Directorate General Research

Competitiveness Network

Micro-based evidence of EU competitiveness:
The CompNet database

Vienna CompNet workshop, 19-20 September

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Objectives of this paper and findings

Objectives

- Provide a **first overview** of the dataset
- **Show the potential** of the dataset by highlighting some preliminary but suggestive findings, which deserve further research efforts:

Findings

- **Firm heterogeneity** within sectors larger than across sectors, for all countries
- **Top productive firms relatively more homogeneous** (size) across countries; more churning within low productive firms
- As a result of this heterogeneity, **resource reallocation** important for overall productivity
- Reallocation has virtually **stopped** in all countries during the crisis
- Firm heterogeneity also matter for current account rebalancing

Content of the paper

1. Introduction

2. The CompNet database

3. Descriptive analysis of industry indicators across countries

4. Allocative efficiency differences across countries, sectors and time

5. An application of CompNet data: Explaining trade balance

6. Some preliminary conclusions

2. The CompNet database

2.1. Distributed micro-data analysis
2.2. Description of the data
    - Country samples
    - Sample representativeness
2.3. Variables and indicators
    - Inputs and output of the production process
    - Productivity indicators
    - Allocative efficiency indicators
2.4. Summary Statistics
2.5. Data validation with Eurostat and EU KLEMS
2.6. Comparison with Amadeus data

Country samples

	Average No. of Firms*	Total Coverage/Eurostat**				Year Coverage	Sector Coverage		
		Firms	N. of Employees	Turnover	Labour Costs		Mining and Quarrying	Manufacturing	Services
BELGIUM	66,842	33%	73%	86%	101%	1996-2011	3/5	full	full
CZ	21,156	4%	64%	78%	62%	2002-2011	full	full	full
ESTONIA	12,186	66%	85%	78%	62%	1995-2011	4/5	full	full
FRANCE	348,179	n/a	n/a	n/a	n/a	1995-2007	full	23/24	full
GERMANY	30,688	2%	38%	66%	55%	1997-2010	1/5	23/24	27/29
HUNGARY	13,683	4%	47%	73%	53%	2003-2010	full	full	full
ITALY	53,054	2%	17%	22%	24%	2001-2008	2/5	23/24	full
POLAND	6,250	1%	14%	80%	86%	2002-2011	full	full	28/29
ROMANIA	196,514	92%	94%	91%	93%	2005-2011	full	full	full
SLOVAKIA	3,954	8%	67%	89%	80%	2000-2002; 2006-2011	full	23/24	full
SLOVENIA	16,676	33%	78%	92%	94%	1995-2011	4/5	23/24	full
SPAIN	245,121	24%	42%	58%	60%	1995-2011	full	full	full

* average across all years available

** average across comparable years in Eurostat and CompNet

- – In the analysis, we use data from 2002 to 2010 for 12 countries across 58 2-digit (NACE REV.2) manuf. and non-manuf. sectors
- – Portugal is not in this version of the paper…but it will be in the next

Is our sample representative of the population of firms?

	Size Distribution						Sector Distribution				Period
	0 to 19 employees		20 to 249 employees		>250 employees		Manufacturing		Non-Manufacturing		
	Compnet*	Eurostat*	Compnet*	Eurostat*	Compnet*	Eurostat*	Compnet*	Eurostat*	Compnet*	Eurostat*	
BELGIUM	89.2%	96.0%	10.0%	3.8%	0.8%	0.2%	19.3%	14.4%	80.7%	85.6%	2008-2011
CZ	49.4%	97.4%	45.9%	2.4%	4.7%	0.2%	44.0%	25.6%	56.0%	74.4%	2005-2011
ESTONIA	88.3%	90.4%	11.2%	9.1%	0.5%	0.4%	23.4%	20.6%	76.6%	79.4%	2005-2011
FRANCE	86.3%	96.4%	12.8%	3.4%	0.9%	0.2%	19.2%	14.9%	80.8%	85.1%	2007;2009
GERMANY	22.7%	91.6%	61.7%	7.8%	15.6%	0.6%	51.2%	16.3%	48.8%	83.7%	2008-2010
HUNGARY	58.5%	97.2%	37.1%	2.6%	4.3%	0.2%	70.5%	16.2%	29.5%	83.8%	2005-2010
ITALY	56.5%	97.4%	42.5%	2.5%	1.0%	0.1%	58.2%	19.5%	41.8%	80.5%	2008
POLAND	0.0%	94.9%	95.4%	4.6%	4.6%	0.5%	63.3%	35.9%	36.7%	64.1%	2005-2011
ROMANIA	90.8%	91.3%	8.5%	8.0%	0.7%	0.7%	25.0%	25.5%	75.0%	74.5%	2005-2011
SLOVAKIA	14.9%	89.6%	76.0%	9.5%	9.1%	0.9%	50.4%	29.7%	49.6%	70.3%	2008-2011
SLOVENIA	88.6%	96.1%	10.5%	3.5%	0.8%	0.3%	25.6%	24.4%	74.4%	75.6%	2005-2011
SPAIN	93.0%	96.4%	6.5%	3.4%	0.5%	0.2%	19.4%	17.2%	80.6%	82.8%	2008-2011

* average across all years available

**Data for Czech Republic, Spain, France, Hungary, Italy, Romania, Slovakia on self-employed persons is included in Eurostat, but excluded in CompNet.

***CompNet data represents the universe of firms for Belgium, Estonia and Romania, while Eurostat only has survey samples for those countries.

🟩 Countries with representative samples of firms

🟥 Countries where small firms and services seem to be under-represented

Use of common sector weights for all countries to mitigate bias

6

- Correlation of the sector-year levels and growth rates per country in CompNet with EUROSTAT (SBS)

Sector	Turnover	L
10	0.87	-0.85
18	0.99	-0.76
43	0.98	-0.54
60	-1.00	0.65
71	-0.97	0.99
82	-1.00	-0.67

	correlation with Eurostat (levels)[12]				correlation with Eurostat (growth rates)[12]			
	Turnover	VA	L	LC	Turnover	VA	L	LC
BELGIUM	0.77*	0.97*	0.94*	0.98*	0.27*	0.30*	0.16*	0.15*
CZ***	0.96*	0.92*	0.81*	0.97*	0.90*	0.40*	0.92*	0.69*
ESTONIA***	0.83*	0.74*	0.84*	0.80*	0.83*	0.52*	0.84*	0.64*
GERMANY	0.96*	0.83*	0.66*	0.83*	0.93*	0.92*	0.87*	0.90*
HUNGARY***	0.96*	0.93*	0.52*	0.85*	0.80*	0.71*	0.74*	0.78*
ITALY	0.87*	0.68*	0.69*	0.90*	n/a	n/a	n/a	n/a
POLAND	0.93*	0.77*	0.72*	0.85*	0.83*	0.44*	0.81*	0.76*
ROMANIA***	0.97*	0.95*	0.99*	0.99*	0.64*	0.47*	0.80*	0.48*
SLOVAKIA	0.99*	0.95*	0.67*	0.96*	0.60*	0.62*	0.24*	0.57*
SLOVENIA***	0.98*	0.95*	0.90*	0.94*	0.72*	0.58*	0.35*	0.37*
SPAIN	0.77*	0.81*	0.87*	0.92*	0.13*	-0.01	-0.01	0.10*

[1] (*) indicates significance at 5%

2 across all years available

*** indicates coverage of more than 3 years

szclass	Turnover	VA	L	LC
1	-0.07*	-0.05	-0.02	-0.13*
2	-0.03	0.14*	0.33*	0.48*
3	0.09*	0.08*	0.17*	0.15*
4	0.53*	0.49*	0.19*	0.32*
5	0.63*	0.53*	0.33*	0.40*

Countries with more than 3 years of overlapping info with Eurostat

Data validation with EUKLEMS

- ## Correlation of the sector-year levels CompNet-EUKLEMS[1]

  - EUKLEMS designed to sum up to National Accounts, no to follow variables along time

	Levels		Years included in validation
	Turnover	Labour	
BELGIUM	0.96*	0.84*	1996-2007
CZ	0.97*	0.94*	2002-2007
ESTONIA	0.95*	0.45*	1995-2007
FRANCE	0.85*	0.59*	1995-2007
GERMANY	0.80*	0.93*	1997-2007
HUNGARY	0.89*	0.72*	2003-2007
ITALY	0.86*	0.89*	2001-2007
SLOVAKIA	0.95*	0.83*	2000-2007
SLOVENIA	0.93*	0.94*	1995-2006
SPAIN	0.85*	0.91*	1995-2007

