WHY ARE SPANISH SMALL FIRMS LESS PRODUCTIVE? AN ANALYSIS USING SPANISH, FRENCH AND ITALIAN FIRM-LEVEL DATA

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Content

Ratio of labour productivity in Spanish small and large firms to EU-4

	Less than 20 employees	More than 250 employees
ALL FIRMS	0.7	0.9
MANUFACTURING	0.8	1.1
Fodd products, beverages and tobacco	1.1	1.0
Textiles and textile products	0.8	0.8
Leather and leather products	0.8	
Wood and wood products	0.8	0.8
Pulp, paper, publishing and printing	0.7	1.3
Coke and refined petroleum products		
Chemicals, chemicals products and fibres	0.6	0.9
Rubber and plastic products	0.7	1.0
Other non-metallic products	0.8	1.3
Basic metals and fabricated metal products	0.7	1.1
Machinery and equipment	0.7	0.9
Electrical and optical equipment	0.7	0.9
Transport equipment	0.9	0.9
Other manufactures	0.6	0.9
CONSTRUCTION	0.7	0.9
MARKET SERVICES	0.7	0.8
Hotels and restaurants	0.7	1.0
Wholesale and retail trade	0.8	1.0
Transport	0.7	1.0
Storage and Communications	0.3	1.5
Real state	0.8	0.7
Renting of machinery and equipment	0.3	1.0
IT services	0.5	0.6
R&D	0.8	0.9
Other market services	0.6	0.5

Source: EUROSTAT (Structuctural Business Indicators).

a. UE (4) = Germany, France, Italy and UK.

Questions, questions….

- **Labour productivity in Spanish small firms is lower than in other European small firms across ALL sectors – but this is NOT the case for large firms**

Why?

- **Is this related to some horizontal (cross-sector) factor? Institutions perhaps?**
- **Are small Spanish firms systematically different to those in other countries, even if they operate in the same sector?**
- **Are the returns to those characteristics different?**

Related literature (I)

- **Productivity cross-country comparisons – thousands of papers, mostly macro-founded, with exceptions:**

Ortega-Argiles, Piva and Vivarelli (IZA DP 2011): ***"The transatlantic productivity gap: Is R&D the main culprit?"***

- Micro-founded study of productivity differences between European and USA firms
- Highlights lower R&D investment AND lower capacity of European firms to translate those investments into productivity gains

Griffith, Huergo, Mairesse and Peters (Oxford REP 2006): ***"Innovation and productivity across four European countries"***

- Micro-founded, data for Germany, France, UK and Spain
- Concludes that innovation systems are very similar across the 4 countries
- The productivity premium of large firms is much larger in Spain

Altomonte, Aquilante and Ottaviano (2011): "The triggers of competitiveness: the EFIGE cross-country report"

- Micro-founded study of the relation between firm-level TFP and externationali-zation in a number of European countries

Related literature (II)

- **Micro-founded studies of productivity differences in Spain:**

Alonso-Borrego (BdE WP 2010): ***"Firm behaviour, market deregulation and productivity in Spain"***

- **Use CBA data to study the evolution of TFP in Spanish firms and its relation to the regulatory framework**
- **Concludes that greater competition fosters firm-level TFP**

Castany, Lopez-Bazo, Moreno (IREA WP 2007): ***"Differences in TFP across firm size: A distributional analysis"***

- **Use the ESEE to explore the determinants of the TFP gap between large and small firms in Spain**
- **Find that it is equally explained by differences in characteristics and in returns to those characteristics**
- **In recent periods, however, the contribution of firm-specific characteristics seems to be increasing**

1. **We estimate TFP at firm level in Italy, France and Spain using Amadeus data for the period 2001-2009**
   - In order to avoid the potential simultaneity problem in the production function estimation, we use a "control function approach" à la Wooldridge (2009)
   - We allow the technological coefficients to vary for firms operating in different countries, sectors and size segments (small versus medium and large firms)

2. **We compare the TFP distribution of firms in the same size segment and sector, but operating in different countries**
   - We test whether those distributions are statistically different

3. If there are differences, what factors can explain them?

- We use for this purpose the rich information contained in the EFIGE dataset
- We perform an *Oaxaca-type decomposition.* The estimated TFP gap (between small firms in Spain and France, for example) is determined by:

- *The difference in the "usual" determinants of competitiveness across firms*
  - ✓ *Firm ownership (belongs to a group, family-owned)*
  - ✓ *Human capital (graduates, training, performance related pay)*
  - ✓ *Innovation (process or product innovation)*
  - ✓ *Externalization of the firm (exports, imports, outsourcing)*
  - ✓ *Financial factors (dependence on external financial sources, cash ratio)*
- *The difference in the firm-level returns to those determinants*
- *Some unexplained residual: Institutions perhaps?*

Content

Amadeus and EFIGE

- **AMADEUS (Bureau van Dijk)**
  - Used to estimate TFP at firm level
  - Database of ”comparable” financial information on Europe‘s biggest companies
  - We look at firms in Italy, France and Spain for which we have EFIGE data
  - Data on value added, tangible fixed assets, employees, material costs and some financial variables for the period 2001-2009

- **EFIGE**
  - Used to explain the TFP gap
  - Firm-level data on some 150 variables, both qualitative and quantitative
  - Comparable across seven countries (!)
  - Representative sample of manufacturing firms of more than 10 employees
  - Data for 2008 – cross-section

The matched sample, data for 2008

	SPAIN	FRANCE	ITALY
Number of observations	2832	2759	3021
SECTOR DITRIBUTION (in %)			
Food products, beverages and tobacco	16.4	7.7	7.9
Textiles and leather products	5.1	7.4	13.9
Wood, pulp, paper, publishing and printing	21.9	12.3	16.3
Coke, refined petroleum, chemicals, rubber and plastics	9.5	12.0	9.4
Metal and other non-metallic products	28.6	38.4	28.3
Machinery, electrical, potical and transport equipment	18.6	22.2	24.3
SIZE DISTRIBUTION (in %)			
Micro-firms: Less than 20 employees	36.6	33.7	34.4
Small firms: Between 20 and 49	43.9	38.7	46.6
Medium firms: Between 50 and 249	14.3	20.5	14.2
Large firms: More than 250 employees	5.2	7.2	4.8

Content

TFP estimation

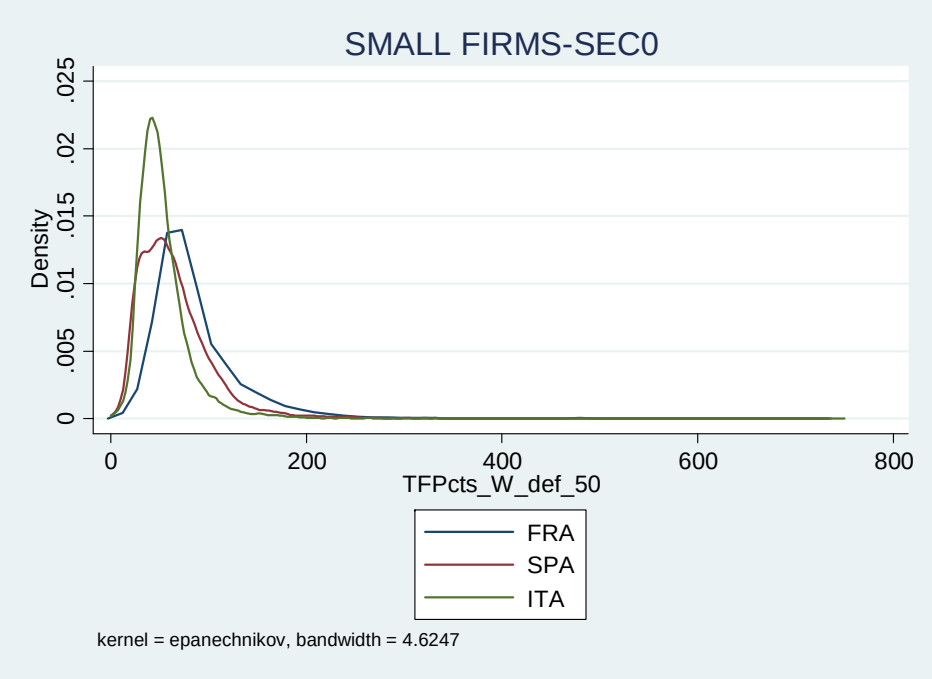
Our approach

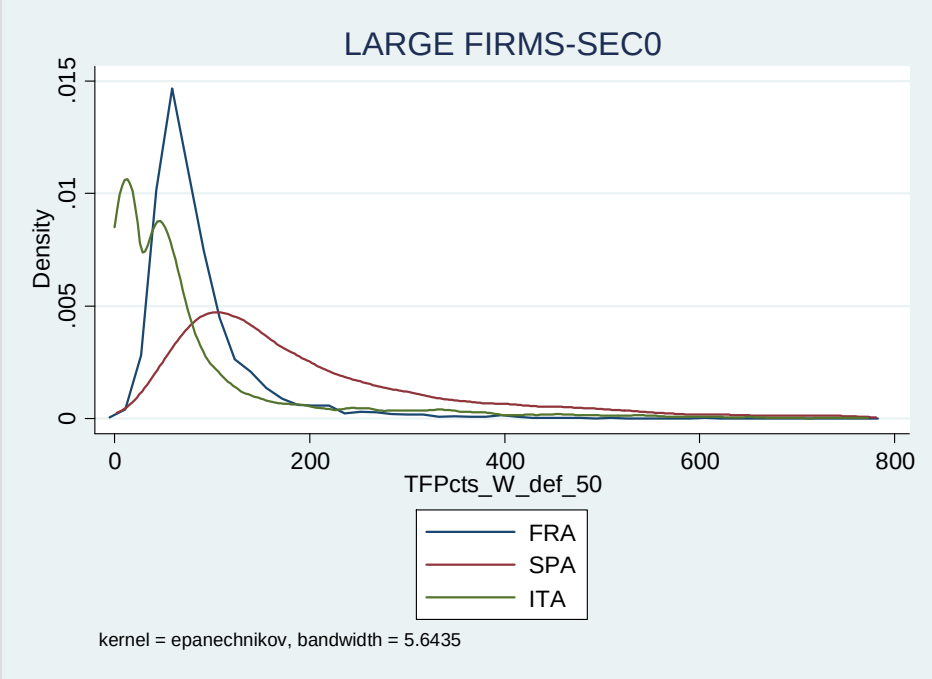
- **Estimate different production functions for firms operating in a certain country, sector and size segment** – number of observations per cell ➔
- **Follow Wooldridge (2009) to correct for the simultaneity bias**
- **We were worried about industry dispersion within broad sectors and time effects. However, after testing their impact, we discarded these factors**

- **First results:**
  - Estimated technological coefficients ➔ are significantly different across cells
  - Estimated TFP using the Levinsohn & Petrin methodology is highly correlated ➔ with the one using Wooldridge (2009)
  - TFP growth rates estimated with Amadeus data are quite similar ➔ to those estimated with the "Balance Sheet Office" of the Bank of Spain

