CompNet The Competitiveness Research Network

FIRMS AND AGGREGATE TRADE PERFORMANCE

(*Waiting for - More than - a Moment)*

- G. Barba Navaretti, M. Bugamelli, E. Forlani and G.I.P. Ottaviano

Compnet conference, Bank of Italy, Rome 14/03/2013

Motivation: from macro to micro

- **Macro heterogeneity**: exports vary across countries and sectors within countries
- **Micro heterogeneity**: exports vary across firms and across firms-products within countries
- **Aggregation issue**: *how many summary statistics do we have to keep track of as we go from lower to higher levels of aggregation if we want to understand the drivers of aggregate behavior?*

Two alternative approaches: margins approach and moment approach

Margins approach (MAP)

- Dominant strategy

a. Decomposes through an identity macro aggregates into averages ("intensive margins") & number of sectors/firms/products ("extensive margins")

b. Regresses the various margins on explanatory variables through an empirical model

c. As aggregation relies on an identity based on averages and number, the role of micro heterogeneity in macro behavior is a bit shallow

- Generalized reliance on CES makes MAP identity looks like a model

Moment approach (MOP)

- New strategy

a. Regresses macro aggregates on various moments (not only first moment) of micro heterogeneity

b. Regresses the various moments on explanatory variables through another empirical model

c. As aggregation relies on a model based on various moments, the role of micro heterogeneity in macro behavior is deeper

Analytics of MOP

Denote:

X_{ij} : exports from *i* to *j*

N_i : number of firms in *i* (exporters and non-exporters)

x_{ij} : exports of firm with marginal cost *c* from *i* to *j*

c_j : cutoff cost for domestic firms in *j*

τ_{ij} : iceberg trade cost from *i* to *j*

$G\left(c_j/\tau_{ij}\right)$: probability a firm in *i* exports to *j* (i.e. the share of firms in *i* that export to *j*)

$N_{ij}^X = N_i G\left(c_j/\tau_{ij}\right)$: number of exporters from *i* to *j* (a.k.a. "extensive margin")

$\bar{x}_{ij} = \left[\int_0^{c_j/\tau_{ij}} x_{ij}(\omega) dG(\omega)\right] / G(c_j/\tau_{ij})$: expected exports per exporter (i.e. average exports per exporter) from *i* to *j* ((a.k.a. "intensive margin"))

By definition

$X_{ij} = N_{ij}^X \cdot \bar{x}_{ij}$

Given:

$N_{ij}^X = N_i G\left(c_j/\tau_{ij}\right)$

$\bar{x}_{ij} = \left[\int_0^{c_j/\tau_{ij}} x_{ij}(\omega) dG(\omega)\right] / G(c_j/\tau_{ij})$

Both the extensive and the intensive margins are affected by $G\left(c_j/\tau_{ij}\right)$

Hence the question we want to answer:

How many moments (corresponding parameters) are needed to characterize/approximate $G\left(c_j/\tau_{ij}\right)$ - and thus $dG\left(c_j/\tau_{ij}\right)/d\tau_{ij}$ and $dG\left(c_j/\tau_{ij}\right)/dc_j$?

This paper

WHAT IT DOES

- Early explorer of the MOP approach
- Regress aggregate trade performance at the country-industry level to various features of productivity distributions: mean, median, dispersion, asymmetry
- Prove that standard aggregate indicators based on the representative agent hypothesis cannot fully explain aggregate trade outcomes
- Test whether different features of productivity distributions are differently relevant in different countries or sectors

This paper

- NOVELTIES WRT EARLIER VERSIONS
- Start developing analytical framework (firm ground for expected impact of dispersion measures)
- Work with export shares as dependent variables (to normalise for industry effects and control – partly - for scale effects)
- Use new measures for dispersion/asymmetry which are invariant to the shape of the distribution (which we do not know ex ante)
- Interact moments with industry and country characteristics
- Estimate relationship to extensive and intensive margins