[1]Could match only 7 sectors: R&D, Rental and leasing, Teleco, Manuf. of machinery and equipment
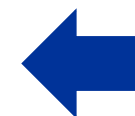
- Firm coverage of CompNet and Amadeus is different
  - Can lead to important differences in labour productivity distribution
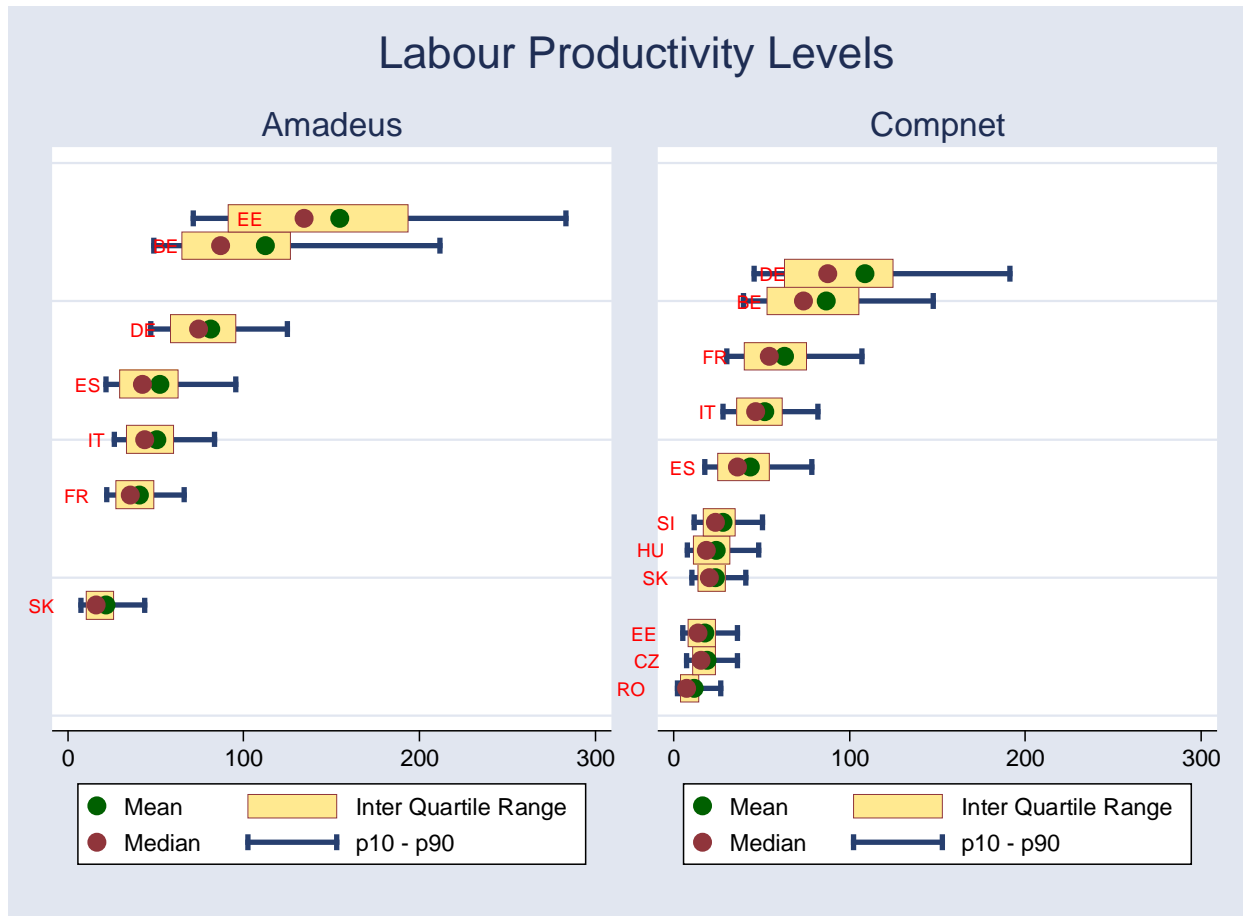
Labour Productivity Levels

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- There is huge heterogeneity, in terms of firm performance, within narrowly defined sectors – more than across sectors!

Labour Productivity Heterogeneity
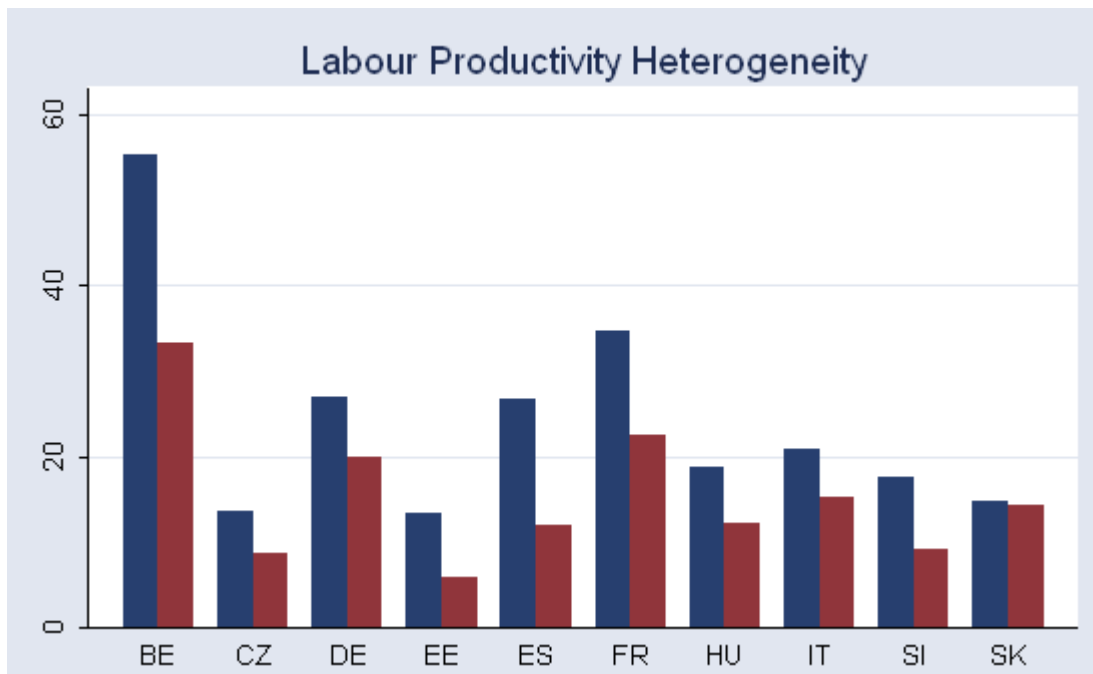
Average dispersion within a sector:

How heterogeneous are firms **within the same industry**?

Dispersion of averages across sectors:

How heterogeneous are firms **across different industries**?

Firm heterogeneity within sectors (II)