Results: TFP Kernel density functions by size

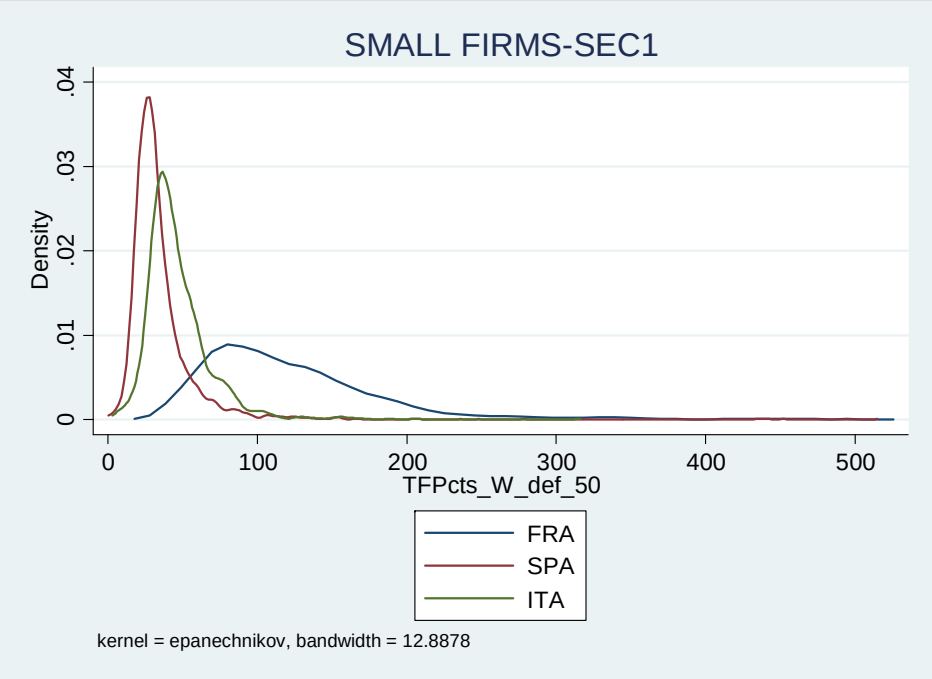
Total manufacturing sector

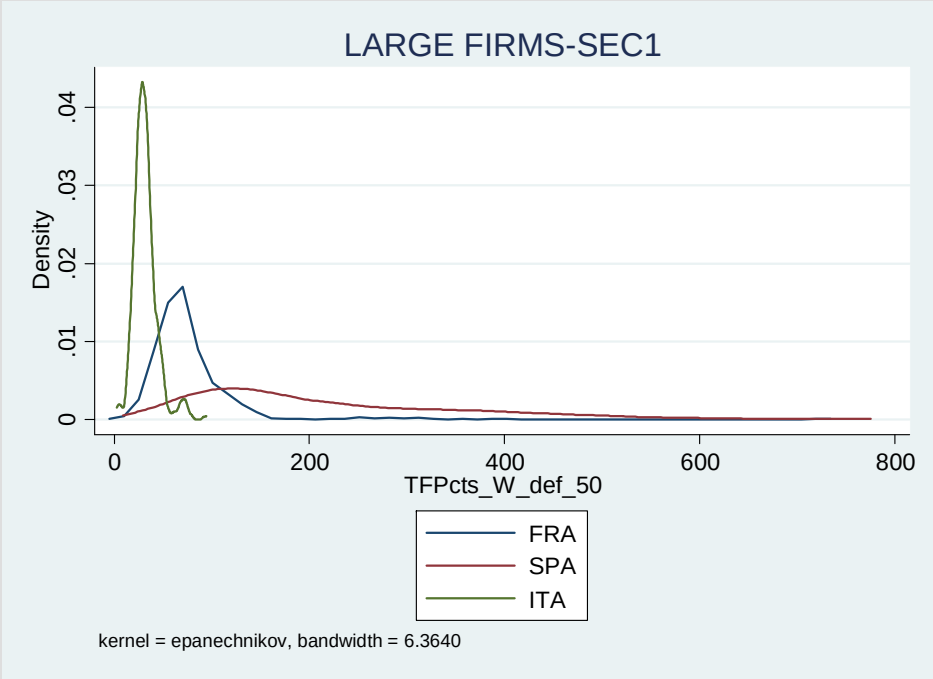




TFP Kernel density functions by size

Food products, beverages and tobacco

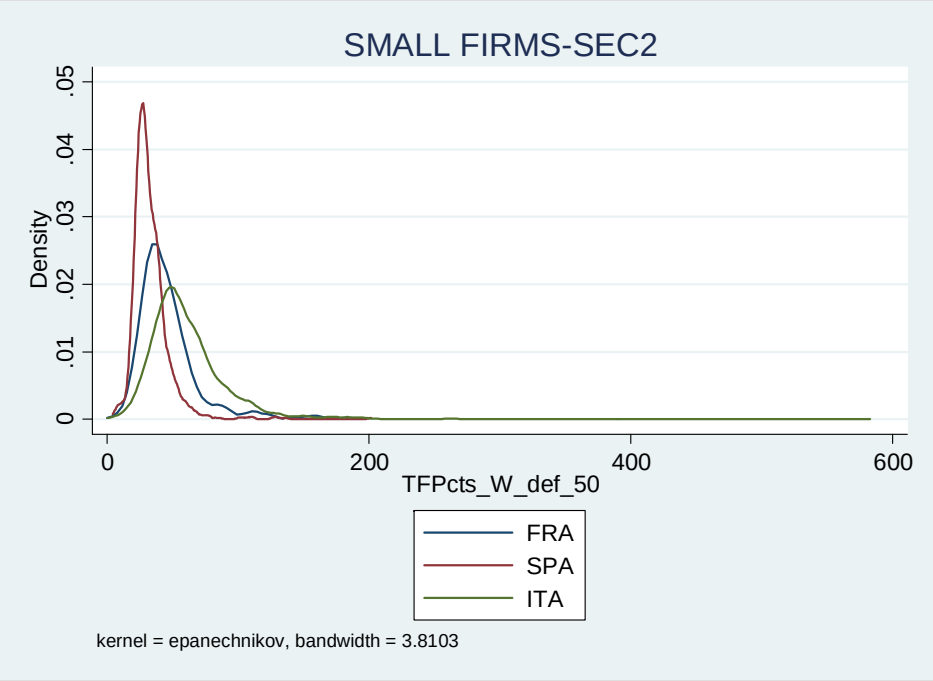


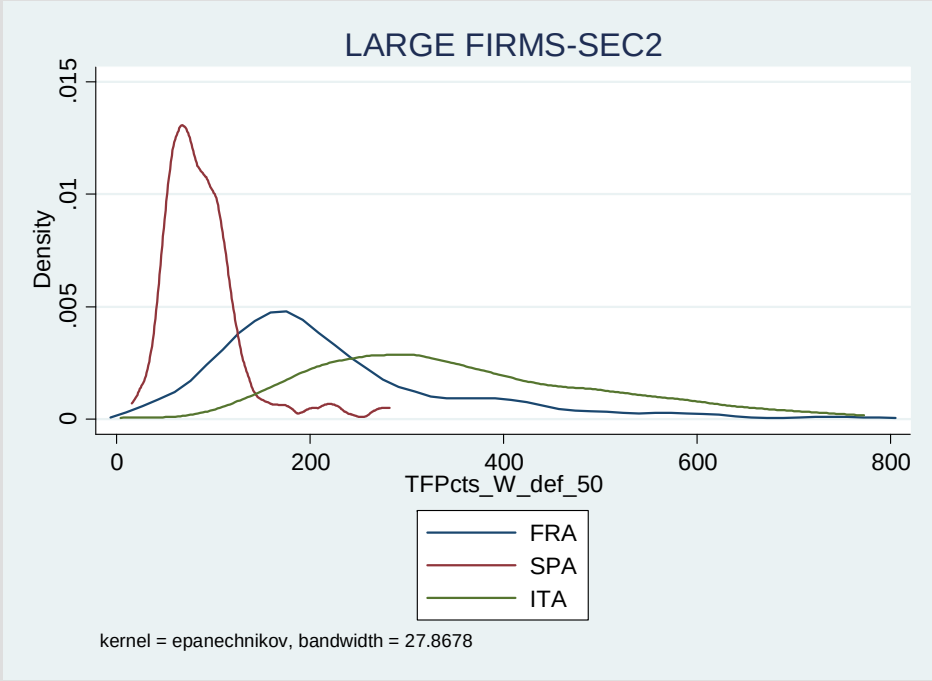


SEC1: Food products, beverages and tobacco (1500-1600)

TFP Kernel density functions by size

Textiles and textile products
Leather and leather products

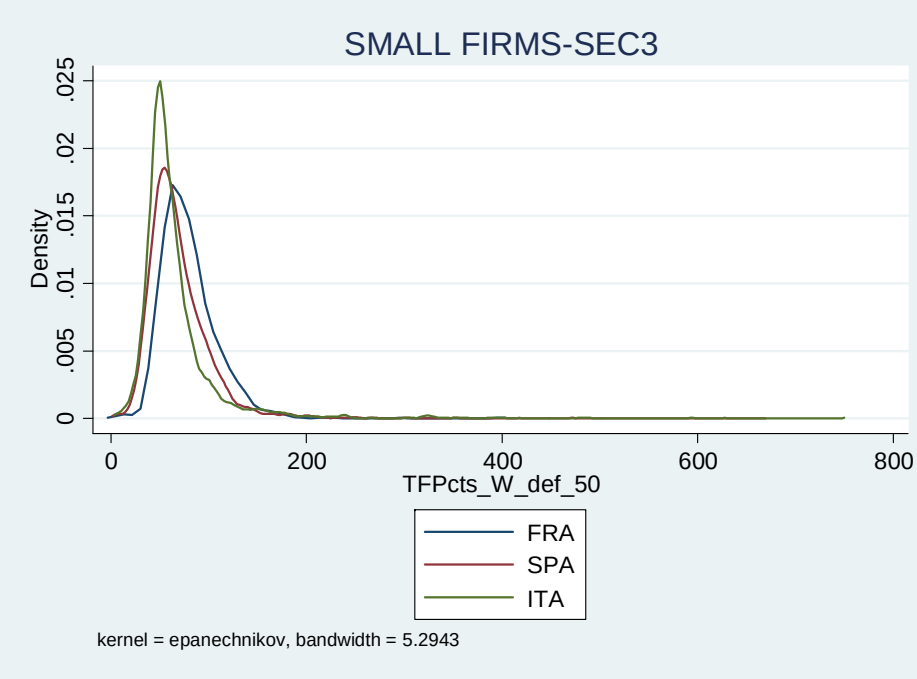


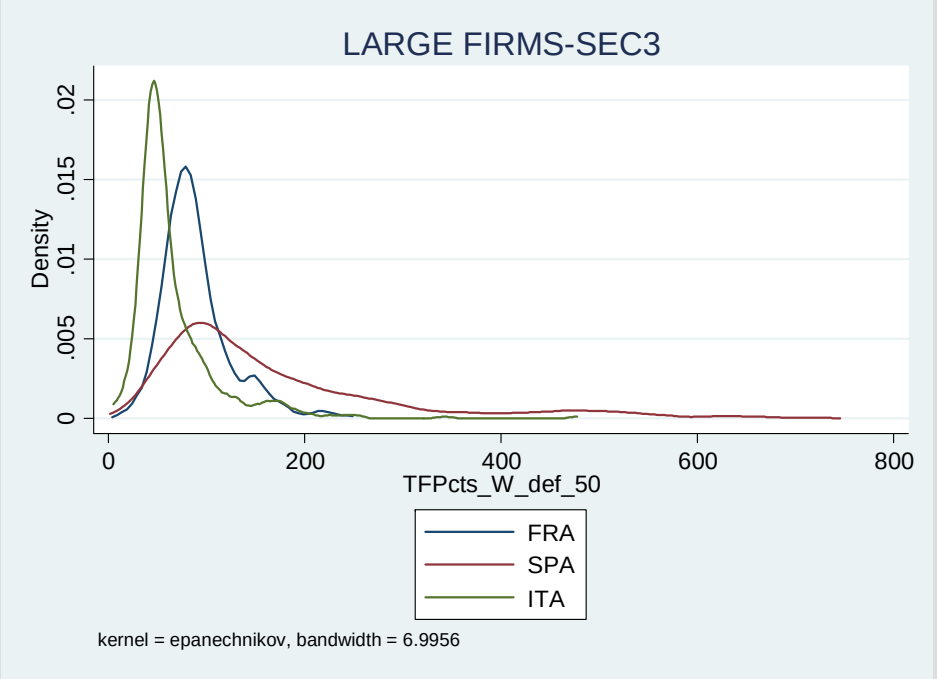


SEC2: textiles and textile products (1700-1830) + Leather and leather products (1900-1930)

TFP Kernel density functions by size

Wood products
Pulp, paper, publishing & printing

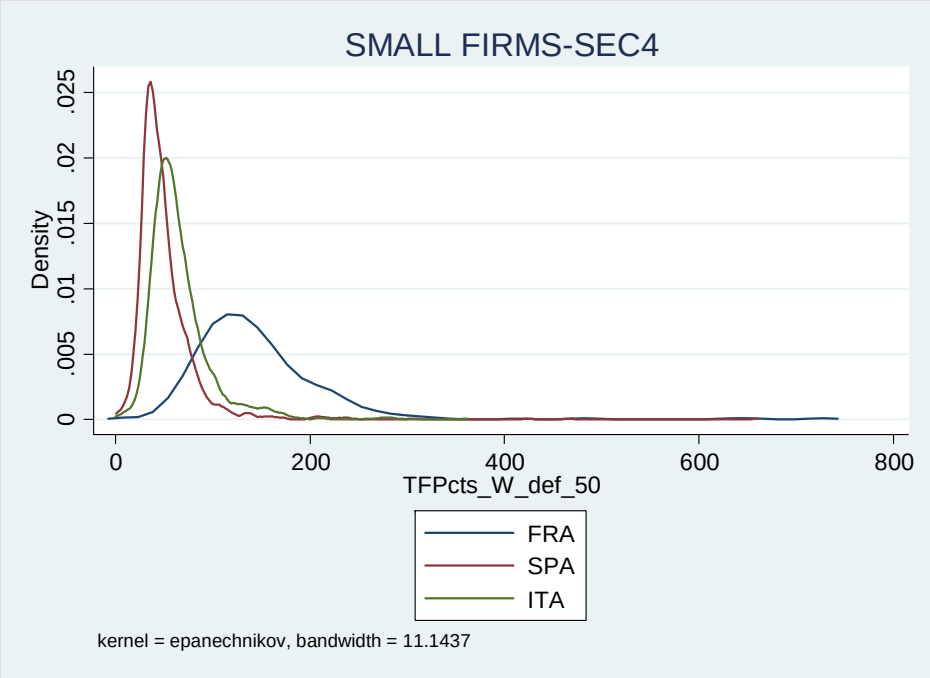


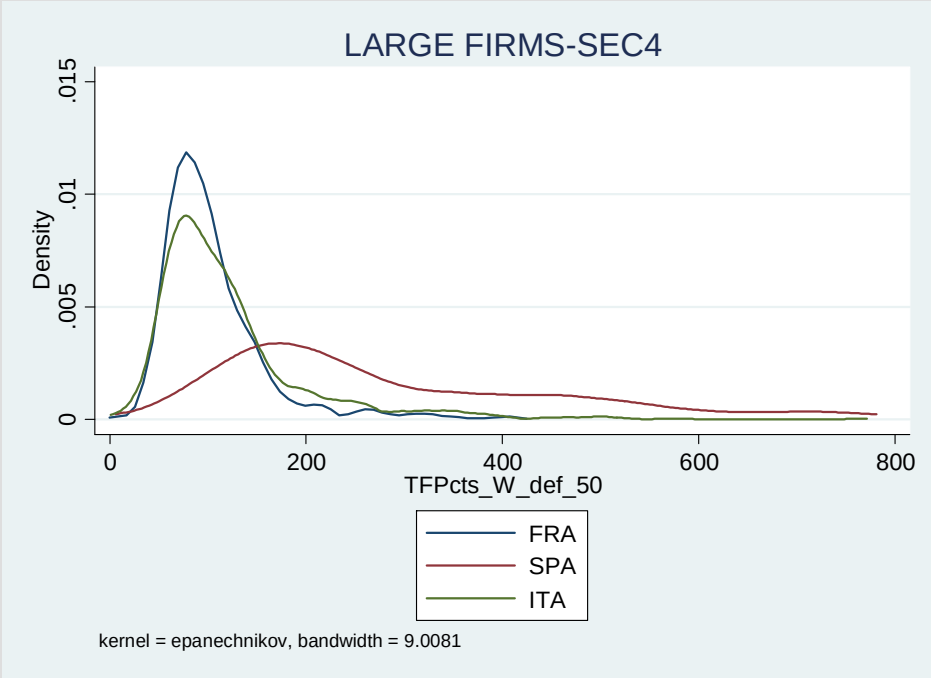


SEC3: Wood and wood products (2000-2052)+Pulp, paper and paper products, publishing and printing (2100-2233)+nec (3600-3720)

