand. - Source: OeNB, Statistics Austria, WIFO calculations.

Counterfactual results II - Intensive and extensive margin



Counterfactual results III - Intensive and extensive margin



Summary and Conclusions I

- We empirically examine determinants of service trade flows and investigate trade responses of different counterfactual scenarios.
- Distance to the destination market, firm productivity and destination market characteristics significantly influence the probability of exporting but even more so the volume of service export flows.
- Productivity, distance and common language seem to be more important determinants for service sector firms.

Summary and Conclusions II

- Increases in export flows are more pronounced in the more "distant" markets.
- Export growth predominantly assigned to adjustments of existing trade relationships (trade deepening), starting new trade relations occurs at a much smaller scale.
- Larger overall changes in exports and more pronounced contributions at the extensive margin for manufacturing firms as compared to services firms.
- Export market growth and reduction in distance related costs produce relative strongest impact on entry into new markets (broaden the exporter base) $\longrightarrow$ Extra-EU markets.
- Policies aiming at promoting firm productivity bear the potential to broaden the exporter base and play an important role for trade deepening in services.

Thank you!

Decomposition I

Inserting the conditional expectations and the probabilities to export from above yields the decomposition:

$$
\begin{aligned}
G_{ij} &= \frac{\Phi(v_{ij}^{C}\gamma + \rho\sigma_{\epsilon})\left[e^{x_{ij}^{C}\beta+\sigma_{\epsilon}^{2}/2} - e^{x_{ij}\beta+\sigma_{\epsilon}^{2}/2}\right]}{e^{x_{ij}\beta+\sigma_{\epsilon}^{2}/2}\Phi(v_{ij}\gamma + \rho\sigma_{\epsilon})} \\
&+ \frac{\left(\Phi(v_{ij}^{C}\gamma + \rho\sigma_{\epsilon}) - \Phi(v_{ij}\gamma + \rho\sigma_{\epsilon})\right)\left[e^{x_{ij}\beta+\sigma_{\epsilon}^{2}/2}\right]}{e^{x_{ij}\beta+\sigma_{\epsilon}^{2}/2}\Phi(v_{ij}\gamma + \rho\sigma_{\epsilon})} \\
&= \frac{\Phi(v_{ij}^{C}\gamma + \rho\sigma_{\epsilon})}{\Phi(v_{ij}\gamma + \rho\sigma_{\epsilon})}\left[e^{(x_{ij}^{C}-x_{ij})\beta} - 1\right] + \left(\frac{\Phi(v_{ij}^{C}\gamma + \rho\sigma_{\epsilon})}{\Phi(v_{ij}\gamma + \rho\sigma_{\epsilon})} - 1\right).
\end{aligned}
$$

Decomposition II

The contribution to the internal margin of firm i is therefore given as:

$$int_{ij} = \frac{\Phi(v_{ij}^{C}\gamma + \rho\sigma_{\epsilon})}{\Phi(v_{ij}\gamma + \rho\sigma_{\epsilon})}\left[e^{(x_{ij}^{C} - x_{ij})\beta} - 1\right],$$

while contribution of the external margin reads:

$$ext_{ij} = \left(\frac{\Phi(v_{ij}^{C}\gamma + \rho\sigma_{\epsilon})}{\Phi(v_{ij}\gamma + \rho\sigma_{\epsilon})} - 1\right).$$

Adding these two components yields the corresponding overall change:

$$tot_{ij} = int_{ij} + ext_{ij}$$

In order to obtain the aggregate percentage change for a group of firms of size N, we use the following weighting scheme:

$$\frac{\sum_{i=1}^{N} E[x_{ij}^{C}] - E[x_{ij}]}{\sum_{i=1}^{N} E[x_{ij}]} = \sum_{i=1}^{N} tot_i \frac{E[e^{x_{ij}}]}{\sum_{k=1}^{N} E[e^{x_{kj}}]}$$

and similarly for the external an internal margin. In our empirical exercise these weights are based on the predictions of the baseline model.

Robustness analysis

	SNP Binary Choice Model		FE Estimation			
			Service		Manufacturing	
	Service	Manufacturing	Selection	Outcome	Selection	Outcome
Ln Size	0.222^{***}	0.340^{***}	0.188^{***}	0.614^{***}	0.209^{***}	0.594^{***}
	(0.013)	(0.034)	(0.002)	(0.014)	(0.005)	(0.047)
Ln Productivity	0.187^{***}	0.140^{***}	0.150^{***}	0.636^{***}	0.087^{***}	0.685^{***}
	(0.011)	(0.020)	(0.003)	(0.014)	(0.011)	(0.046)
Ln Distance	-0.287^{***}	-0.308^{***}				
	(0.019)	(0.041)				
Time zone diff.	-0.069^{***}	-0.068^{***}				
	(0.006)	(0.013)				
Ln GDP	0.247^{***}	0.336^{***}				
	(0.015)	(0.034)				
Ln GDP pc.	-0.085^{***}	-0.135^{***}				
	(0.008)	(0.022)				
Contiguity	0.362^{***}	0.717^{***}				
	(0.027)	(0.091)				
Colony	0.202^{***}	0.199^{***}				
	(0.021)	(0.053)				
Com. Language	0.463^{***}	0.533^{***}				
	(0.029)	(0.066)				
Landlocked	-0.122^{***}	-0.294^{***}				
	(0.019)	(0.060)				
Foreign control	-0.021^{*}	0.088^{***}		-0.025^{***}		0.060^{***}
	(0.011)	(0.029)		(0.009)		(0.017)
Ln Start Business	-0.085^{***}	-0.059^{***}				
	(0.009)	(0.021)				
Mills ratio				0.844^{***}		0.461^{*}
				(0.083)		(0.278)
Observations	146510	42875	146510	34576	146510	7750
Skewness	0.586	0.352				
Kurtosis	4.039	2.935				
Industry dummies	Yes	Yes	Yes	Yes	Yes	Yes
Country dummies	No	No	Yes	Yes	Yes	Yes