- Important to acknowledge this high dispersion:
  - The impact of macro/policy shocks depends on the underlying distribution
  - Average labour productivity of a sector is not representative –test
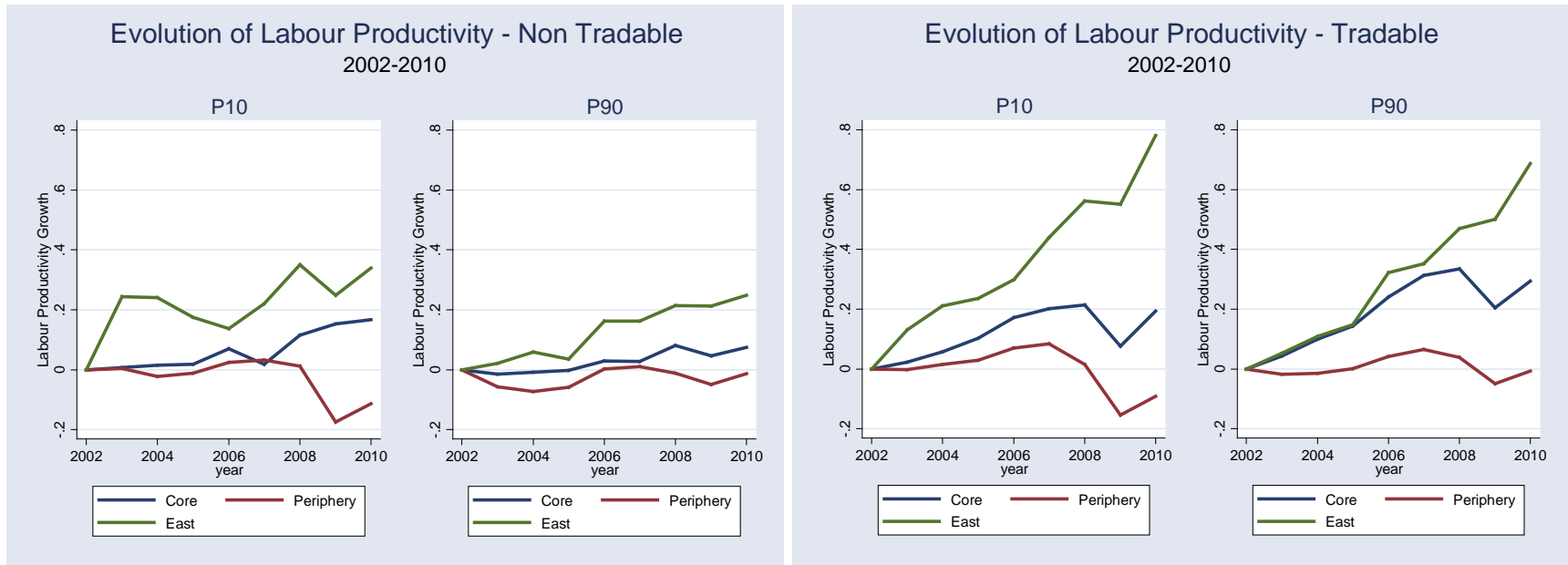
Labour Productivity Levels
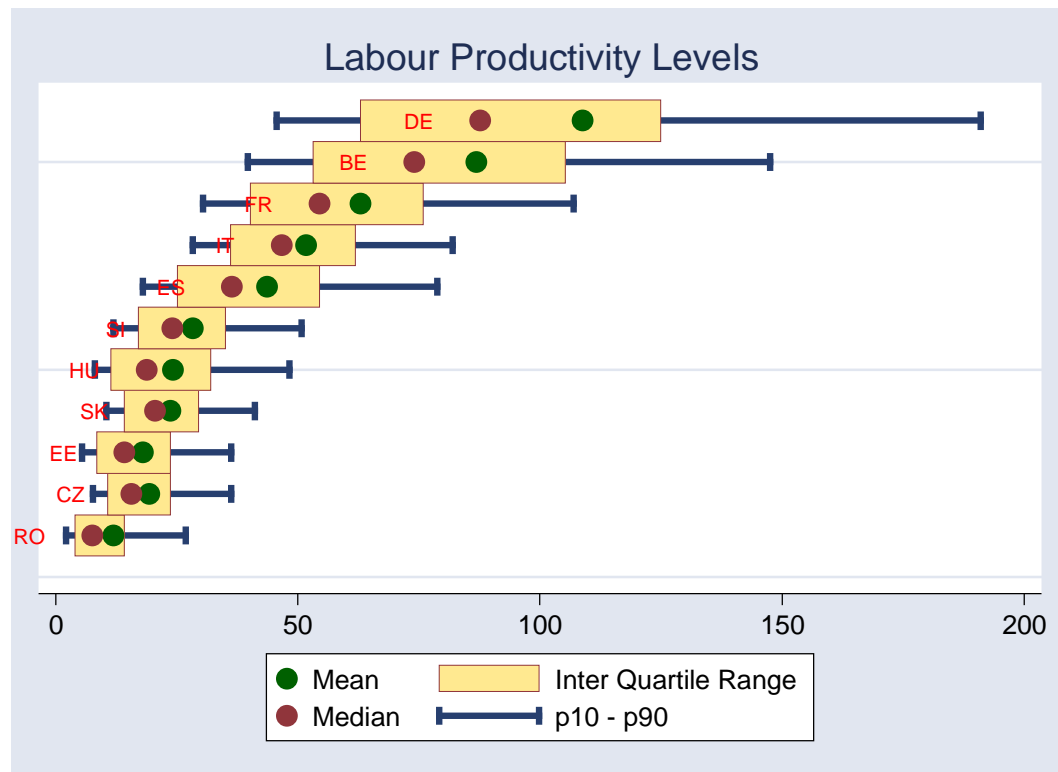
Similar picture if we look at the 20+ employees sample

- Dispersion in terms of size is even larger
  - The distribution of size is very very skewed, large differences bet. average and median size
  - A bit different if we look at the 20+ employees sample
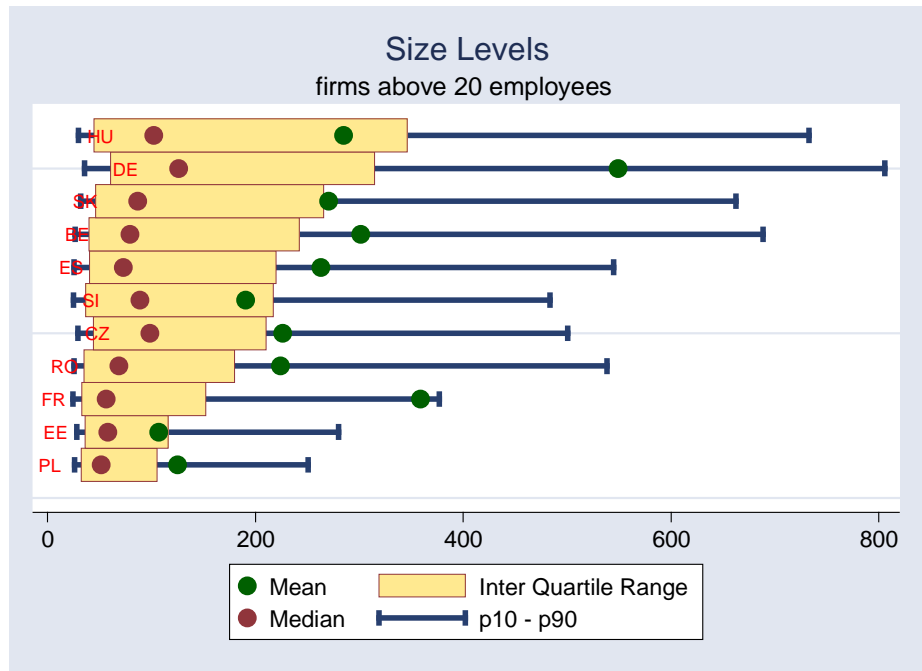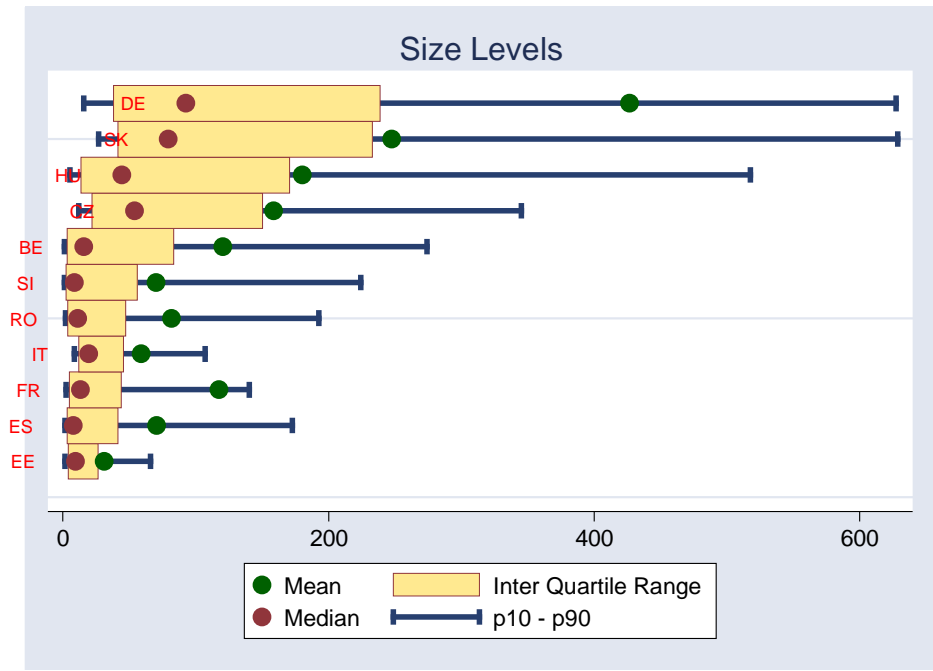
Labour productivity growth

- Evolution of the labour productivity distribution can be seen by tracking productivity changes in bottom and top tails of the distribution (base year=2002)

Evolution of Labour Productivity - Non Tradable 2002-2010

Evolution of Labour Productivity - Tradable 2002-2010

- Catch-up effect in Eastern countries
- Higher productivity growth in tradables
- Bad productivity performance of Spain and Italy especially, but not only, in low tail of productivity distribution

Labour productivity and unit labour cost

- Now we add the ULC evolution on top of the productivity one, for p10 and p90 firms. Non-tradables.