TFP Kernel density functions by size

Coke, refined petroleum products
Chemicals, rubber and plastic products

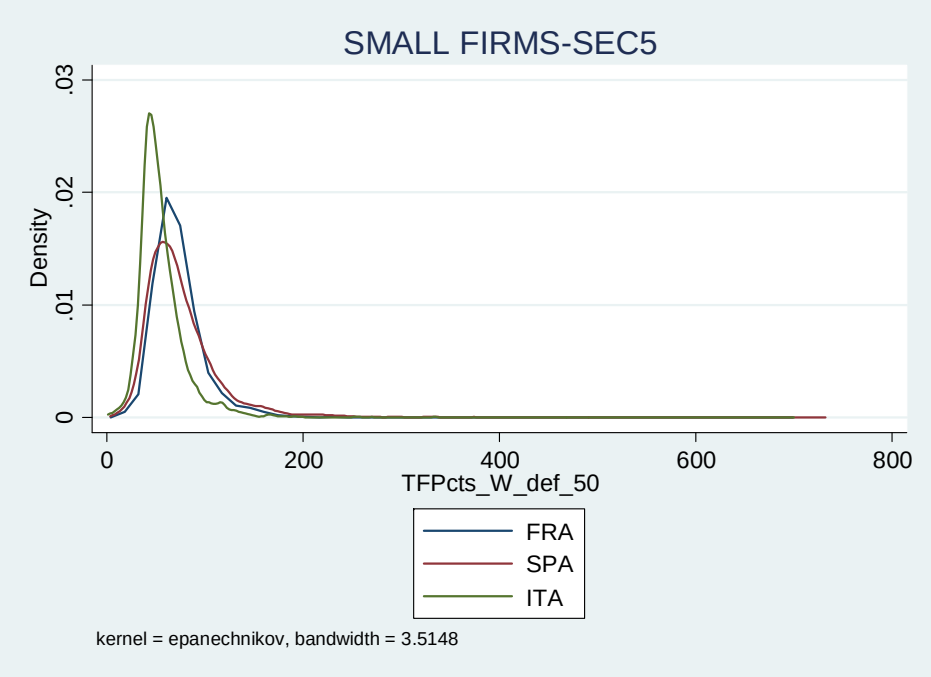


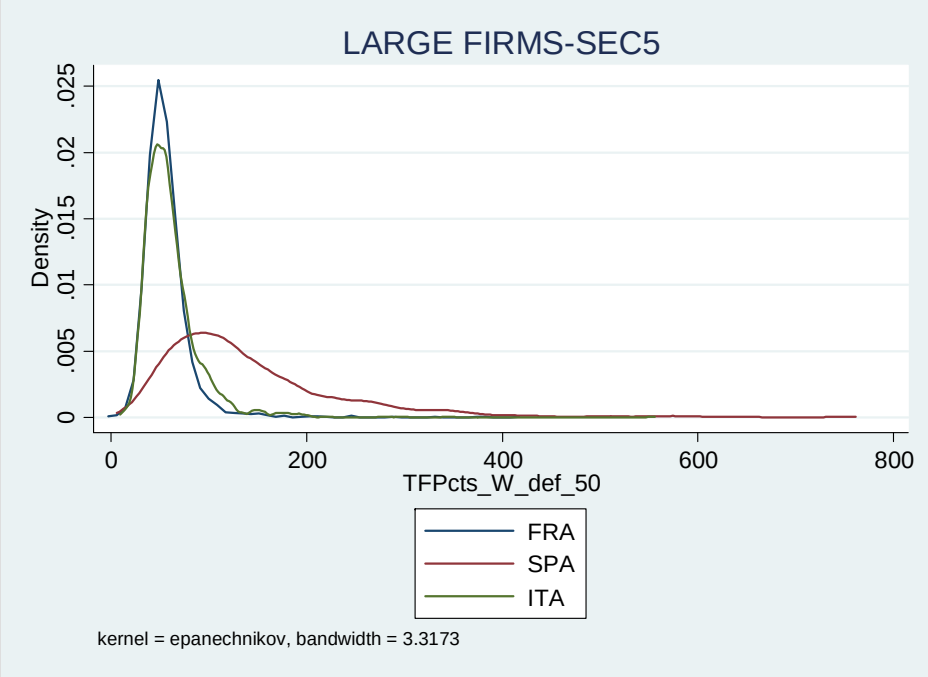


SEC4: Coke, refined petroleum products and nuclear fuel (2300-2330)+chemicals, chemical products and man-made fibres (2400-2470)+rubber and plastic products (2500-2524)

TFP Kernel density functions by size

Non-metallic mineral products
Basic and fabricated metal products

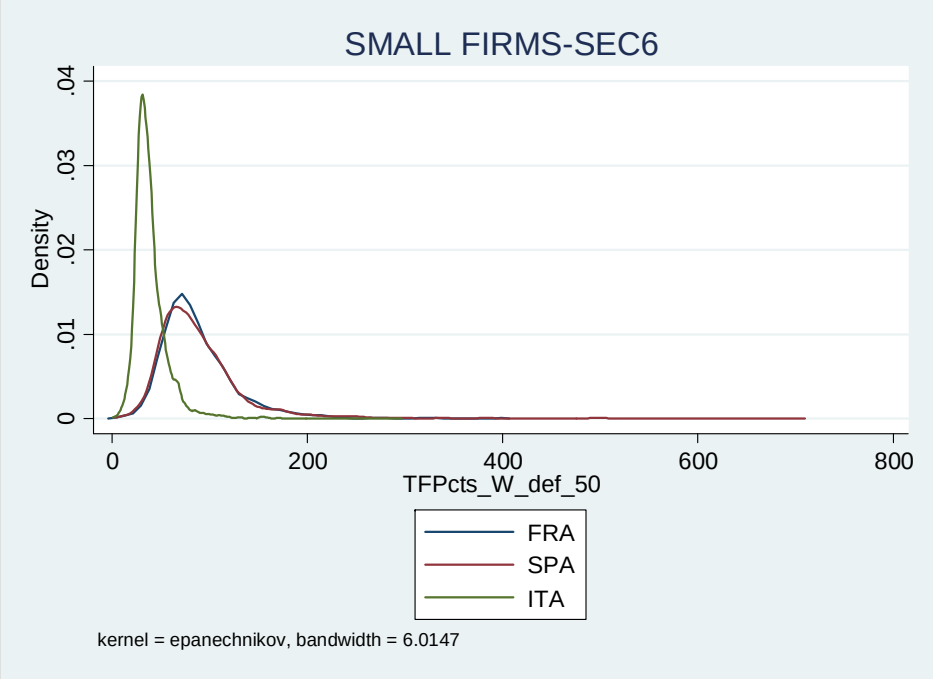


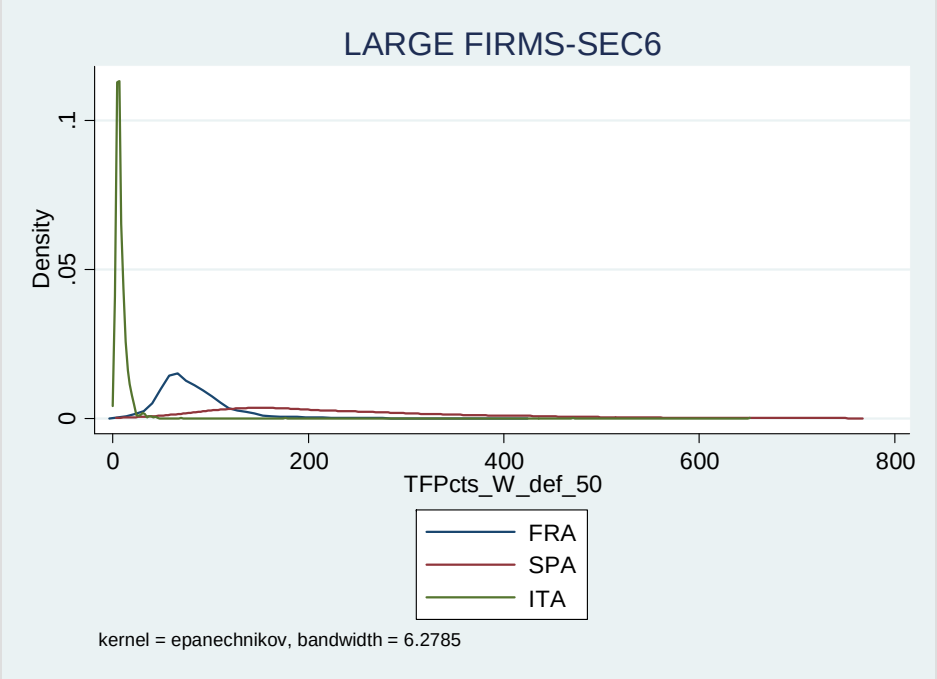


SEC5: Other non metallic mineral products (2600-2682)+basic metals and fabricated metal products (2700-2875)

TFP Kernel density functions by size

Machine and equipment
Electrical and optical equipment, Transport equipment

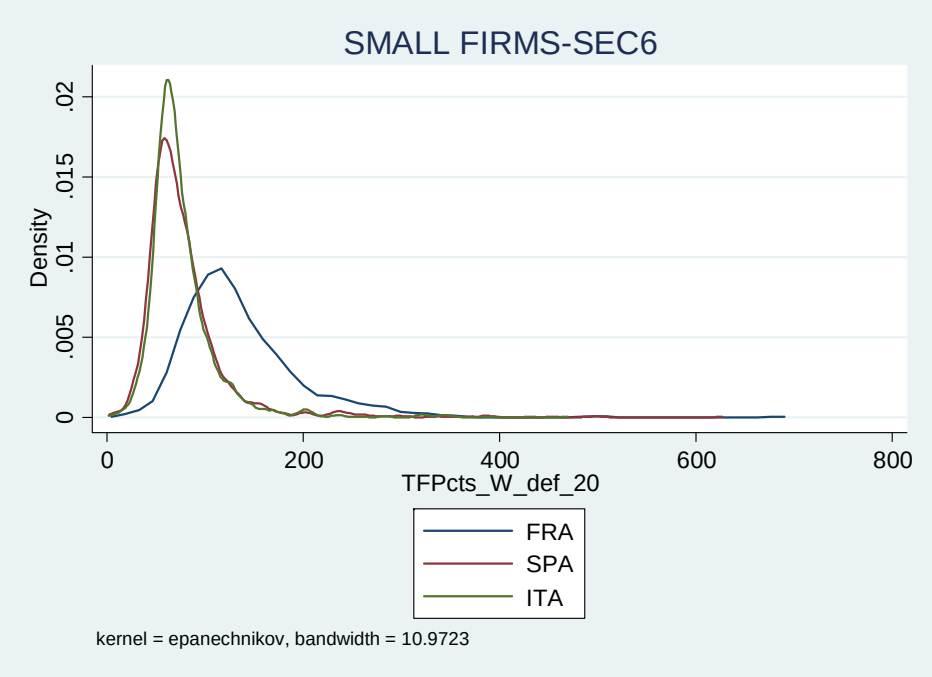


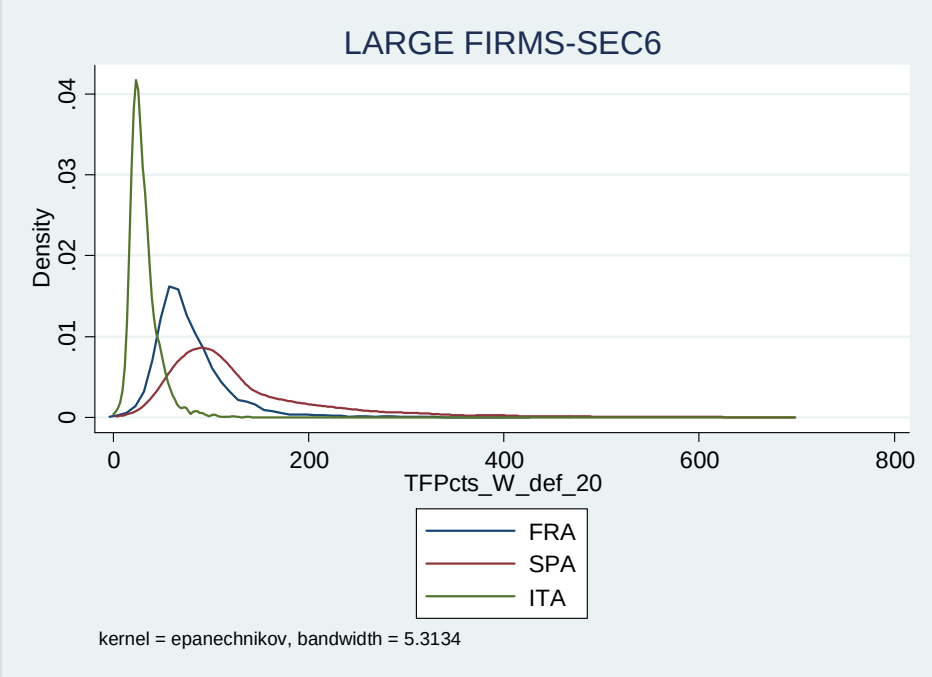


SEC6: Machine an equipment nec (2900-2972)+electrical and optical equipment (3000-3350)+transport equipment (3400-3550)

TFP Kernel density functions by size

Machine and equipment
Firms with less than 20 employees





SEC6: Machine an equipment nec (2900-2972)+electrical and optical equipment (3000-3350)+transport equipment (3400-3550)

Content

Oaxaca decomposition – Details

- **TFP at firm i is determined by a group of determinants Xi**

$$TFP_i = \begin{cases} \beta^{sc} X_i + \varepsilon_i^{sc} & \text{if small in country c} \\ \beta^{sj} X_i + \varepsilon_i^{sj} & \text{if small in country j} \end{cases}$$