Empirical Strategy

Empirical model

- We estimate the following equation:

$$Exp.Share_{jct} = a_0 + a_1 LP(mean)_{jct-1} + a_2 LP(disp.)_{jct-1} + a_3 LP(asim.)_{jct-1} + \delta_{jt} + \varepsilon_{jct},$$

for sector *j* in country *c* at time *t*. Export share is the ratio of export by country *c* to the total export level of sample country, i.e.

$$Exp.Share_{jct} = \frac{export_{jct}}{\sum_{c=1}^{n} export_{jct}}. \qquad (1)$$

- OLS estimation (and Tobit for robustness)
- Sector: Nace 2 digit level (rev.2)
- All the explanatory variables are one period lagged
- Country*year fixed effects are included (δ_{jt}).
- Robust standard errors included

Empirical Strategy

Main explanatory variables

Average productivity

- LP(Mean)
  - **lprod:** Labour productivity average (unweighted)

Measure of Dispersion

- LP(Disp.)
  - **lprod_p75_p25**: ratio of 75th pct to 25th pct of labour productivity
  - **lprod_p90_p10**: ratio of 90th pct to 10th pct of labour productivity

Measure of Asimmetry

- LP(asim1)
  - **Asim1:** difference of mean and median divided by standard deviation $(mean - median)/st.dev.$

DATA

- *Countries*: Belgium, Czech Republic, Estonia, France, Germany, Hungary, Italy, Romania, Slovenia, Slovakia, Spain
- *Sectors*: manufacturing sectors at Nace 2-digit rev.2 (with the exclusion of Tobacco (12), Printing and publishing (18), Coke and Petroleum (19))
- *Time period*: 1996-2008. Unbalanced panel with 2,200 observations

Compnet database

- Productivity measured as labour productivity, i.e., value added per worker.
- Known features of labour productivity distribution: unweighted average, median, standard deviation, 10^{th}, 25^{th}, 75^{th}, and 90^{th} percentiles
- We eliminate from the estimation sample observations below the 1^{st} and above the 99^{th} percentile of unconditional distribution of labour productivity
- We eliminate moments that are obtained from cells with less than 10 observations (at least 10 firms by sector, year, country)

Eurostat

- Eurostat Comext: export values in millions of euros by country, year & sector (deflated)

Results Baseline

- *mean* has a positive and significant coefficient
- *dispersion* has a negative and significant coefficient when measured as the ratio between 90^{th} and 10^{th} pct of labour productivity (lprod_p90_p10). NOTE DIFFERENT FROM EARLIER VERSIONS
- *asymmetry*: has positive and significant coefficient (asim1)

Results

Table 1: Export share and LP dispersion (lag1)							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	exp_share	exp_share	exp_share	exp_share	exp_share	exp_share	exp_share
L.lprod	.0005575***	.0005758***	.0005771***	.0005454***	.000571***	.0005704***	.0005742***
	(1.9e-04)	(1.9e-04)	(1.9e-04)	(1.9e-04)	(1.9e-04)	(1.9e-04)	(1.9e-04)
L.lprod_p75_p25		-.0019868			-.0030149**		-.0008905
		(.0015)			(.0015)		(.0017)
L.lprod_p90_p10			-.0005317**			-.0007569***	-.0006449**
			(2.4e-04)			(2.4e-04)	(2.5e-04)
L.asim1				.0214952*	.0254288**	.0268915**	.0272545**
				(.0113)	(.0112)	(.0114)	(.0113)
Cons	.2935***	.2954***	.2935***	.29***	.2923***	.2891***	.29***
	(.029)	(.0287)	(.0289)	(.0291)	(.0288)	(.0291)	(.0289)
N	2200	2200	2200	2200	2200	2200	2200
R2	.7633	.7634	.7634	.7635	.7636	.7637	.7637
OLS model. All variables are in levels. Robust standard errors. Country X year dummies included.							