Evolution of Labour Productivity - Non Tradables 2002-2010

Evolution of Labour Productivity - Tradables 2002-2010
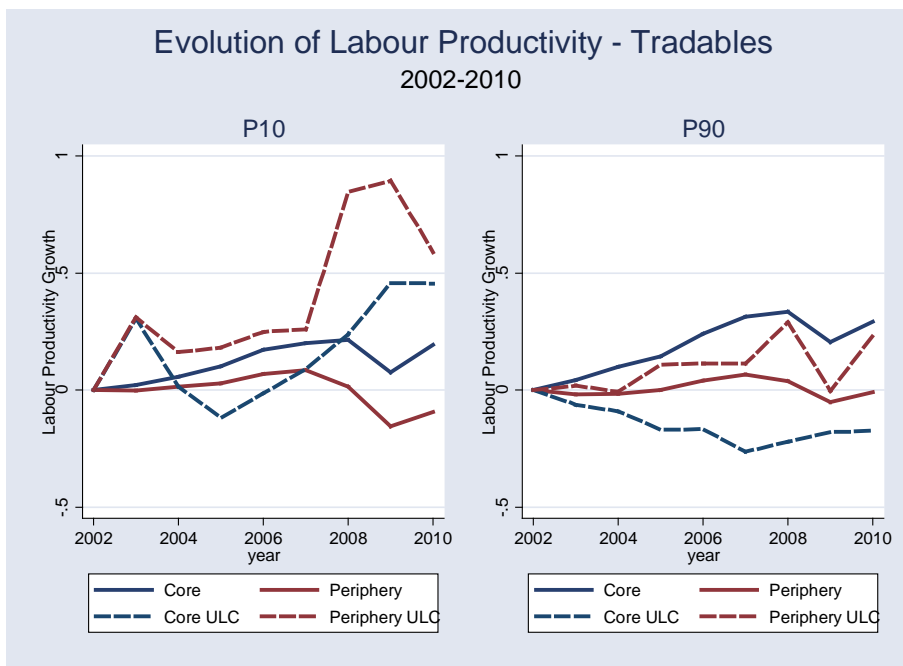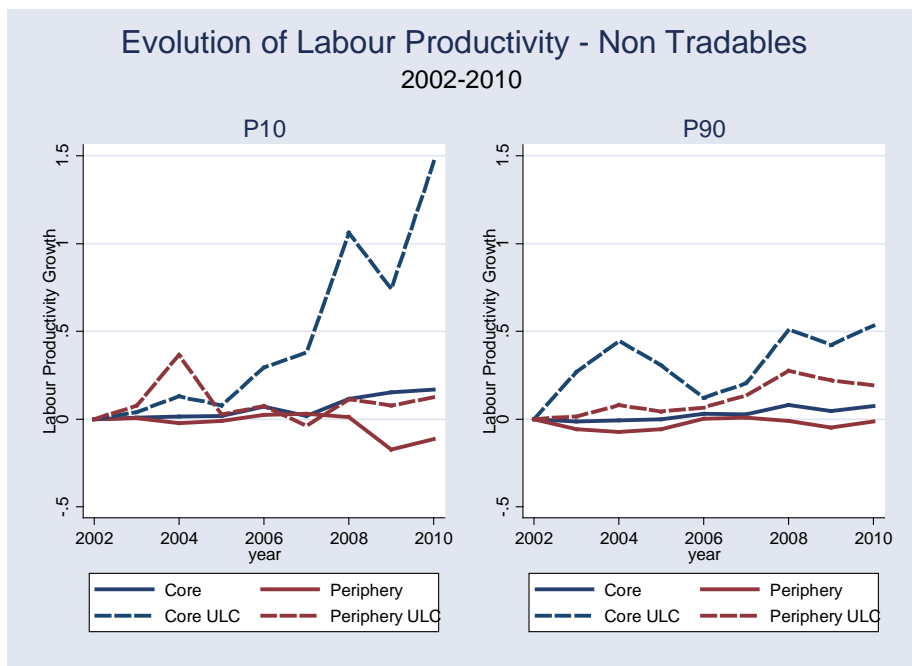
- Top productive firms contained ULC, in all sectors, across all countries. In tradables, ULC actually decreased constantly in core countries
- Low productive firms increase a lot their ULC, in tradables in Spain and Italy, in non-tradables in core

TFP growth differences, before and during the crisis
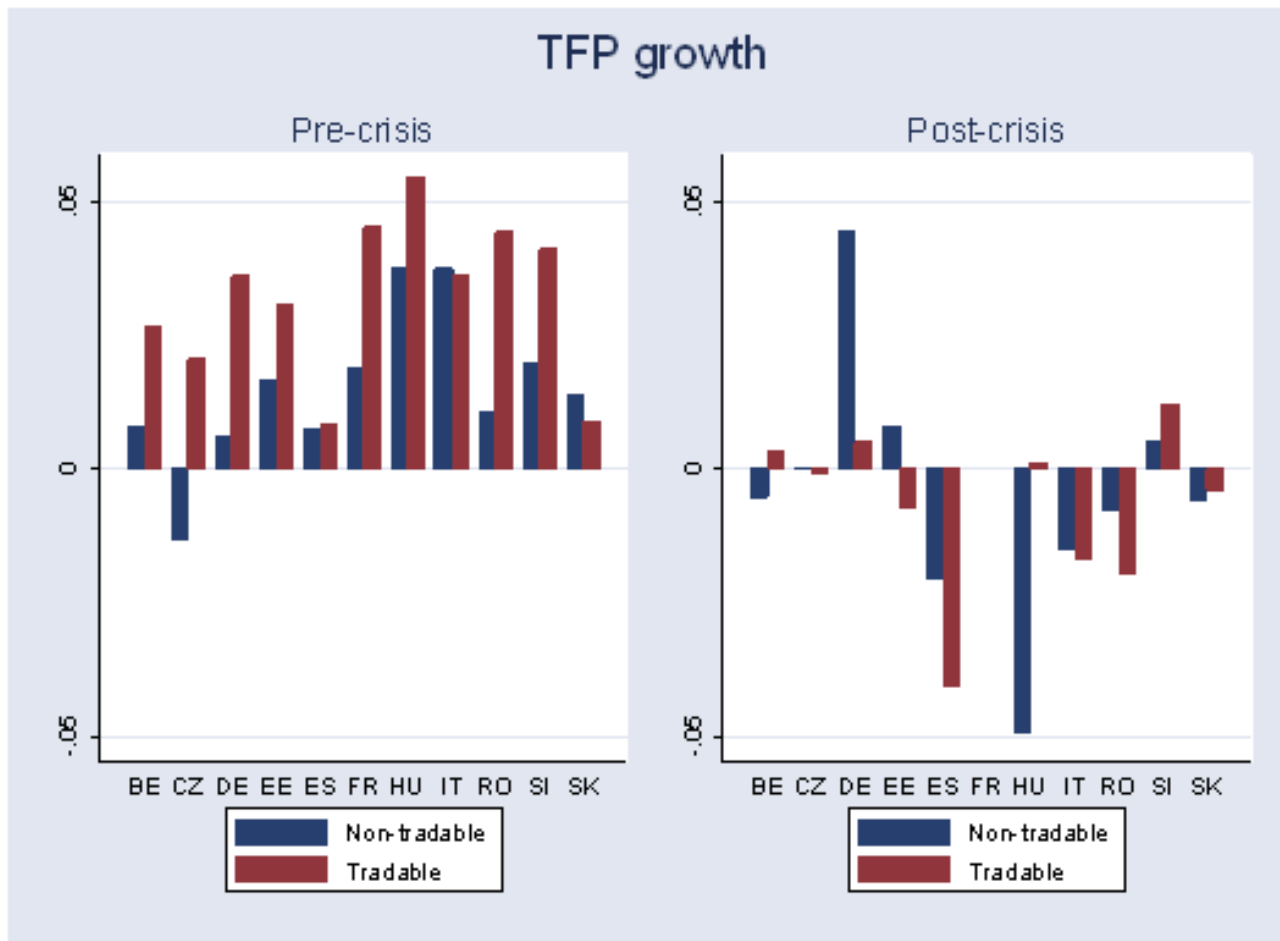
Not very different if we look at the 20+ employees sample

- Large differences in terms of TFP growth rates
- Generally (much) larger in tradables
- Drop to negative numbers during the crisis

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Why are dispersion and productivity related?

Scope for resource reallocation

Allocative efficiency: At each moment of time, available resources (within a sector) are put to their best use

- **Static allocative efficiency**: Allocation of resources across firms in any period of time: More productive firms enjoy higher market shares
  – Measurement

- **Dynamic allocative efficiency**: Allocation of resources along time: Resources are reallocated from low productive to high productive firms
  – Measurement

Static allocative efficiency

- The percentage of industry productivity explained by the covariance is small, ranges between 5-20% - although great potential

Contribution of Covariance Term to Weighted Productivity

Note: Weighted averaged across sectors. Average 2002-2010.