- **The difference in TFP mean can be expressed:**

$$\overline{TFP}^{sc} - \overline{TFP}^{sj} = \left(\alpha^{sc} - \alpha^{sj}\right) + \Delta X \beta^{sc} + \Delta \beta X^{sj}$$

  - We do not assume one of the groups is the discriminated (pooled version)
  - We take into account the identification problem that arises when using dummies (Gadearzabal and Ugidos 2004 and Yun 2005)

Oaxaca decomposition – Explanatory variables

Firm ownership	
Young	=1 if firm is 5 or less years
Group	=1 if firm belongs to a group
Family owned	=1 if firm is family-owned
Human capital	
Performance_pay	=1 if executives rewarded on the basis of performance
Graduates	=1 if % of graduates in workforce above 2-digit sector's mean
Training	% of workers participating in formal training (in 2008)
Innovation	
Process innovation	=1 if firm has carried out process innovation (innovative to the firm) in the last 3 years
Product innovation	=1 if firm has carried out product innovation (innovative to the firm) in the last 3 years
Internationalization	
Exports	=1 if the firm has sold abroad any product or service in 2008
Imports	=1 if the firm has purchased service or intermediate goods for the domestic production in 2008
FDI	=1 if the firm runs part of its production activity in another country
Finance	
External finance	=1 if the firm has recurred to external financing over the last year
Cash-ratio	=1 if firm's cash-ratio (cash-flow over current liabilities) above 2-digit sector's mean
Alternatives (robustness)	
Young2	=1 if firm is 10 years or less
Foreign group	=1 if firm belongs to a foreign group
Training2	=1 if % of workforce in formal training above 2-digit sector's mean
RD_inhouse	=1 if firm carries out R&D activities in house
Patents	=1 if firm has applied for a patent, registered an industrial design, a trademark or claimed a copyright over the last two years
Cash-ratio 2	Cash-flow over current liabilities

Average characteristics of firms

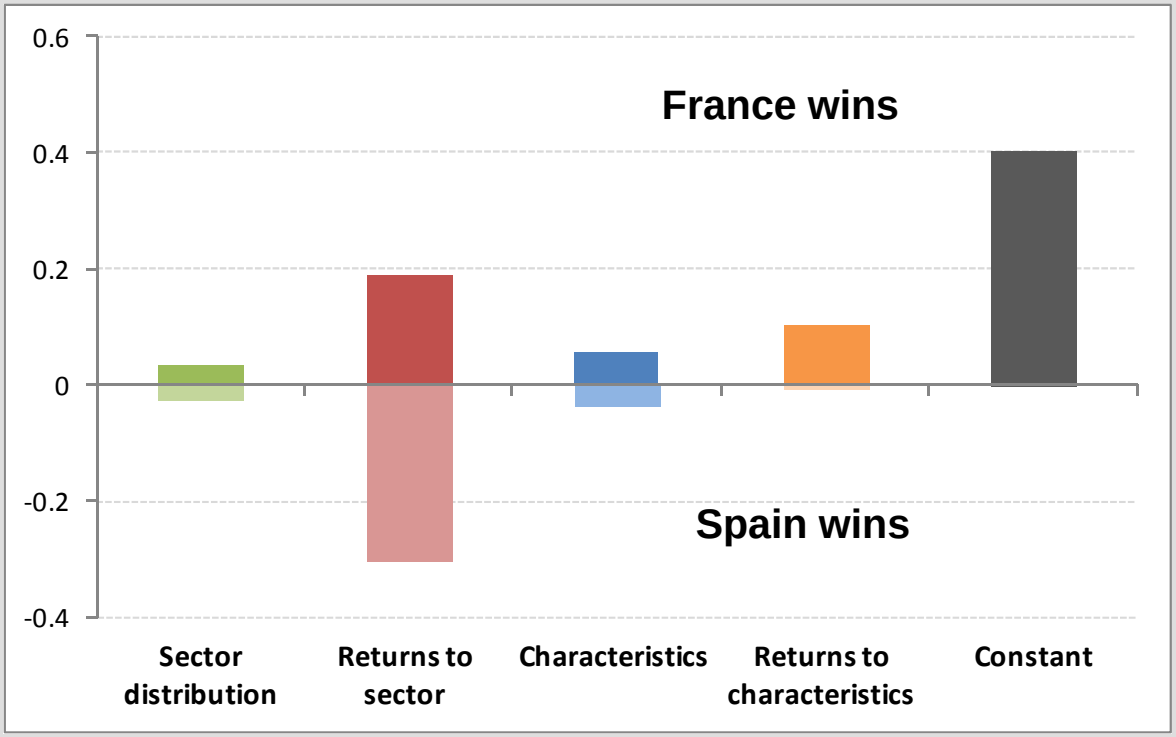
SUMMARY STATISTICS

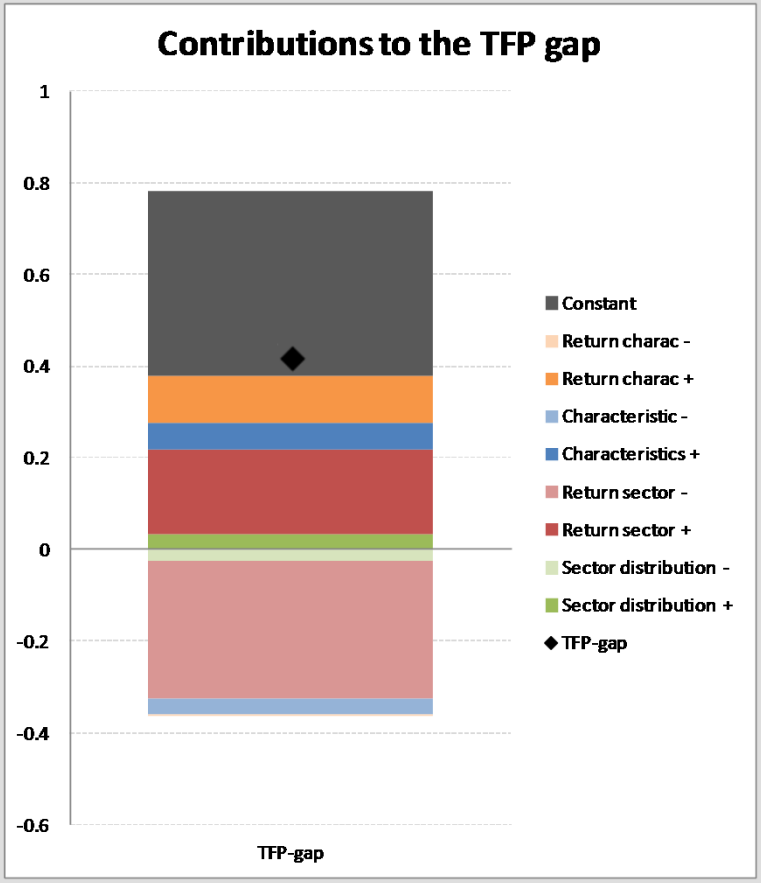
LESS THAN 50 EMPLOYEES

	SPAIN	FRANCE	ITALY
TFP	81.40	88.66	75.52
TFP in logarithmics	4.07	4.50	3.91
Younger than 5 years	4.1%	3.3%	4.0%
Belongs to a group	8.8%	22.5%	11.0%
It is family owned	80.8%	60.5%	77.4%
Manager's pay linked to performance	20.2%	40.8%	14.6%
Percentage of graduates larger than average in the sector	48.5%	35.5%	27.6%
Percentage of the workforce in formal training	29.6%	22.4%	12.1%
It has performed process innovation in the period 2007-2009	49.5%	33.8%	41.5%
It has performed product innovation in the period 2007-2009	42.8%	43.6%	45.2%
It exports products/services in 2008	50.5%	47.0%	65.0%
It imports intermediate products/services in 2008	37.1%	49.4%	31.6%
It runs part of its production activity in another country	2.7%	5.5%	4.6%
It has recured to external finance in 2008-2009	64.1%	42.6%	59.3%
Cash ratio larger than the average in the sector	45.0%	46.0%	25.9%

Explaining the TFP gap

Oaxaca decomposition: France vs Spain
Spanish small firms' TFP is 65% of French ones





- **Sector dummies:** Sector distribution of Spanish small firms does not contribute to the gap
- **Return to sector dummies:** After controlling for observables, TFP in Spain is larger in some sectors
- **Observable characteristics:** Some contribute to enlarge the gap and some to diminish it
- **Return to the characteristics:** The (low) return to the characteristics is an important factor
- **Constant:** Differences in TFP not explained by observables or sector…institutions? Informal economy?

Explaining the TFP gap

Oaxaca decomposition: France vs Spain

TFP gap: 65.8%	Characteristics: 0.029	Returns: -0.014
Tenure of the firm	0.001	0.033
Group	**0.013**	0.013
Family owned	**0.024**	**0.010**
Manager's pay linked to performance	**0.013**	0.001
Graduates in workforce	**-0.011**	0.007
Process innovation	-0.004	**0.012**
Product innovation	0.000	-0.004
Export activity of the firm	-0.001	0.000
Import of intermediate goods/servcies	0.004	**0.005**
FDI	0.000	0.003
External financing	-0.003	**0.005**
Cash ratio	0.003	0.000
% workforce in training	**-0.015**	0.013

Firm characteristics:

- ↑ Family owned
- ↑ Group
- ↑ Performance pay

France wins

- ↓ % graduates
- ↓ % training

Spain wins

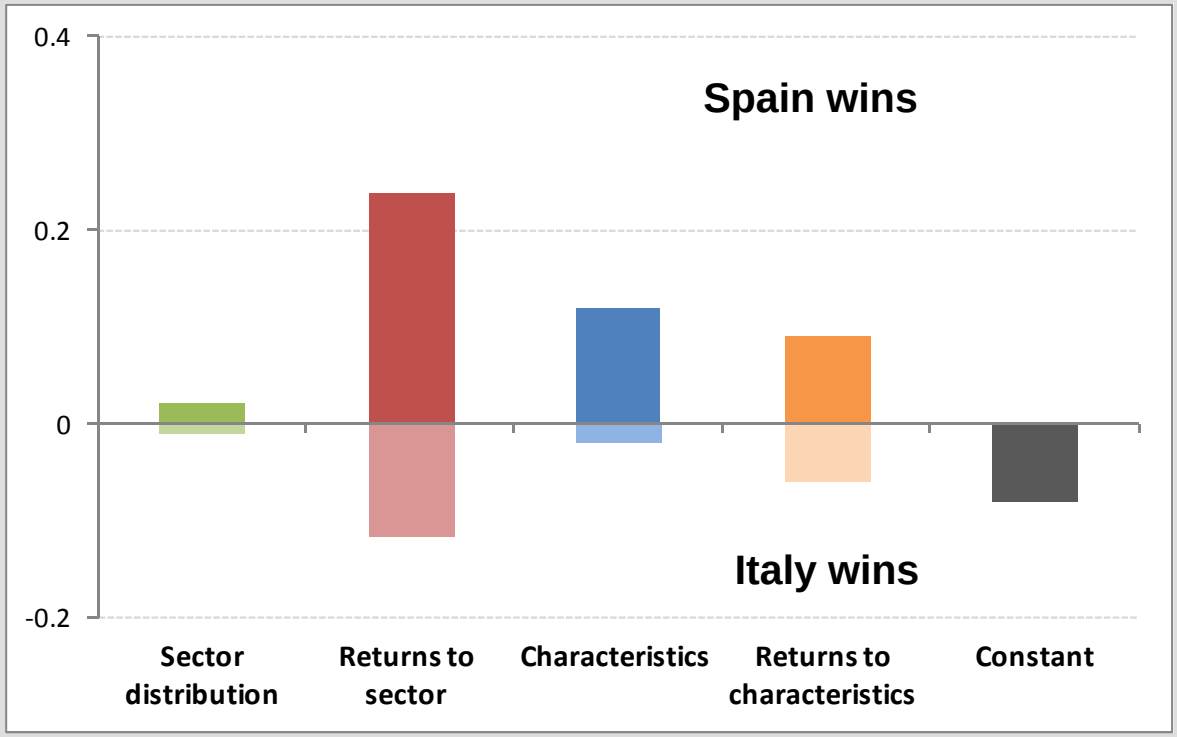
Returns:

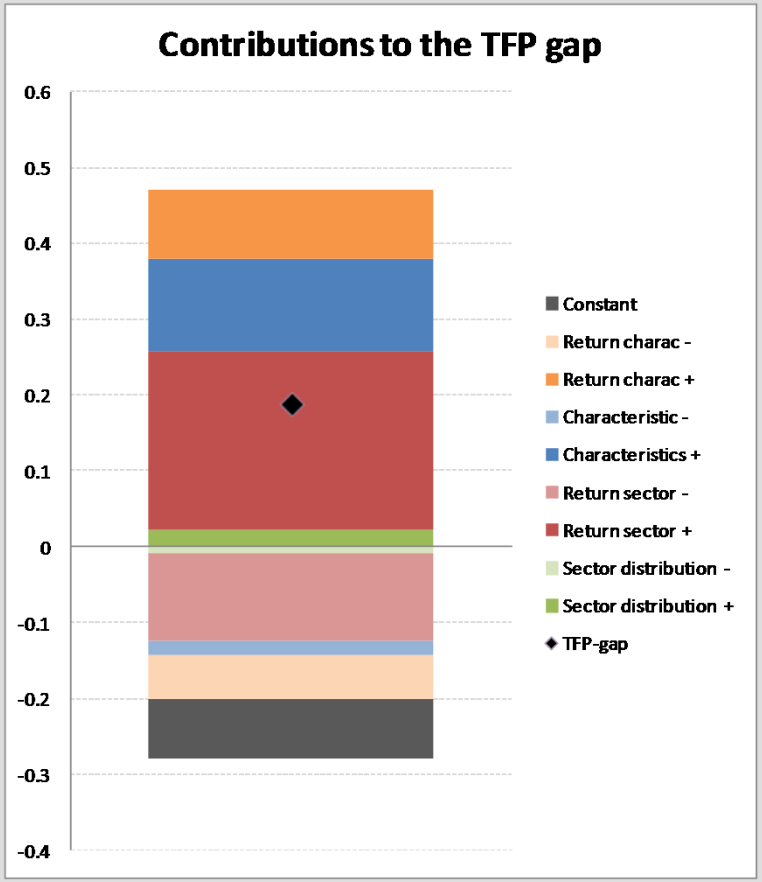
- ↑ Process innovation
- ↑ Imports
- ↑ External financing