Country and industry heterogeneity
Results for high income countries and oigh tech industries

HIC = 1 if c = Germany, Italy, France and Spain

High_tech = 1 if j = Pharmaceutical and computers

- The mean is positive and significant especially for high income economies, and high tech sectors
- Dispersion is negative for low income economies and positive for high income economies
- Asymmetry is positive only for high income economies and high tech sectors
- The following results hold if we consider simultaneously the interactions with *HIC*, and *high_tech (*but also dispersion of high tech becomes positive)
- The reported results are robust if we substitute average productivity (lprod) with the median value, and by introducing sector dummies. Results do not change if we estimate a non-linear model (Tobit).

Results HICs

- We define a binary variable ***HIC*** (High Income Countries): it takes value one for Belgium, France, Germany, Italy, and Spain, otherwise it is equal to zero. For each estimation, we interact the dummy variable with each indicator of labour productivity.

Table 2: Export share and LP dispersion – High Income Countries					
	(1)	(2)	(3)	(4)	(5)
	exp_share	exp_share	exp_share	exp_share	exp_share
L.lprod	.0005742***	-.0000904	.0005192***	.0005142***	.0005515***
	(1.9e-04)	(8.6e-05)	(1.9e-04)	(2.0e-04)	(1.9e-04)
HIC	.0483545***	.2682508***	.0316212*		.0178735
	(.0089)	(.0312)	(.0179)		(.0156)
L.lprod_p90_p10	-.0006449**	-.0004074*	-.0006495**	-.0005593**	-.0005569**
	(2.5e-04)	(2.3e-04)	(2.6e-04)	(2.6e-04)	(2.5e-04)
L.lprod_p75_p25	-.0008905	.0000131	-.0018798	-.002382**	-.0013763
	(.0017)	(.0016)	(.0016)	(.0012)	(.0017)
L.asim1	.0272545**	.0282671**	.0235511**	.0246321**	.0029649
	(.0113)	(.0114)	(.0105)	(.0108)	(.0036)
L.lprod*HIC		.0007622***			
		(2.3e-04)			
L.lprod_p90_p10*HIC			.004514		
			(.0042)		
L.lprod_p75_p25*HIC				.0151251	
				(.0128)	
L.asim1*HIC					.1411528**
					(.0628)
_cons	.0037473	.0096466***	.0073611*	.2705264***	.011521***
	(.0048)	(.0037)	(.0039)	(.0349)	(.0031)
N	2200	2200	2200	2200	2200
R2	.764	.764	.764	.764	.765
OLS model. All variables are in levels. Robust standard errors. Country X year dummies included.					

Results High tech industries

- We define a binary variable ***High Tech*****:** it takes value one for pharmaceuticals (21) and computer (26), otherwise it is equal to zero.

Table 3: Export share and LP dispersion (lag1) - High Tech Sectors					
	(1)	(2)	(3)	(4)	(5)
	exp_share	exp_share	exp_share	exp_share	exp_share
L.lprod	.0005584***	.0004883**	.0005586***	.0005584***	.0005722***
	(2.0e-04)	(2.1e-04)	(2.0e-04)	(2.0e-04)	(2.0e-04)
High_Tech	.0026159	-.0100062	-.0005278	.0018111	-.0238922*
	(.0052)	(.0073)	(.0106)	(.0181)	(.0127)
L.lprod_p90_p10	-.0006347**	-.000632**	-.0006745**	-.0006311**	-.0004111
	(2.6e-04)	(2.5e-04)	(2.7e-04)	(2.6e-04)	(2.7e-04)
L.lprod_p75_p25	-.0010587	-.0007082	-.001035	-.0010951	-.0010007
	(.0017)	(.0017)	(.0017)	(.0017)	(.0017)
L.asim1	.0275133**	.0275967**	.0279161**	.027521**	.003682
	(.0114)	(.0114)	(.0114)	(.0114)	(.013)
L.lprod*High_Tech		.0002947			
		(2.2e-04)			
L.lprod_p90_p10*High_Tech			.0006458		
			(.0013)		
L.lprod_p75_p25*High_Tech				.000368	
				(.0064)	
L.asim1*High_Tech					.1059399**
					(.0449)
_cons	.2917***	.2977***	.2917***	.2917***	.2946***
	(.0295)	(.0301)	(.0295)	(.0294)	(.0294)
N	2200	2200	2200	2200	2200
R2	.7637	.7641	.7637	.7637	.7643
OLS model. All variables are in levels. Robust standard errors. Country X year dummies included.					