Source: CompNet Dataset
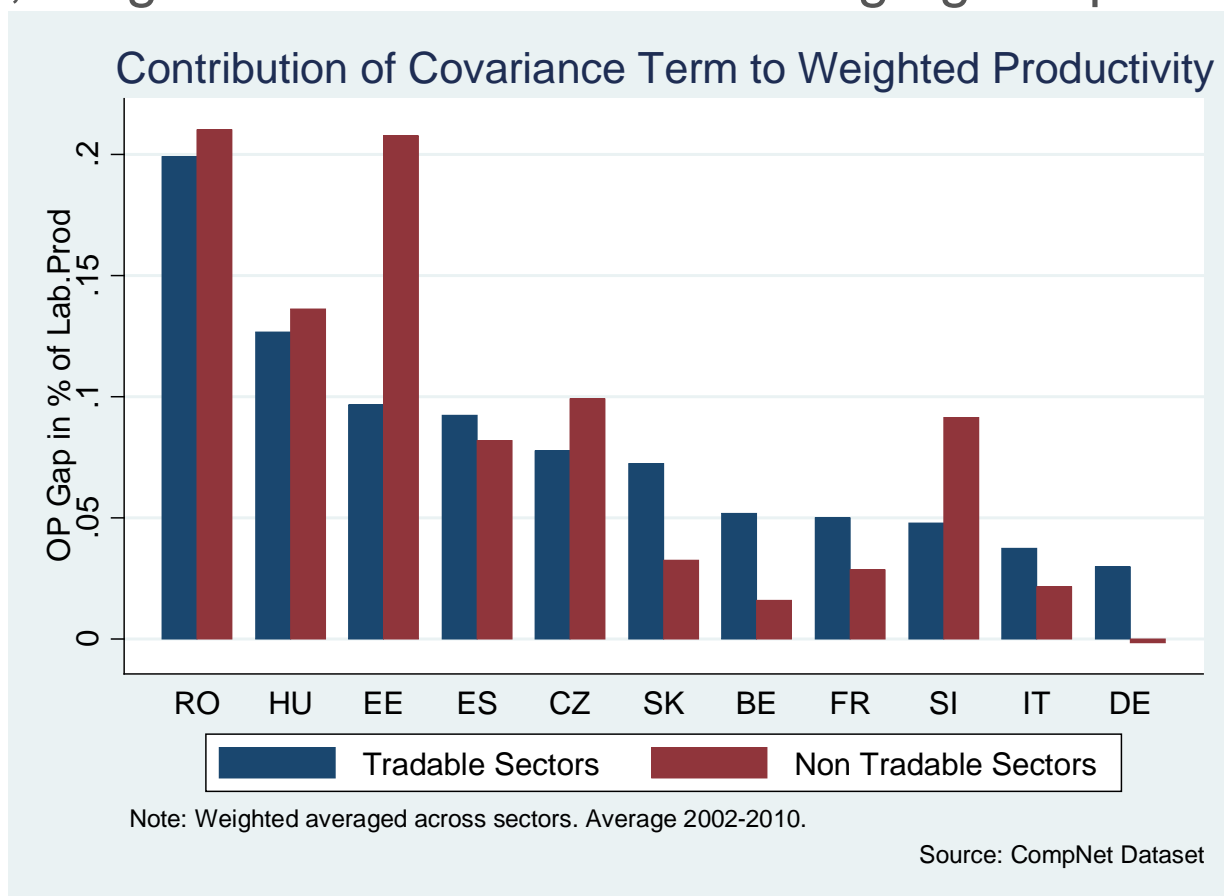
- It is quite stable across years
- It is larger in non-tradable sectors (higher reallocation) and in Eastern countries

Dynamic allocative efficiency

- Productivity growth= within firm productivity growth + reallocation of resources from less to more productive firms in the sectors

Contribution of Within and Reallocation Terms to Productivity Growth

Pre-2007

Post-2007

Note: Average 2002-2007.

Note: Average 2008-2010.

Source: CompNet Dataset
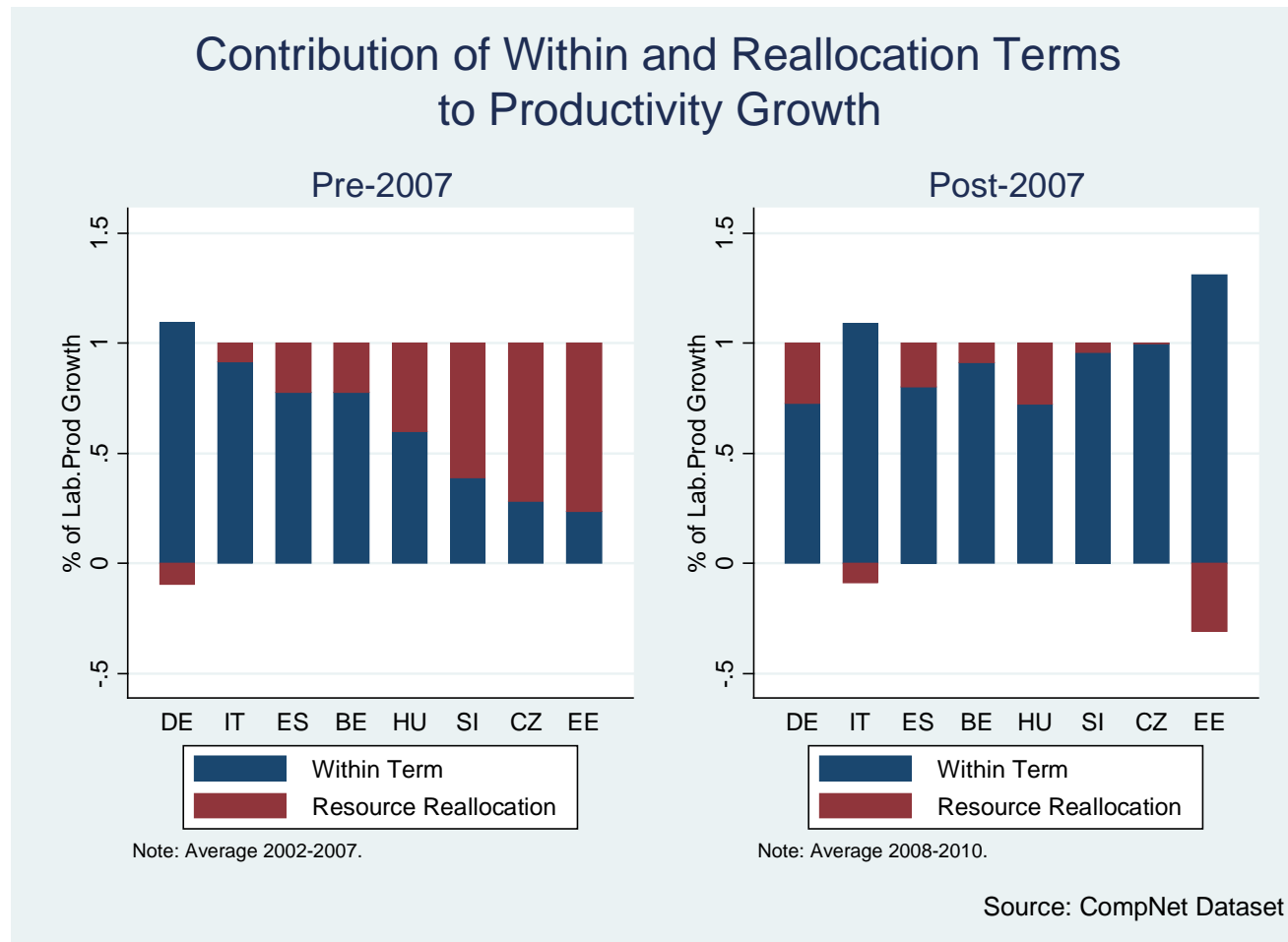
– The contribution of both terms has changed during the crisis

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Productivity and competitiveness

- Explore the correlation between internationalization, and the dispersion indicators and distribution parameters of TFP

  - Better explanation of export performance than averages
  - Internationalization is measured with export value, trade balance, and Balassa index
  - Data: only manufacturing sectors from 1996 to 2011. Unbalanced panel with 2382 observations

- Findings:

  - Contemporaneous trade performances are positively correlated with TFP dispersion (lagged two years)
  - In country-sectors, where the TFP distribution is more positively skewed (fatter and longer right tail), it is more likely to observe surplus in trade balance (col.7)
  - The level of productivity at the top of distribution is positively correlated with the export performances

Productivity and Competitiveness (II) Barba-Navaretti, Bugamelli, Castellani, Forlani

Table: Trade and TFP dispersion

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	Exp.	Exp.	Exp.	Exp.	TradeBal.	TradeBal.	TradeBal.	TradeBal.	B.Index	B.Index	B.Index	B.Index
TFP(mean)$_{t-2}$	.059***	-.166***	.046**	-.098*	-6.3e-03	-.055***	-8.1e-03	-9.4e-03	-.11***	-.51***	-.112***	-.55***
	(.0178)	(.0425)	(.0191)	(.0532)	(.0066)	(.0163)	(.0071)	(.0207)	(.037)	(.1179)	(.0406)	(.1417)
Sect.V.A.$_{t-2}$	.834***	.819***	.818***	.829***	.277***	.273***	.27***	.276***	1.47***	1.44***	1.47***	1.46***
	(.0272)	(.0271)	(.0276)	(.0274)	(.0099)	(.0099)	(.0099)	(.01)	(.1444)	(.1413)	(.1457)	(.1422)
TFP(s.d.)$_{t-2}$		.232***				.048***				.429***		
		(.0414)				(.0154)				(.109)		
TFP(skew)$_{t-2}$			.079***				.039***				.129***	
			(.021)				(.0088)				(.0471)	
TFP(iqr)$_{t-2}$				.144***				-1.3e-03				.43***
				(.0471)				(.0196)				(.1228)
Obs.	1624	1619	1598	1619	1624	1619	1598	1619	1624	1619	1598	1619
R2	.965	.966	.965	.965	.63	.63	.628	.628	.53	.535	.533	.533