France wins

Explaining the TFP gap

Oaxaca decomposition: Spain vs Italy
Italian small firms' TFP is 83% of Spanish ones





- **Sector distribution:** It does contribute slightly to the gap
- **Sector dummies:** After controlling for observables, TFP of small Spanish firms is higher in most sectors
- **Observable characteristics:** They contribute to enlarge the gap
- **Return to the characteristics:** The return to the characteristics does not explain in net terms much
- **Constant:** It is not statistically significant

Explaining the TFP gap

Oaxaca decomposition: Spain vs. Italy

TFP gap: 82.6% **Characteristics: 0.116** **Returns: 0.153**

Tenure of the firm	0.000	-0.018
Group	**-0.003**	0.017
Family owned	**-0.003**	**-0.030**
Manager's pay linked to performance	**0.006**	0.024
Graduates in workforce	**0.020**	-0.003
Process innovation	**0.004**	-0.001
Product innovation	0.001	0.003
Export activity of the firm	**-0.009**	0.000
Import of intermediate goods/servcies	**0.007**	**0.011**
FDI	-0.001	0.030
External financing	-0.001	0.001
Cash ratio	**0.050**	0.004
% workforce in training	**0.033**	-0.007

- **Firm characteristics:**

  ↑ **Cash ratio**
  ↑ **% training**
  ↑ **% graduates**
  ↑ **Imports** — **Spain wins**
  ↑ **Performance pay**
  ↑ **Process innovation**

  ↓ **Exports**
  ↓ **Group**
  ↓ **Family owned** — **Italy wins**

- **Returns:**

  ↑ **Family owned**
  ↓ **Imports**

Conclusions

- **We observe *technological differences* across countries, sectors and firm size**
  - These differences translate into differences in TFP

- **We show that TFP distributions within a certain *sector* and firm *size segment* are statistically different across countries**

- **We identify *drivers* of this TFP gap based on EFIGE data**

  - French small firms are more productive than Spanish ones due to:
    1. Difference in returns of firm characteristics
    2. Difference in the constant term

  - Spanish firms are more productive than Italian ones due to:
    1. Differences in firm characteristics
    2. Differences in the returns across sectors

  - French firms are more productive than Italian ones due to:
    1. Differences in firm characteristics
    2. Differences in the returns to characteristics and in the constant term

Thanks a lot for your attention!!

Number of observations per cell (< 50)

Sample sizes for TFPcts estimation wooldridge

	FRANCE		ITALY		SPAIN	
	Greater than 50	Smaller than 50	Greater than 50	Smaller than 50	Greater than 50	Smaller than 50
Sector 1	334	373	242	996	529	2092
Sector 2	232	449	383	1410	105	731
Sector 3	342	919	394	1775	569	3000
Sector 4	552	789	485	965	441	1147
Sector 5	1055	2653	792	3007	964	4004
Sector 6	1024	1316	912	2542	723	2352

Technological coefficients

TECHNOLOGICAL COEFFICIENTS (WOOLDRIDGE); NO INDUSTRY DUMMIES
(SMALL FIRMS: < 50 EMPLOYEES)

	FRANCE				ITALY				SPAIN			
	Greater than 50		Smaller than 50		Greater than 50		Smaller than 50		Greater than 50		Smaller than 50	
	lne	lnk	lne	lnk	lne	lnk	lne	lnk	lne	lnk	lne	lnk
Sector 1	0.629***	0.172***	0.598***	0.046	0.708***	0.215***	0.678***	0.156***	0.573***	0.033	0.661***	0.139***
Sector 2	0.430***	0.167***	0.691***	0.182***	0.543***	-0.016	0.775***	0.046	0.538***	0.105***	0.689***	0.113***
Sector 3	0.726***	0.090**	0.699***	0.078***	0.986***	-0.021	0.804***	0.031	0.584***	0.062	0.614***	0.045***
Sector 4	0.629***	0.160**	0.569***	0.052	0.643***	0.129*	0.656***	0.12	0.683***	-0.037	0.791***	0.059
Sector 5	0.749***	0.149***	0.735***	0.083***	0.802***	0.101***	0.730***	0.102***	0.406***	0.197***	0.702***	0.025*
Sector 6	0.767***	0.109**	0.683***	0.107***	0.807***	0.364**	0.802***	0.136***	0.562***	0.054	0.669***	0.022

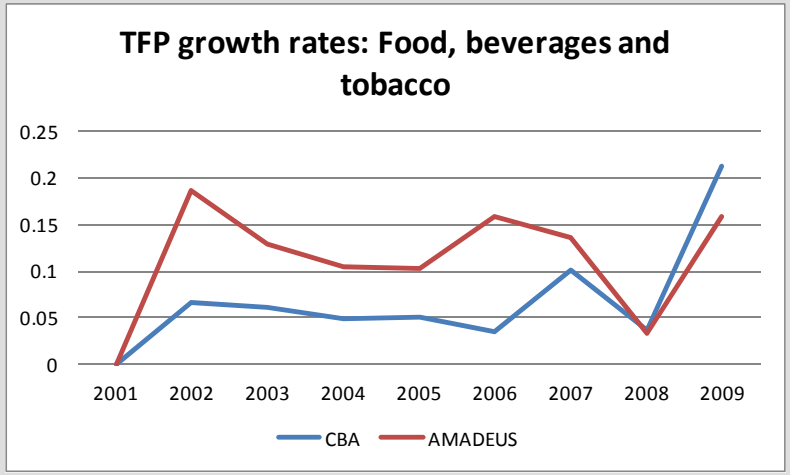
Correlation between different productivity estimators

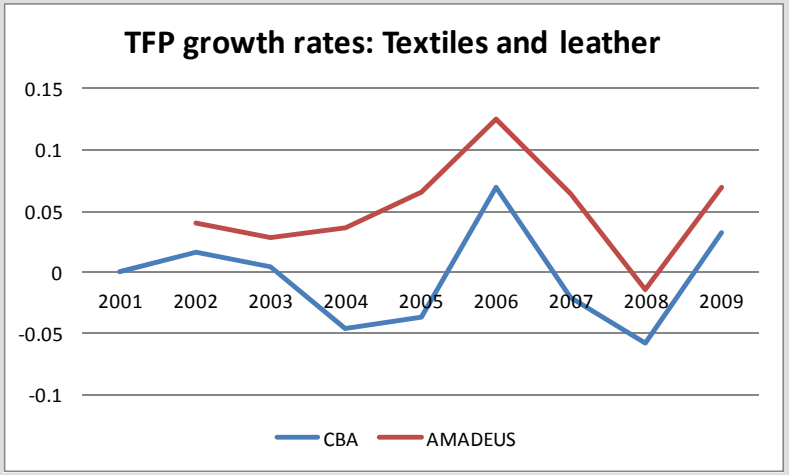
Correlations across productivity estimators. ALL SAMPLE

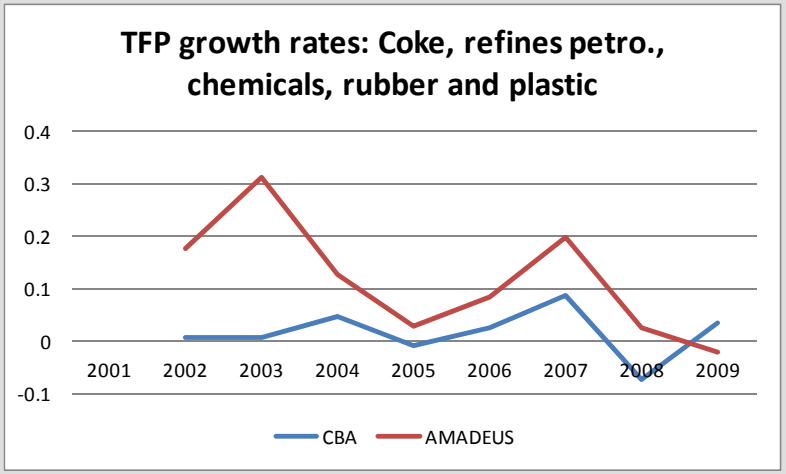
	TFPcts_LP_20	TFPcts_LP_50	TFPcts_W_20	TFPcts_W_50	ProdL
TFPcts_LP_20	1				
TFPcts_LP_50	0.9485	1			
TFPcts_W_20	0.9837	0.9282	1		
TFPcts_W_50	0.9341	0.9791	0.9426	1	
ProdL	0.8928	0.9614	0.9045	0.981	1

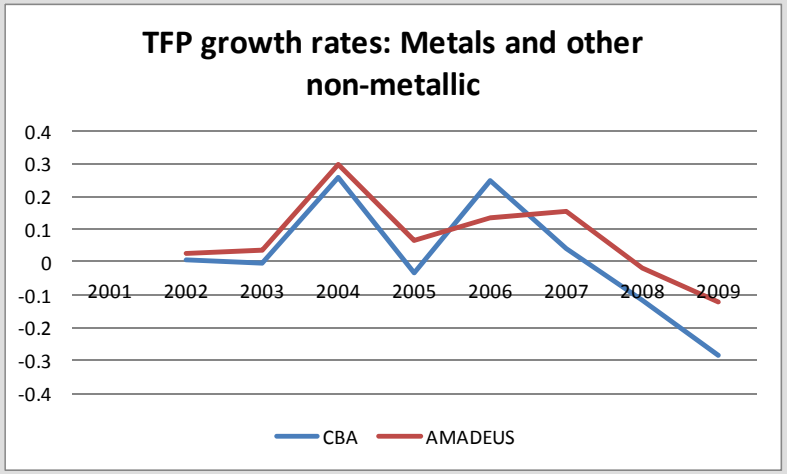
Checking goodness of AMADEUS data

Comparison with estimated TFP growth rates using CBA data for Spain









Some details I

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

$$y_{it} = \beta_0 + \beta_k k_{it} + \beta_L l_{it} + \beta_M m_{it} + \omega_{it} + u_{it} \qquad (1)$$

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 consistently estimated by OLS only if** $E(\omega_{it}, x_{it}) = 0$
  - Unlikely, given that firm-level productivity is observed by the firm which means that most probably will affect 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

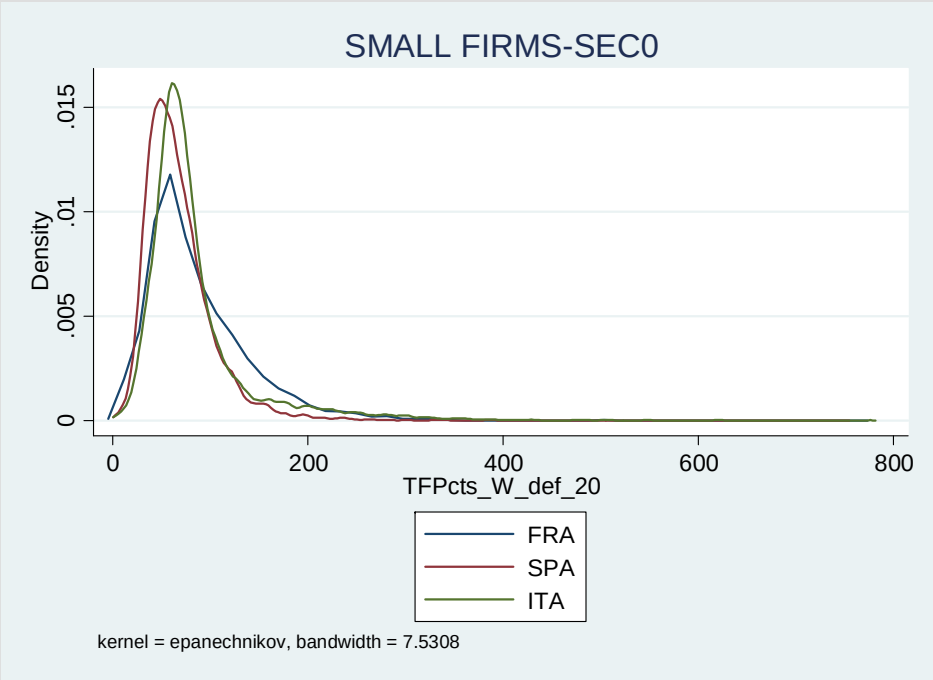
Some details II

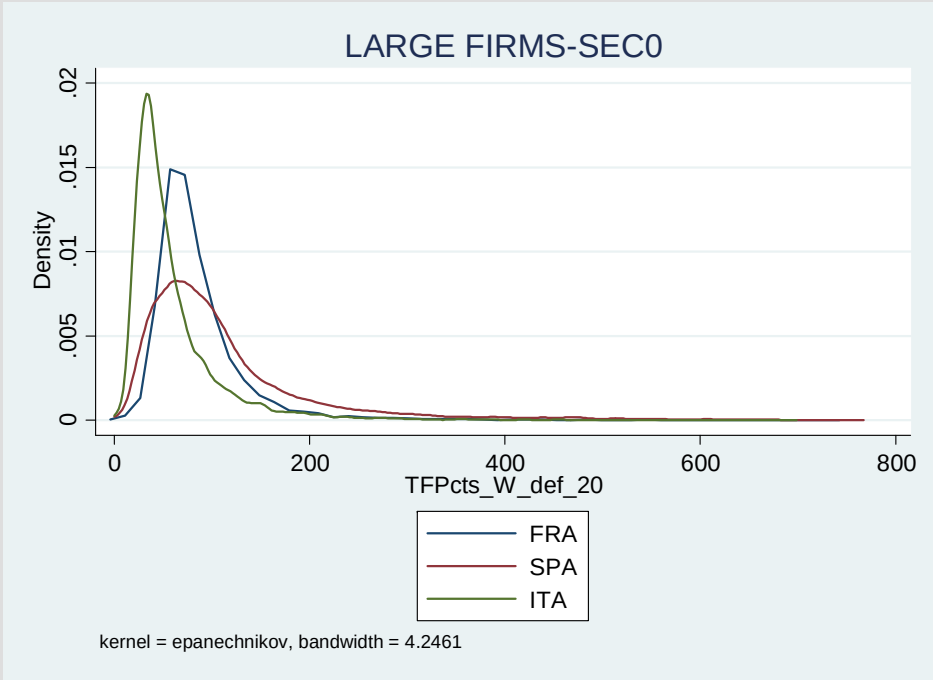
- **Solutions**
  - Instrumental variables: find instruments correlated to inputs but not to unobserved productivity; or lagged values of inputs (GMM)
  - Fixed-effect estimation: only when you think that unobserved productivity is constant over time
  - Semi-parametric estimators or control function 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*