Results High income countries and High tech industries

Table 5: Export share and LP dispersion (lag1) – High Income Countries and High Tech Sectors					
	(1)	(2)	(3)	(4)	(5)
	exp_share	exp_share	exp_share	exp_share	exp_share
L.lprod	.0008154***	-.000208*	.0003751*	.0003935*	.0007857***
	(2.0e-04)	(1.1e-04)	(1.9e-04)	(2.0e-04)	(2.0e-04)
HIC	.0443887***	.0185559	-.0526925**	-.1465414***	-.0361916**
	(.0089)	(.0115)	(.0229)	(.0279)	(.0157)
High_Tech	-.0089284*	-.0062876	-.0277597***	-.0423605***	-.0377829***
	(.0046)	(.0078)	(.0087)	(.0148)	(.0098)
L.lprod_p90_p10	-.0005495**	-.0001677	-.000636**	.0001184	-.0000962
	(2.3e-04)	(2.5e-04)	(2.7e-04)	(2.0e-04)	(2.4e-04)
L.lprod_p75_p25	.0037939**	.0049805***	-.0022116	-.0050712***	.0028035*
	(.0015)	(.0014)	(.0014)	(.0012)	(.0015)
L.asim1	.0477784***	.049955***	.0250065***	.034094***	-.0327951***
	(.0112)	(.0113)	(.0092)	(.0103)	(.008)
L.lprod*HIC		.001225***			
		(2.5e-04)			
L.lprod*High_Tech		-.0000273			
		(2.6e-04)			
L.lprod_p90_p10*HIC			.0367439***		
			(.0044)		
L.lprod_p90_p10*High_Tech			.0033837***		
			(.0012)		
L.lprod_p75_p25*HIC				.0984481***	
				(.0137)	
L.lprod_p75_p25*High_Tech				.0142127***	
				(.0054)	
L.asim1*HIC					.3684428***
					(.0622)
L.asim1*High_Tech					.1167476***
					(.0354)
_cons	-.0138644***	.0001762	.0098741***	.0151853***	.009509***
	(.0043)	(.0041)	(.0037)	(.0038)	(.0034)
N	1982	1982	1982	1982	1982
R2	.664	.667	.689	.680	.676
OLS model. All variables are in levels. Robust standard errors. Country X year dummies included.					

Step two

Intensive and Extensive Margins

- Data: ComExt data on number of exporters and value of exports for 2008, 2009, 2010 and 2011 (intra and extra EU27) by country and sector. Notice that: sum of exporting firms does not coincide with the total number of exporters.
- Only 474 observations (we lost France).
- Calculate intensive and extensive margins by for intra EU27 and extra EU27 trade.

  - **Extensive margin**: the ratio of a country's number of exporters per industry/year to the total export level per industry year of sample countries
  - **Intensive margin:** the ratio of a country's exports per exporters

Notice. As defined, both the extensive and intensive margins are component of the export share. By multiplying the two margins, we obtain the export share presented in the previous tables.

Results

Benchmark

We just report results for extra eu27 trade.

Table 6 (benchmark): OLS - Export share ExtraEU 27 and lprod dispersion (lag1)							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	exp_share (extra27)	**exp_share (extra27)**	**exp_share (extra27)**	**exp_share (extra27)**	**exp_share (extra27)**	**exp_share (extra27)**	**exp_share (extra27)**
L.lprod	.0015783***	.0016092***	.0016304***	.0013977***	.0014879***	.0015388***	.0015349***
	(5.4e-04)	(5.5e-04)	(5.6e-04)	(5.3e-04)	(5.4e-04)	(5.5e-04)	(5.5e-04)
L.lprod_p75_p25		-.0024158			-.0075594		.0011223
		(.0061)			(.0064)		(.0086)
L.lprod_p90_p10			-.0008913			-.0026717**	-.0028518
			(.0013)			(.0012)	(.0018)
L.asim1				.1869689***	.1938287***	.2026379***	.2026757***
				(.0464)	(.0478)	(.0476)	(.0475)
_cons	.3960731***	.3976287***	.3942793***	.3731118***	.3771373***	.3658109***	.3647211***
	(.0689)	(.0684)	(.0694)	(.07)	(.0694)	(.0709)	(.0711)
N	477	477	477	477	477	477	477
R2	.759	.750	.759	.764	.764	.764	.764
Robust standard errors. Country X year dummies: exp_share27_extra: export to total export by sector year extra eu27							