All variables are in logs and lagged of two year. Each observation is defined by the triple country sector year. Robust standard errors are in parenthesis. We include the following set of fixed effects: year, country, sector, country X year, and sector X year. Sect.V.A. is the log of value added

Table: Trade and TFP percentile

	(1)	(2)	(3)	(4)
	Exp.	Exp.	Exp.	Exp.
Sect.V.A.$_{t-2}$	.837***	.836***	.834***	.811***
	(.0273)	(.027)	(.0272)	(.0269)
TFP(med.)$_{t-2}$	.039**	-.683***	-.345***	-.061
	(.0175)	(.1798)	(.1036)	(.0461)
TFP(pc25)$_{t-2}$		.136		
		(.1136)		
TFP(pc75)$_{t-2}$		.601***		
		(.1125)		
TFP(pc10)$_{t-2}$			.083	
			(.0678)	
TFP(pc90)$_{t-2}$			.319***	
			(.065)	
TFP(pc1)$_{t-2}$				-.059*
				(.0344)
TFP(pc99)$_{t-2}$				.176***
				(.0338)
Obs.	1624	1624	1624	1624
R2	.965	.966	.965	.966

All variables are in logs and lagged of two year. Each observation is defined by the triple country sector year. Robust standard errors are in parenthesis. We include the following set of fixed effects: year, country, sector, country X year, and sector X year. Sect.V.A. is the log of value added.

The countries' competitiveness in the international markets appears to depend on the TFP dispersion within sectors, as well as on the right tail of the TFP distribution.

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Conclusions

1   The new CompNet database has enormous potential to help policy-makers and researchers to better understand competitiveness.

2   The database is dynamic, it will improve (outliers, dofile structure) and expand in terms of countries and variables

THANKS FOR YOUR ATTENTION!!!

- T-Test for Labour productivity differences between within and across dispersion measures

```
Paired t test
────────────────────────────────────────────────────────────────────────
Variable  |      Obs         Mean     Std. Err.    Std. Dev.    [95% Conf. Interval]
──────────┼─────────────────────────────────────────────────────────────
lpr~s_sd  |     4556     14.18508     .1273161     8.593601     13.93548     14.43469
lpr~n_sd  |     4556     23.47036     .1915407     12.92865     23.09485     23.84587
──────────┼─────────────────────────────────────────────────────────────
    diff  |     4556    -9.285275      .091909     6.203689    -9.465461    -9.105089
────────────────────────────────────────────────────────────────────────
    mean(diff) = mean(lprod_across_sd - lprod_within_sd)          t = -1.0e+02
 Ho: mean(diff) = 0                             degrees of freedom =     4555

 Ha: mean(diff) < 0          Ha: mean(diff) != 0          Ha: mean(diff) > 0
 Pr(T < t) = 0.0000       Pr(|T| > |t|) = 0.0000          Pr(T > t) = 1.0000
```

Test of differences (II)

- T-Test for Labour Productivity differences between the mean and median of the distribution
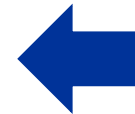
```
Paired t test
─────────────────────────────────────────────────────────────────────────
Variable |     Obs        Mean     Std. Err.    Std. Dev.    [95% Conf. Interval]
─────────┼───────────────────────────────────────────────────────────────
l~t_mean |    4219     39.85591     .346677       22.518      39.17624     40.53558
lp~t_p50 |    4219     33.69703     .3061047     19.88267     33.09691     34.29716
─────────┼───────────────────────────────────────────────────────────────
    diff |    4219      6.15888     .0515713     3.349754     6.057773     6.259987
─────────────────────────────────────────────────────────────────────────
    mean(diff) = mean(lprod_wt_mean - lprod_wt_p50)              t = 119.4246
Ho: mean(diff) = 0                                  degrees of freedom =     4218

Ha: mean(diff) < 0            Ha: mean(diff) != 0            Ha: mean(diff) > 0
Pr(T < t) = 1.0000        Pr(|T| > |t|) = 0.0000        Pr(T > t) = 0.0000
```

Size dispersion (I)

- Size distribution differences are not driven by sector specialization
  - But by country-specific effects

Median size in country/industry to European (weighted) average in industry, selected sectors

sector	BE	CZ	DE	EE	ES	FR	HU	IT	RO	SI	SK	Average Size
Manufacture of textiles	0.25	1.34	2.09	0.30	0.20	0.42	0.51	0.57	0.15	0.26	2.49	37
Manufacture of paper and paper products	0.24	0.88	2.35	0.21	0.18	0.29	0.60	0.36	0.08	0.12	1.24	58
Manufacture of chemicals and chemical products	0.37	0.88	2.23	0.28	0.17	0.38	0.37	0.44	0.12	0.39	1.38	48
Manufacture of rubber and plastic products	0.31	1.37	2.13	0.39	0.21	0.42	0.64	0.49	0.12	0.14	1.91	43
Manufacture of computer, electronic and optical products	0.24	1.11	2.31	0.11	0.18	0.26	0.36	0.44	0.09	0.17	2.42	43
Manufacture of electrical equipment	0.19	0.98	2.35	0.42	0.16	0.27	0.78	0.38	0.15	0.15	2.01	54
Construction of buildings	0.16	1.34	2.25	0.20	0.16	0.24	0.70	0.57	0.16	0.18	1.98	25
Accommodation	0.16	1.23	2.05	0.20	0.30	0.30	2.02	0.67	0.16	0.32	1.72	24
Food and beverage service activities	0.08	1.06	2.27	0.27	0.19	0.25	0.34	0.58	0.12	0.13	1.43	24
Telecommunications	0.18	1.05	2.18	0.14	0.14	0.36	0.93	0.47	0.10	0.12	4.80	27
Legal and accounting activities	0.13	1.24	1.64	0.13	0.20	0.47	1.48	1.18	0.12	0.13	4.34	15
Activities of head offices; management consultancy activities	0.16	2.12	1.52	0.35	0.25	0.34	0.43	1.46	0.11	0.20	5.66	9
Other professional, scientific and technical activities	0.22	2.22	1.48	0.25	0.27	0.46	0.54	1.41	0.21	0.23	3.48	9

- Assume the following Cobb-Douglas production function (in logs)

$$y_{it} = \beta_0 + \beta_k k_{it} + \beta_L l_{it} + \beta_M m_{it} + \omega_{it} + u_{it}$$

(1)

Where *k*, *l* and *m* are the inputs; ω_{it} is an unobserved (for the econometrician) firm-level time-variant productivity level and u_{it} is an i.i.d. error term representing unexpected (by the firm) shocks
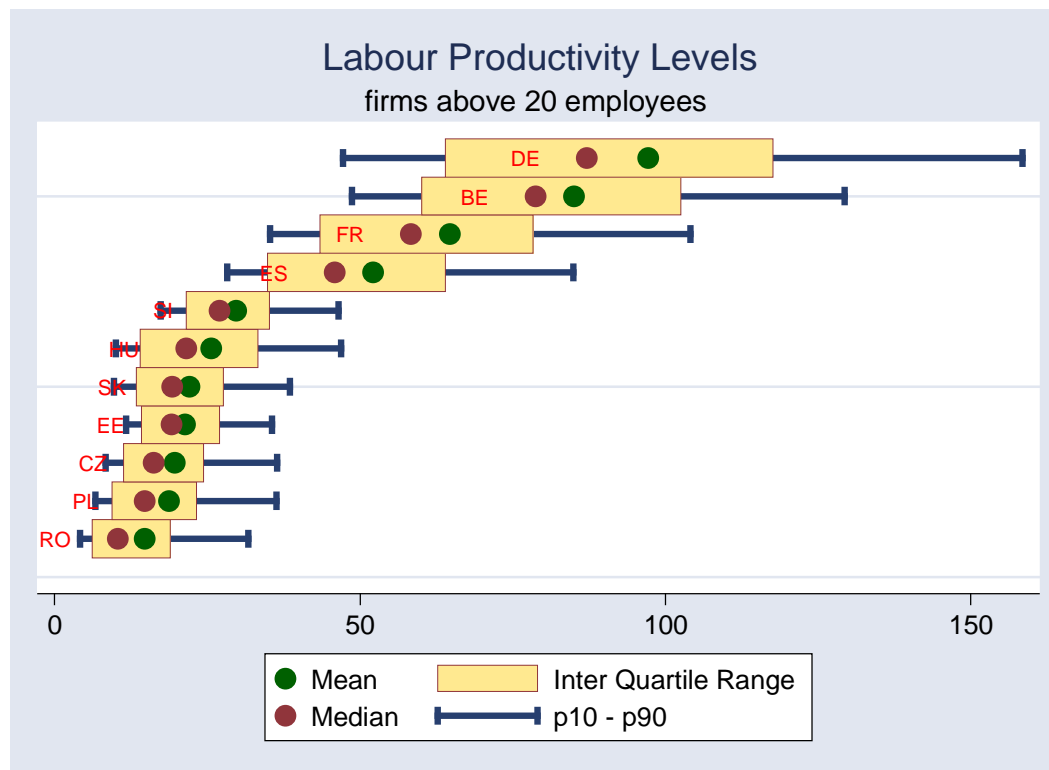
- Equation (1) will be inconsistently estimated by OLS if
  – Firm-level productivity, observed by the firm, affects its choice of inputs
  – This is called the **simultaneity bias** (Marschak and Andrews 1944 and Griliches and Mairesse 1995)
  – Much of the literature on production function estimation of the last 60 years has been devoted to solve this problem