Back

TFP Kernel density functions by size

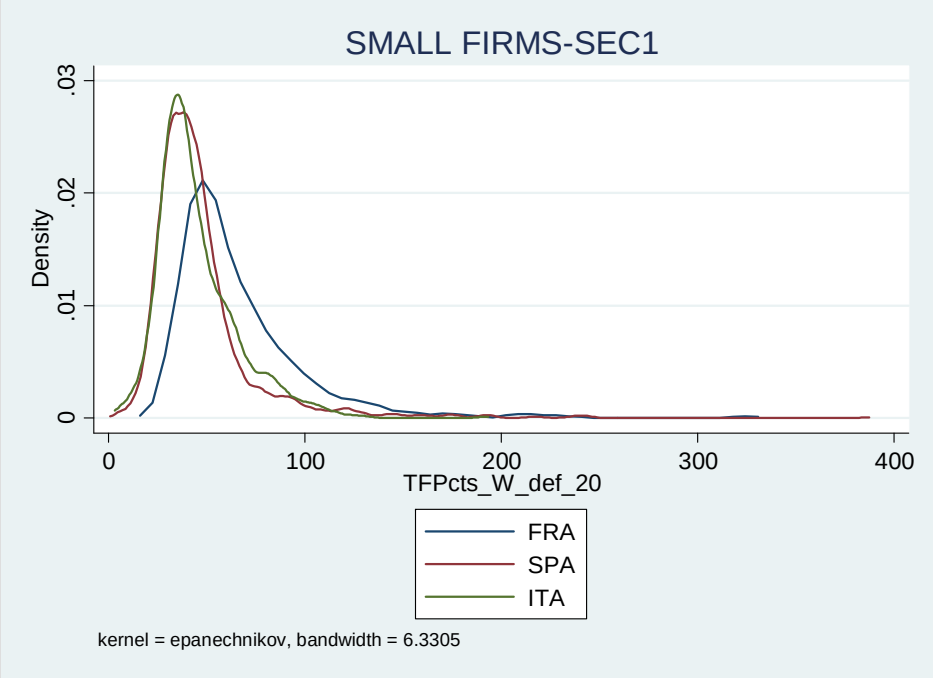
Total manufacturing sector

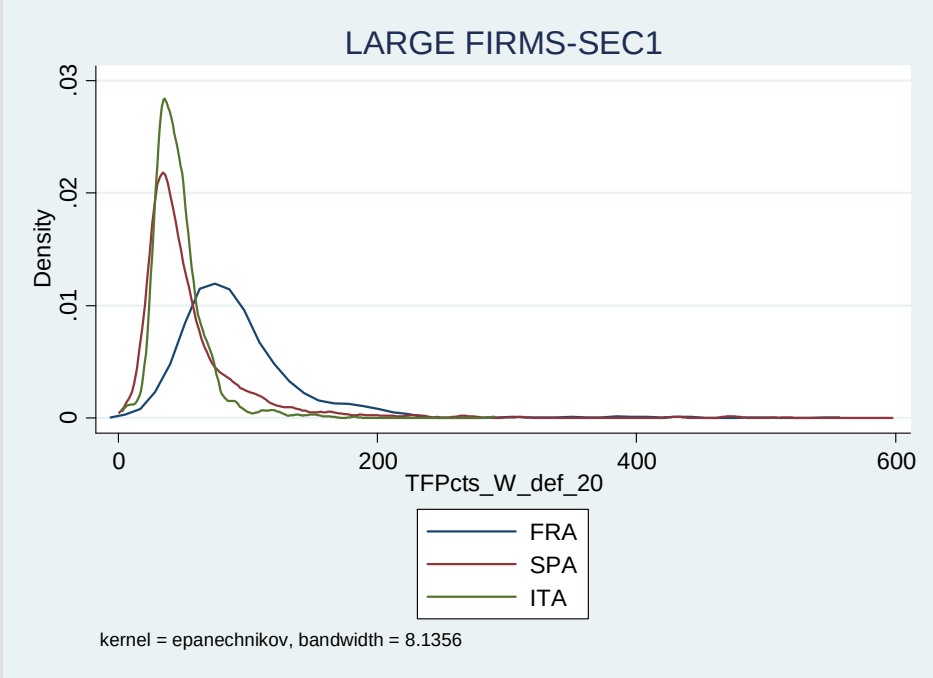




TFP Kernel density functions by size

Food products, beverages and tobacco

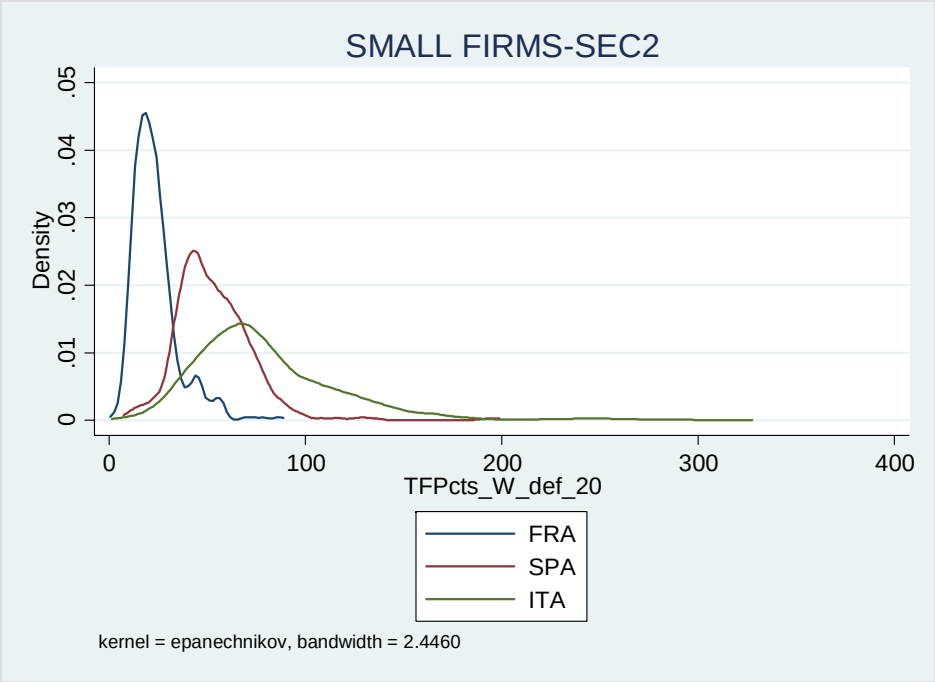


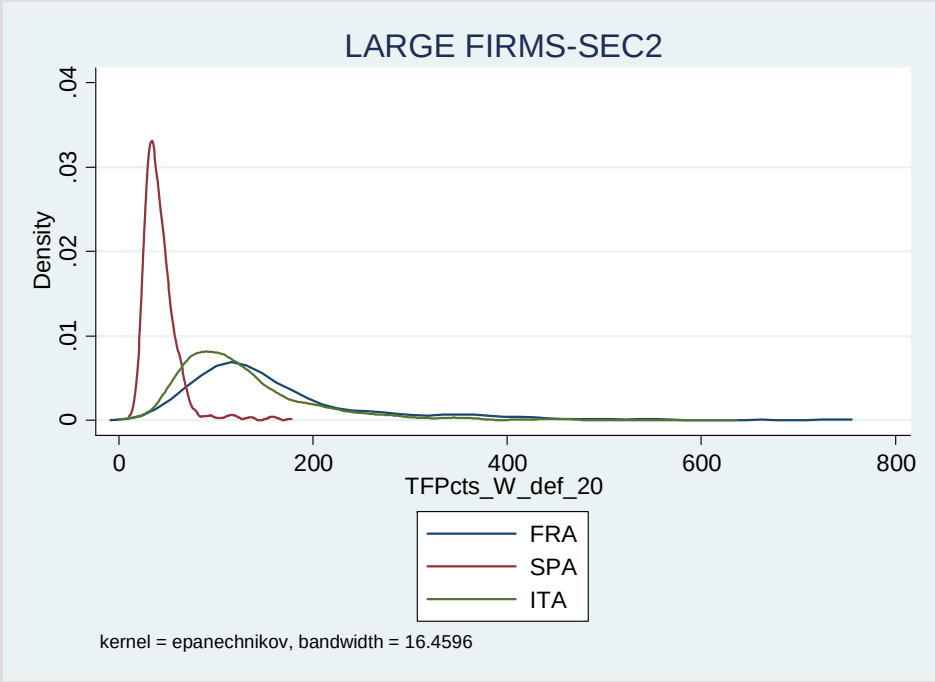


SEC1: Food products, beverages and tobacco (1500-1600)

TFP Kernel density functions by size

Textiles and textile products + Leather and leather products

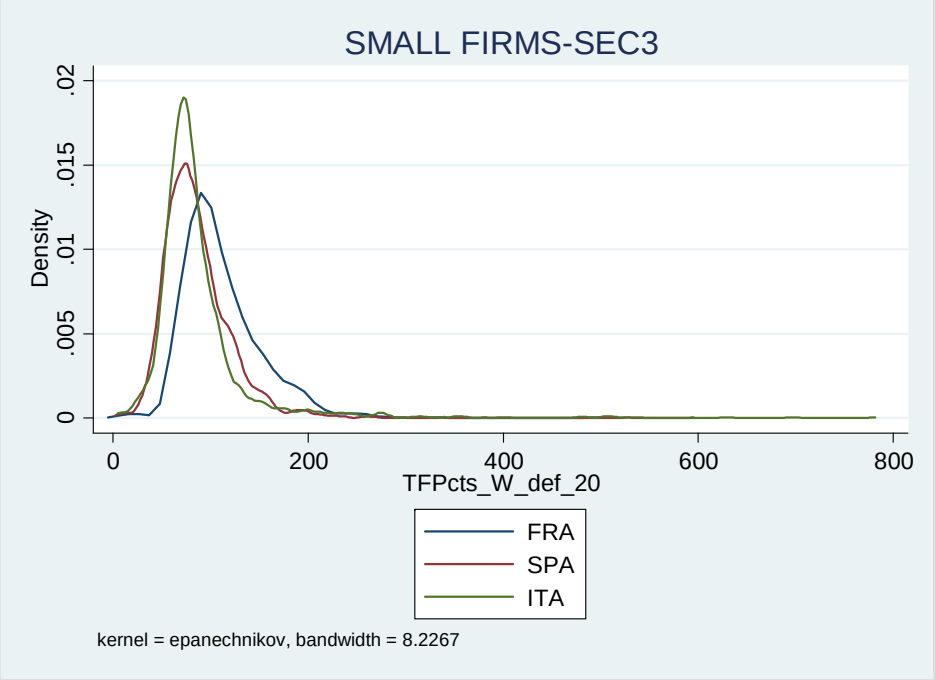


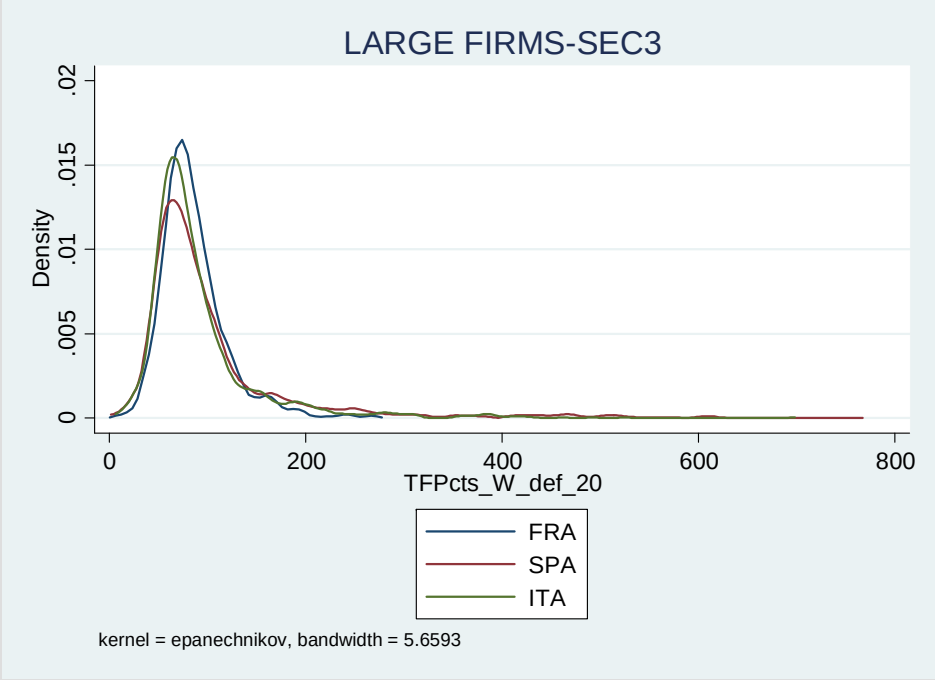


SEC2: textiles and textile products (1700-1830) + Leather and leather products (1900-1930)