Results

Intensive margin

Table 7: Intensive Margin extra EU27 and lprod dispersion (lag1)							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Intensive Margin Extra EU27	Intensive Margin Extra EU27	Intensive Margin Extra EU27	Intensive Margin Extra EU27	Intensive Margin Extra EU27	Intensive Margin Extra EU27	Intensive Margin Extra EU27
L.lprod	.0018722***	.0018941***	.0018781***	.0017112***	.0017862***	.0017984***	.0018069***
	(5.4e-04)	(5.7e-04)	(5.6e-04)	(5.3e-04)	(5.6e-04)	(5.5e-04)	(5.6e-04)
L.lprod_p75_p25		-.0017109			-.0062856		-.0024585
		(.0052)			(.0059)		(.0098)
L.lprod_p90_p10			-.0001021			-.0016516	-.0012571
			(.0012)			(.0011)	(.002)
L.asim1				.1666858***	.1723896***	.1763723***	.1762895***
				(.0526)	(.0548)	(.0537)	(.0541)
_cons	-.08045	-.0793483	-.0806554	-.1009203	-.0975732	-.1054337	-.1030466
	(.063)	(.0626)	(.0632)	(.0637)	(.0633)	(.0643)	(.0639)
N	477	477	477	477	477	477	477
R2	0.148	0.148	0.148	0.162	0.163	0.163	0.163
Robust standard errors. Country X year dummies. Dependent variable: exports per exporters extra eu27							

Results

Extensive Margin

Table 8: OLS – Extensive Margin extra EU27 and lprod dispersion (lag1)							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Extensive Margin extra EU27	**Extensive Margin extra EU27**	**Extensive Margin extra EU27**	**Extensive Margin extra EU27**	**Extensive Margin extra EU27**	**Extensive Margin extra EU27**	**Extensive Margin extra EU27**
L.lprod	-.4089486***	-.4225465***	-.4335876***	-.4091641***	-.4221481***	-.4327146***	-.4307621***
	(.096)	(.0943)	(.0991)	(.093)	(.0926)	(.0977)	(.0957)
L.lprod_p75_p25		1.10691			1.127666		-.5743196
		(.9334)			(.8688)		(1.154)
L.lprod_p90_p10			.4418932**			.4647293**	.5566913**
			(.2017)			(.2042)	(.264)
L.asim1				.2558415	-.7759358	-2.548661	-2.57814
				(8.022)	(7.85)	(8.178)	(8.21)
_cons	58.64263***	57.87656***	59.42397***	58.60814***	57.96681***	59.80796***	60.37201***
	(9.716)	(9.892)	(9.8)	(10.26)	(10.35)	(10.44)	(11.18)
N	455	455	455	455	455	455	455
R2	.436	.436	.437	.436	.436	.437	.437
Robust standard errors. Country X year dummies. Dependent variable: number of exporters to the total export level of sample countries: extra eu27							

Conclusions

IN GENERAL

Really need theory to understand meaning and role of dispersion measures, particularly when used jointly with asymmetry measures

COUNTRIES INDUSTRIES

- High income countries, export more concentrated into fewer large and highly productive firms (intensive margins?) Or reallocation more efficient (the positive sign of dispersion measures may hinge in this direction)?
- High Tech: barriers to entry higher… only large fellows run the show? But less so in high income countries?

INTENSIVE EXTENSIVE

- Would need complete sample
- Intensive margins equal to aggregate: big felllows run the show?
- Extensive margins: dispersion is positive…..again because more entry and exit and allocative efficieny?