- Solutions

  – Instrumental variables: find instruments correlated to inputs but not to unobserved productivity; or lagged values of inputs (GMM)
  – Fixed-effect estimation: only when you think that unobserved productivity is constant over time
  – Semi-parametric estimators or control function approach :
    - Most promising
    - Use observed input demand to instrument for unobserved productivity
      ❑ Olley and Pakes (1996) propose a two-step estimation procedure using investment as a proxy to invert out the unobserved productivity shock ω_t
      ❑ Given that investment can be zero and it is quite lumpy, Levinsohn and Petrin (2003) suggest to use instead demand for intermediate inputs
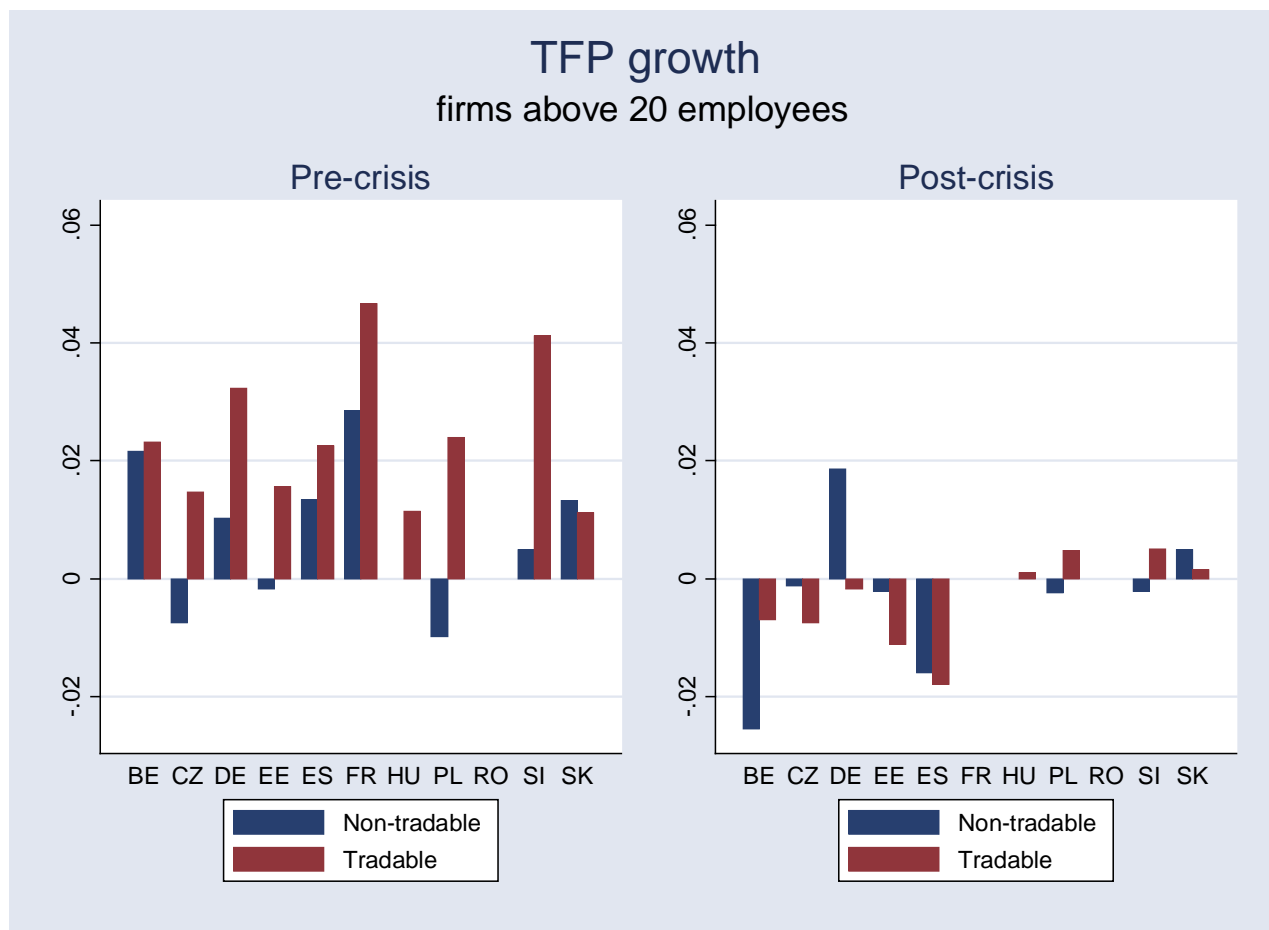   ❑ Wooldridge (2009) implements LP in a GMM framework, obtaining more efficient estimators

- Labour productivity distribution, 20+ samples

Labour Productivity Levels
firms above 20 employees

Legend:
- ● Mean
- ● Median
- Inter Quartile Range
- ├──┤ p10 - p90

- TFP growth rate, 20+ samples

TFP growth
firms above 20 employees

- According to Olley an Pakes (1996), sector productivity level could be decomposed as follows:

$$\Omega_t = \sum_i \theta_{it} \omega_{it} = \overline{\omega}_t + \sum_i (\theta_{it} - \overline{\theta}_t)(\omega_{it} - \overline{\omega}_t)$$

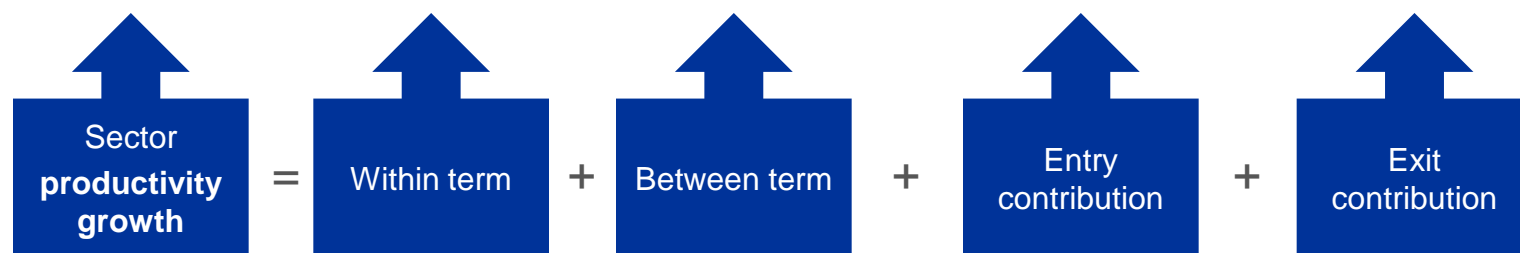| Sector productivity index | = | Average productivity | + | Covariance between size and productivity |
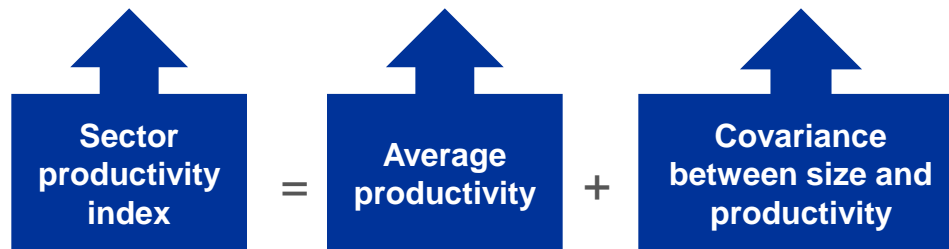
- The covariance could be interpreted as the improvement in the sector productivity due to resource reallocation, as compared to the one resulting from a random reallocation of resources

Dynamic allocative efficiency (I)

- From an accounting point of view, labour productivity growth at the sector level could be decomposed (a la Foster et al.) as follows:

$$\Delta P_{sett} = \sum_{i \in S} \Delta p_i \, \overline{\vartheta}_{sett} + \sum_{i \in S} \Delta \vartheta_i (\overline{p}_i - \overline{P}_{sett}) + \sum_{i \in N} (p_i^t - \overline{P}_{sett}) \vartheta_i^t + \sum_{i \in C} (p_i^{t-k} - \overline{P}_{sett}) \vartheta_i^{t-k} + E_{sett}$$