TFP Kernel density functions by size

Wood products + Pulp, paper, publishing and printing

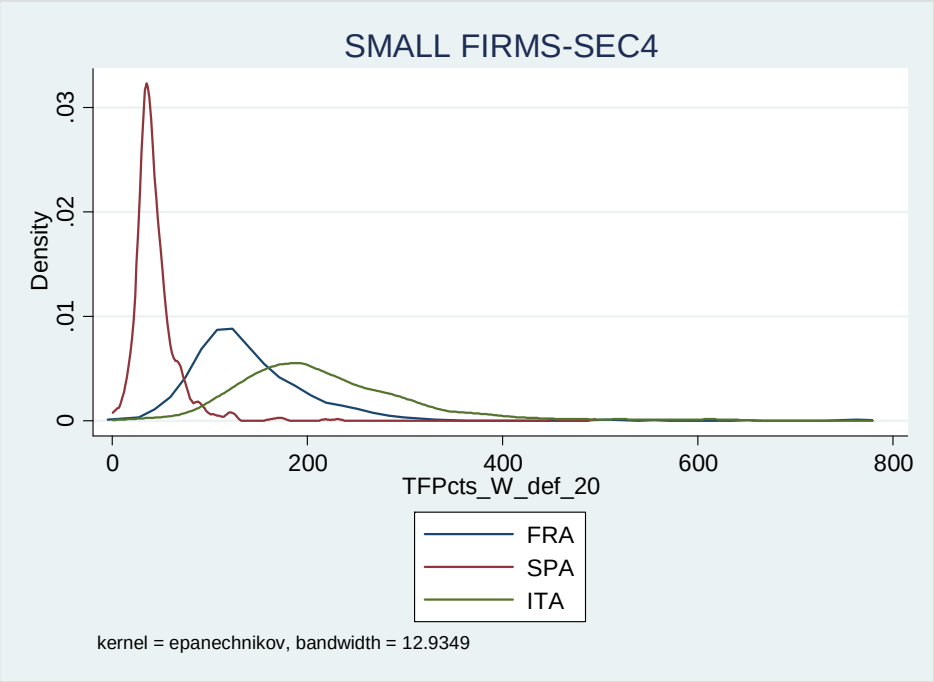


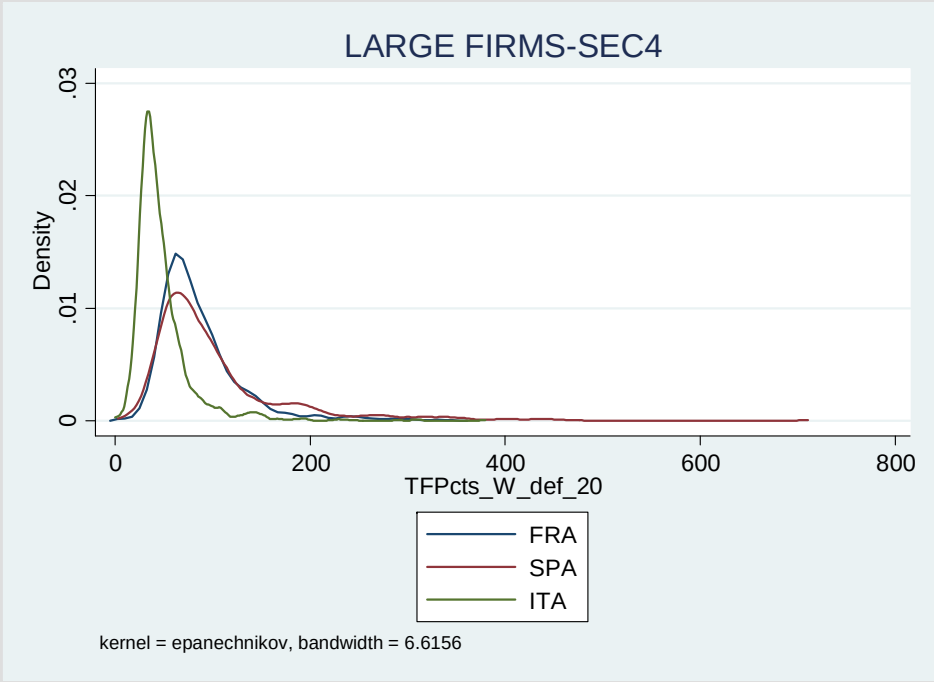


SEC3: Wood and wood products (2000-2052)+Pulp, paper and paper products, publishing and printing (2100-2233)+nec (3600-3720)

TFP Kernel density functions by size

Coke, refined petroleum products + chemicals, rubber and plastic products

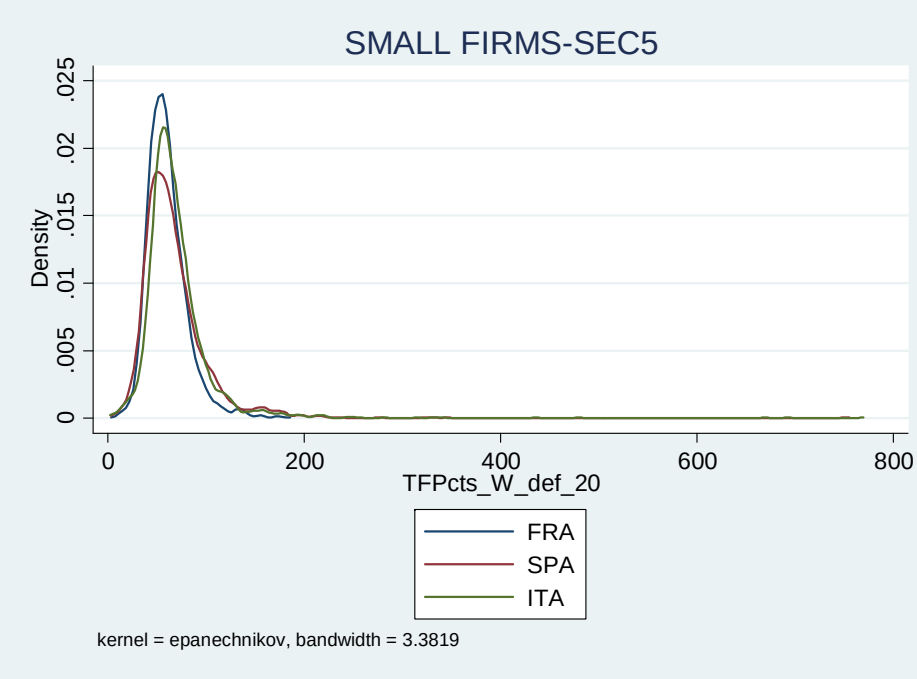


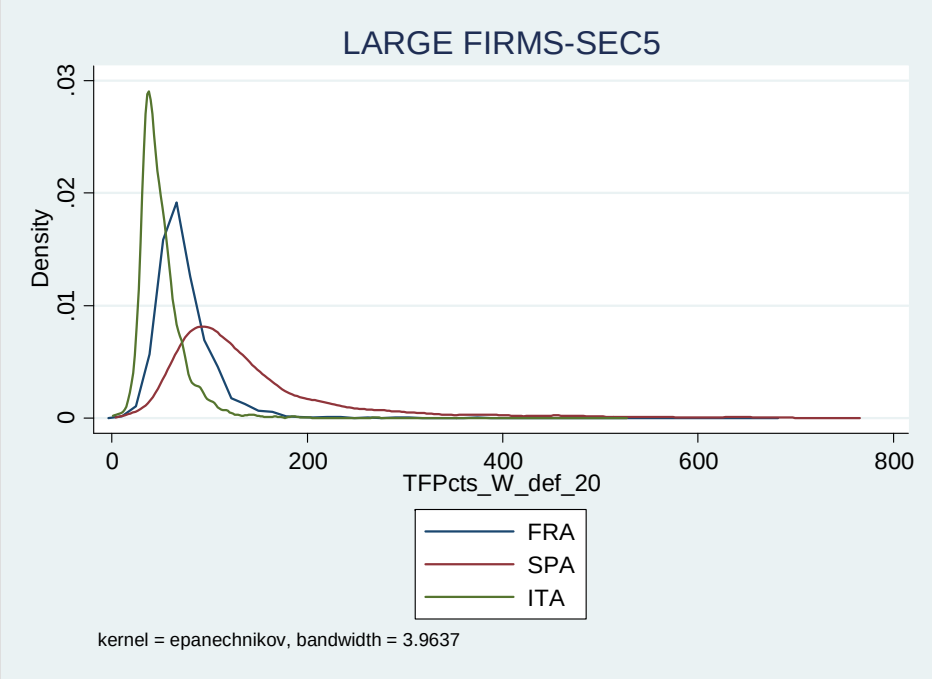


SEC4: Coke, refined petroleum products and nuclear fuel (2300-2330)+chemicals, chemical products and man-made fibres (2400-2470)+rubber and plastic products (2500-2524)

TFP Kernel density functions by size

Non-metallic mineral products + basic and fabricated metal products

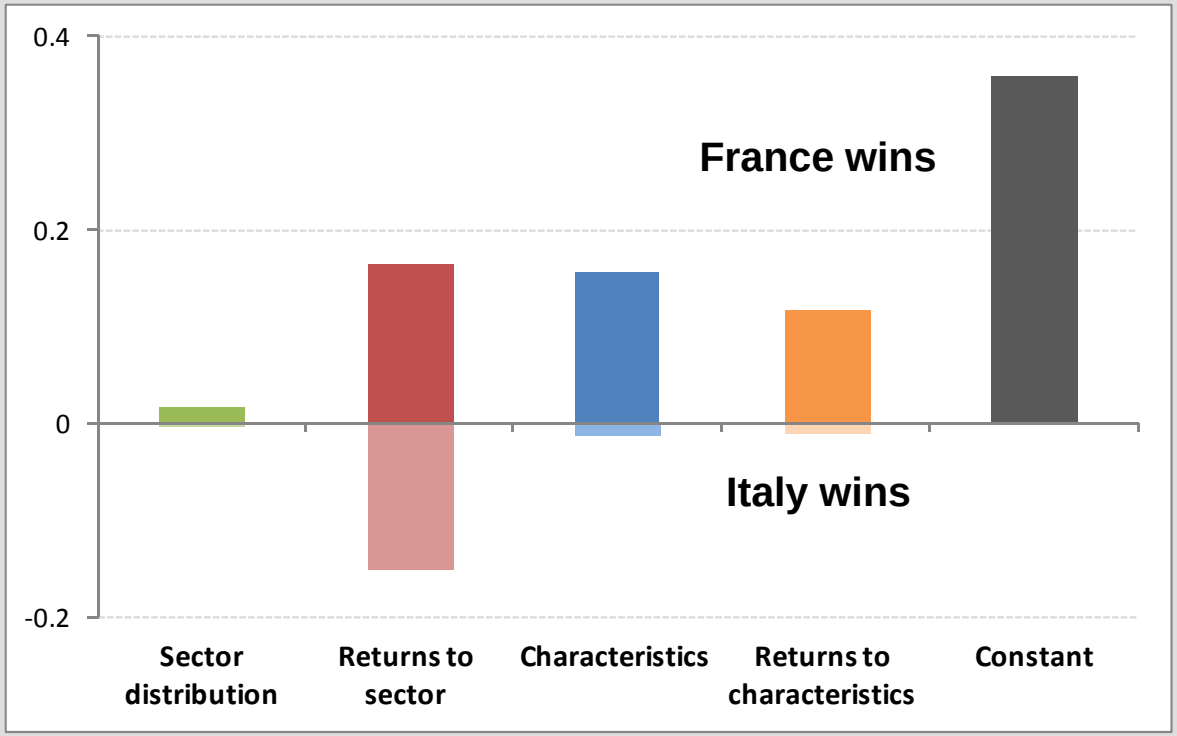


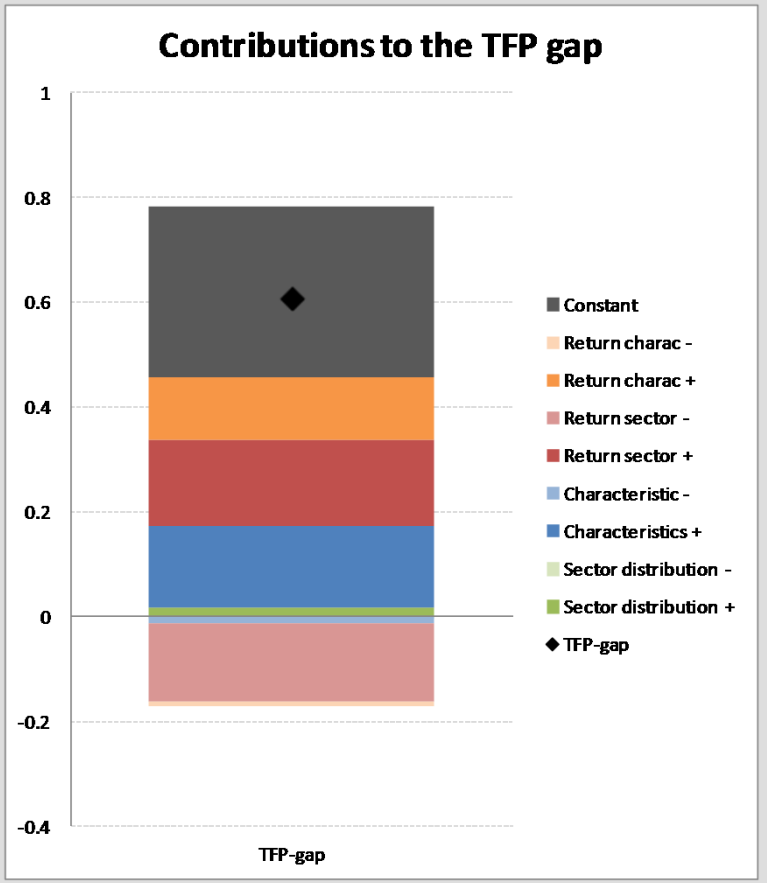


SEC5: Other non metallic mineral products (2600-2682)+basic metals and fabricated metal products (2700-2875)

Explaining the TFP gap

Oaxaca decomposition: France vs Italy
Italian small firms' TFP is 54% of French one





- **Sector dummies:** Sector distribution of Italian small firms does contribute little to the gap
- **Return to the sectors:** It does not contribute in net terms to TFP-gap
- **Observable characteristics:** They are important to explain the gap
- **Return to the characteristics:** The (low) return to the characteristics is also important
- **Constant:** Differences in TFP not explained by observables or sector play clearly in favour of France

Explaining the TFP gap

Oaxaca decomposition: France vs Italy

TFP gap: 54.4%	Endowments: 0.159	Returns: 0.125
Tenure of the firm	0.001	0.015
Group	**0.018**	0.022
Family owned	0.006	-0.005
Manager's pay linked to performance	**0.029**	0.015
Graduates in workforce	**0.005**	0.007
Process innovation	-0.002	**0.012**
Product innovation	0.000	-0.001
Export activity of the firm	**-0.009**	-0.002
Import of intermediate goods/servcies	**0.021**	**0.006**
FDI	0.001	0.032
External financing	0.001	0.002
Cash ratio	**0.056**	0.001
% workforce in training	**0.018**	0.006

- **Firm characteristics:**
  - ↑ Cash ratio
  - ↑ Performance pay
  - ↑ Imports
  - ↑ % training
  - ↑ Group
  - ↑ % graduates

  France wins

  - ↓ Exports

  Italy wins

- **Returns:**
  - ↑ Process innovation
  - ↑ Imports
  - ↑ External financing

Oaxaca decomposition: France vs Spain
Sector detail

- **The sector specific Oaxaca decomposition is very similar to the pooled one, with some exceptions:**

  - TEXTILES: TFP gap in favor of France increases additionally with
    - ***returns to exports***
    - ***tenure of the firm***
    - ***and it decreases with returns to FDI***

  - WOOD, PULP, etc: TFP gap in favor of France increases additionally with
    - ***share of firms that perform process innovation***

  - METALS, etc: TFP gap in favor of France increases additionally due to
    - ***greater share of firms who import.***

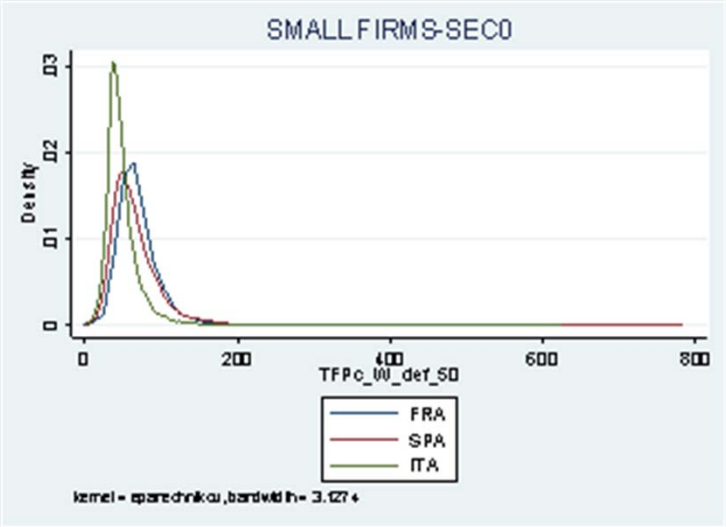
Oaxaca decomposition: Is it worthwhile?

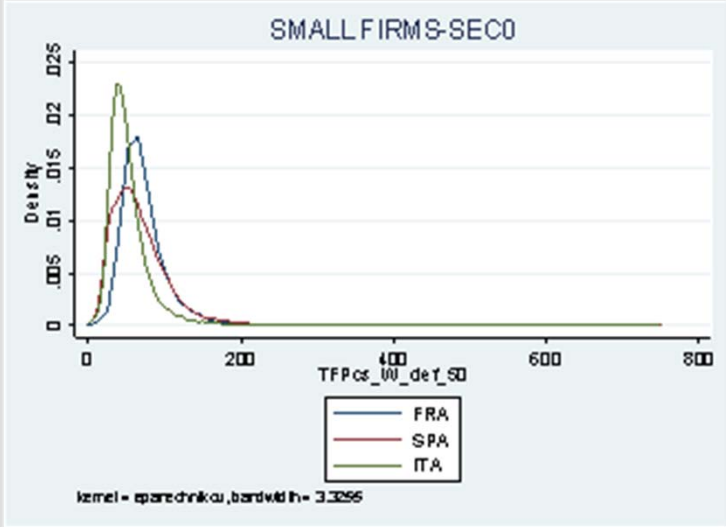
Wald test for join significance of differences between parameters across countries

	Firms with 20 or less than 20 employees	Firms with more than 20 employees
Spain vs France	22.36	32.95
France vs Italy	19.39	34.64
Spain vs Italy	29.56	98.15

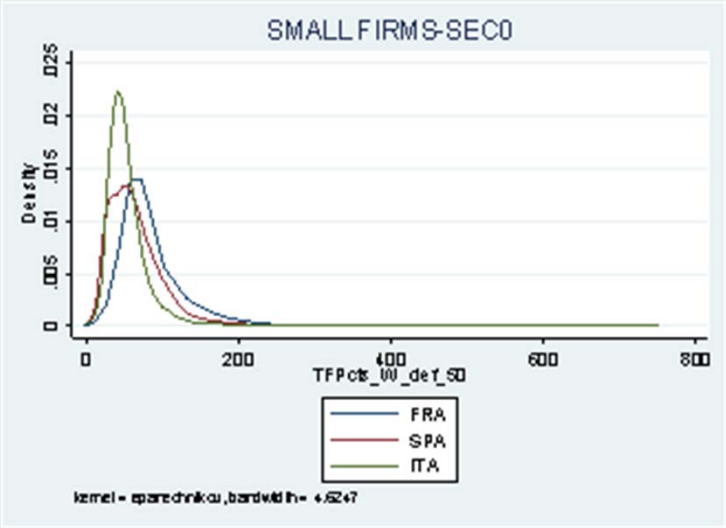
Explaining differences with previous research
TFP Kernel density functions
Total manufacturing sector

Allows for different technology across countries





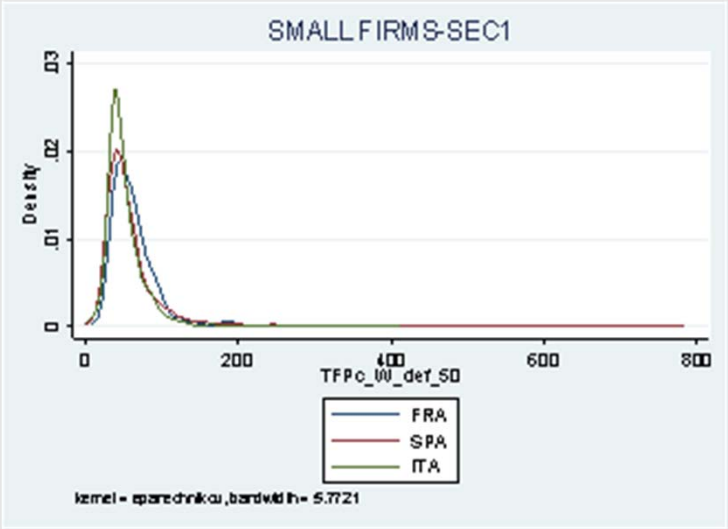
Allows for different technology across countries and sectors

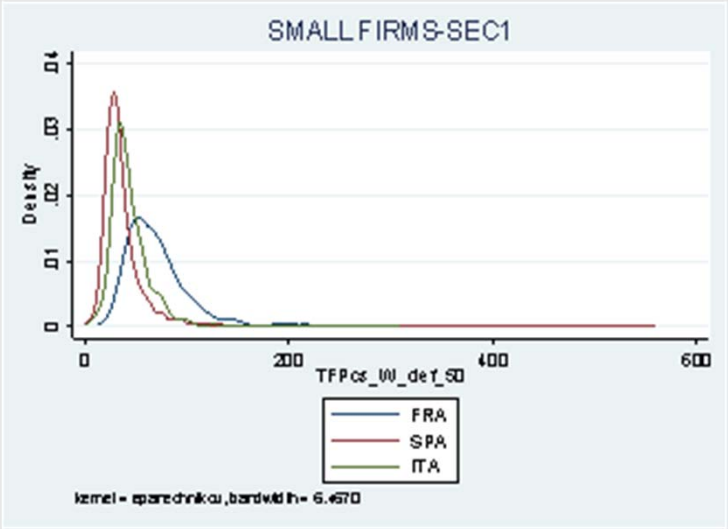


Allows for different technology across countries, sectors and size

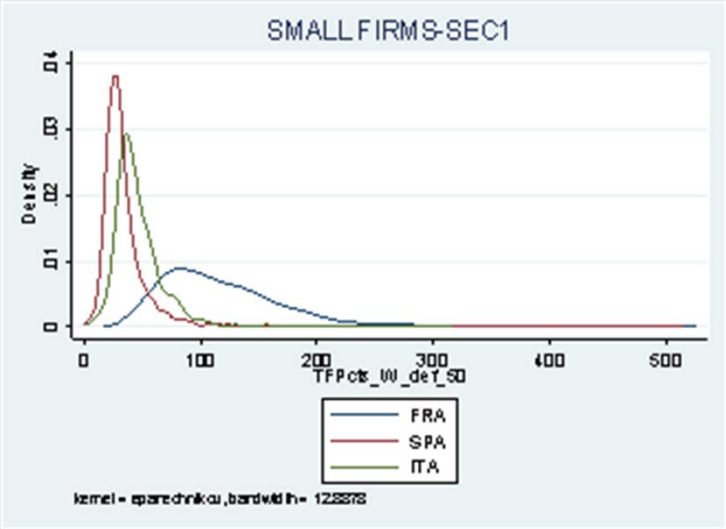
Explaining differences with previous research
TFP Kernel density functions
Food, beverages and tobacco

Allows for different technology across countries





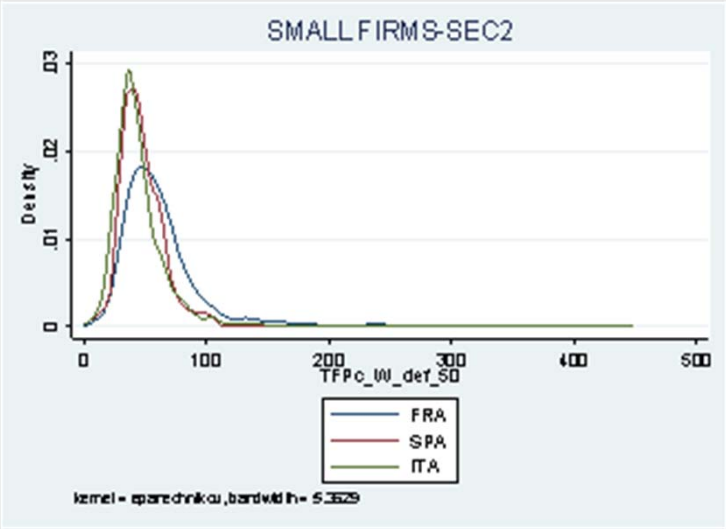
Allows for different technology across countries and sectors

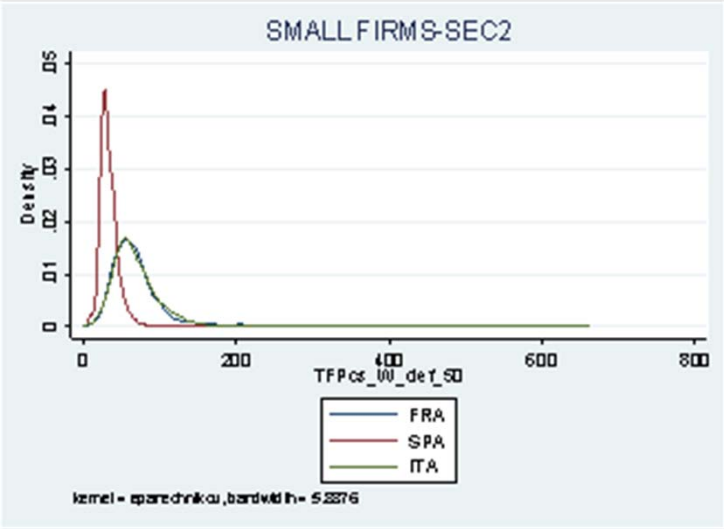


Allows for different technology across countries, sectors and size

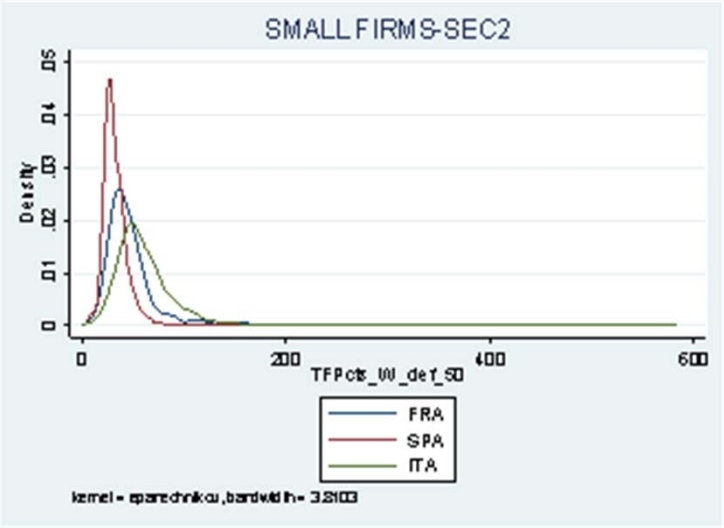
Explaining differences with previous research
TFP Kernel density functions
Textiles and leather products

Allows for different technology across countries





Allows for different technology across countries and sectors



Allows for different technology across countries, sectors and size