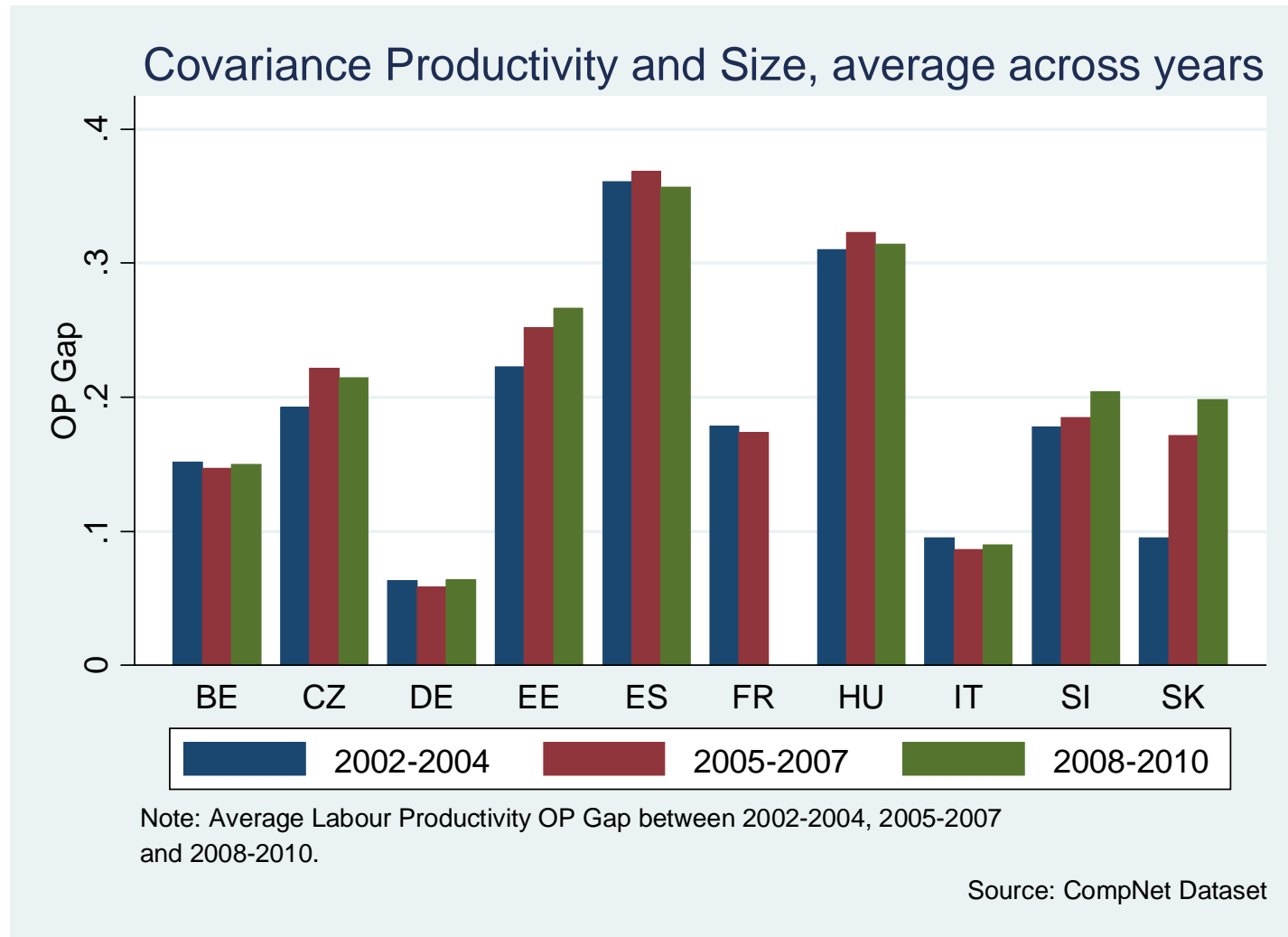| Sector **productivity growth** | = | Within term | + | Between term | + | Entry contribution | + | Exit contribution |

- The between term is measuring the change in market share of firms with a higher/lower productivity than the average in sector
  - The larger the term, the higher (lower) the market share gain (loss) of firms with a higher (lower) than average productivity
  - This is a necessary, although not sufficient condition for "good" resource reallocation within the sector
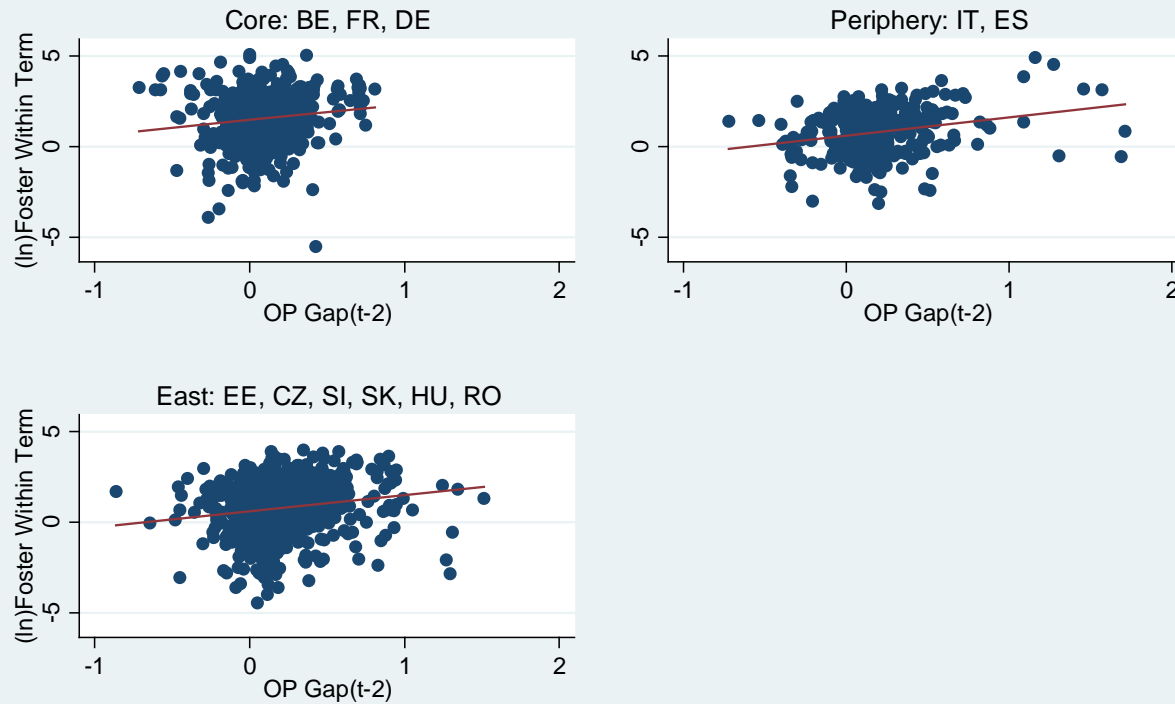
Static allocative efficiency

- Industry productivity level is the sum of the unweighted productivity and the covariance between size and productivity

Covariance Productivity and Size, average across years

Note: Average Labour Productivity OP Gap between 2002-2004, 2005-2007 and 2008-2010.

Source: CompNet Dataset

Foster Within Term and Lagged Static Allocative Efficiency

Note: Regression coefficients: Core=0.8614***, Periphery=1.0109***, East=0.6971***.

Source: CompNet Dataset

Heterogeneity in terms of size

- Differences in size are not homogeneous across productivity percentiles

2002-2007	BE	CZ	DE	EE	ES	FR	HU	RO	SI	SK	Average Size
Labour Productivity P10	0.58	1.16	3.55	0.32	0.41	0.47	0.65	0.47	0.28	2.11	63
Labour Productivity P50	1.25	1.06	2.49	0.24	0.33	0.54	1.15	0.69	0.50	1.76	126
Labour Productivity P90	1.01	0.85	2.96	0.16	0.61	1.33	1.16	0.51	0.61	0.80	234
2008-2010	BE	CZ	DE	EE	ES	FR	HU	RO	SI	SK	Average Size
Labour Productivity P10	0.67	1.21	3.21	0.20	0.22	n.a.	0.85	0.49	0.20	1.95	62
Labour Productivity P50	0.81	1.17	2.85	0.22	0.27	n.a.	0.92	0.68	0.46	1.61	111
Labour Productivity P90	1.06	0.93	2.88	0.16	0.63	n.a.	1.02	0.55	0.61	1.16	224

- In higher productivity percentiles firm average size of firms is more homogeneous
- During the crisis low productivity firms in some countries have downsized more than average. Top productive firms with no dramatic changes