Growing like Spain: 1995-2007

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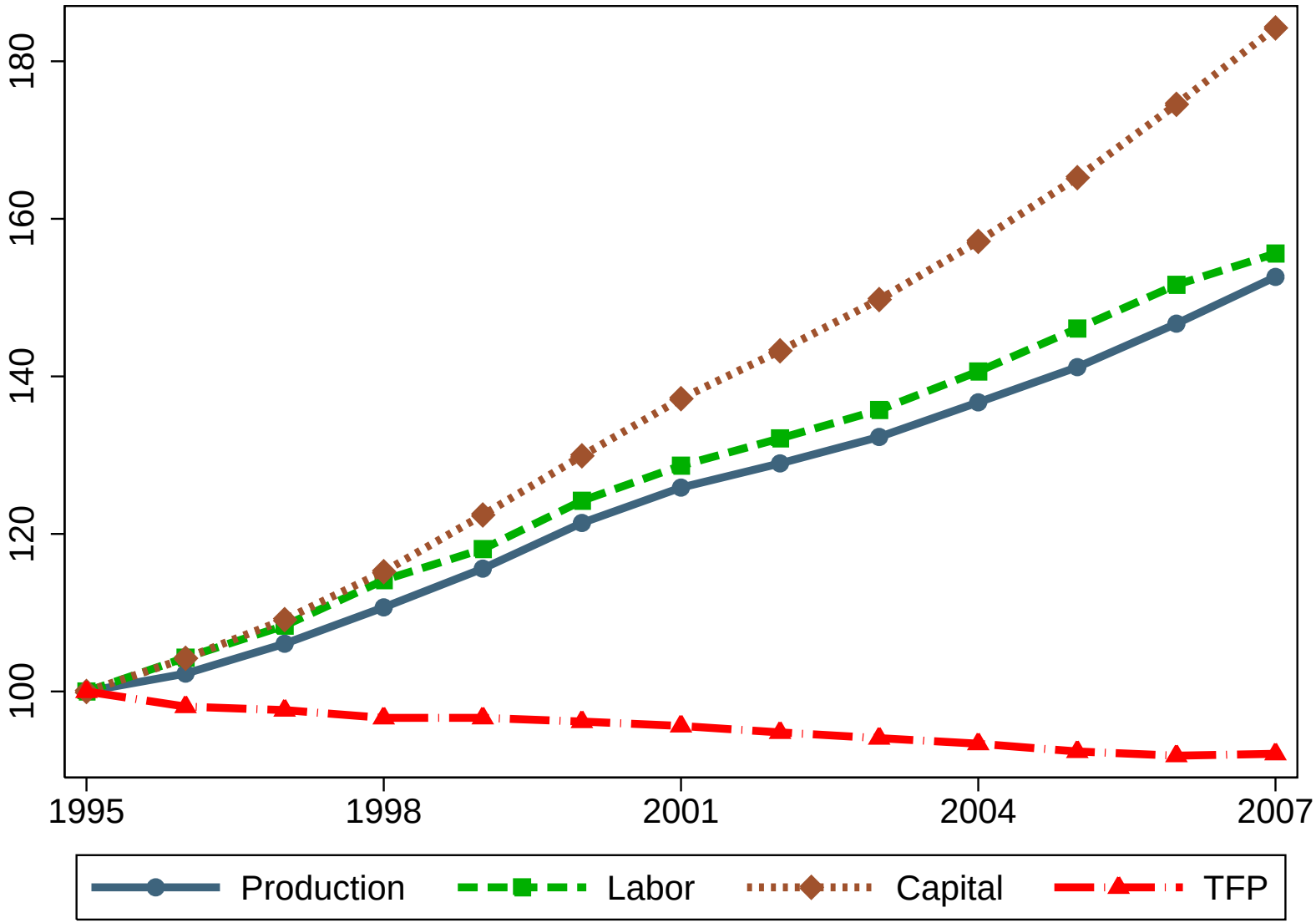
The Spanish Boom - Macro Evidence



The Spanish Boom - Micro Evidence

In a nutshell

- Spanish TFP fell at an annual rate of 0.7% over the years 1995-2007, while it increased at 0.4% in the EU and 0.7% in the US.
- Using firm-level data and the Hsieh and Klenow (2009) framework, we find that within-sector misallocation increased at an annual rate of 1.5%.
- Absent such deterioration, TFP growth would have been around 0.8% per year.
- We provide empirical evidence that differences in the influence of the public sector across industries is a potential source of this pattern.

Data

- We basically use the Spanish sample of the CompNet dataset (1995-2007).
- We use data on value added, capital stock, and wage payments.

Table: Size distribution of firms in our sample and in the census.

	Central Balance Sheet Dataset				Central Business Register			
	Firms		Labor		Firms		Labor	
Number of employees	Total (#)	Share (%)	Total (#)	Share (%)	Total (#)	Share (%)	Total (#)	Share (%)
	PANEL A: Raw Sample							
0-9	406,924	83.90	941,897	20.47	715,795	83.07	1,718,600	20.23
10-19	41,664	8.59	583,312	12.68	77,372	8.98	1,050,038	12.36
20-49	27,125	5.59	828,714	18.01	46,683	5.42	1,400,422	16.49
50-199	8,064	1.66	707,535	15.38	17,781	2.06	1,596,481	18.79
+200	1,245	0.26	1,540,260	33.47	4,082	0.47	2,728,958	32.13
All	485,022	100.00	4,601,718	100.00	861,713	100.00	8,494,499	100.00
	PANEL B: Final Sample							
1-9	249,770	76.34	907,098	20.00	531,399	78.46	1,718,600	20.23
10-19	41,272	12.62	577,844	12.74	77,372	11.42	1,050,038	12.36
20-49	26,919	8.23	822,699	18.14	46,683	6.89	1,400,422	16.49
50-199	7,984	2.44	700,565	15.44	17,781	2.63	1,596,481	18.79
+200	1,219	0.37	1,528,178	33.69	4,082	0.60	2,728,958	32.13
All	327,164	100.00	4,536,384	100.00	677,317	100.00	8,494,499	100.00

Notes: Figures refer to the year 2001. Self-employed persons are not included.

Framework: Hsieh and Klenow (2009)

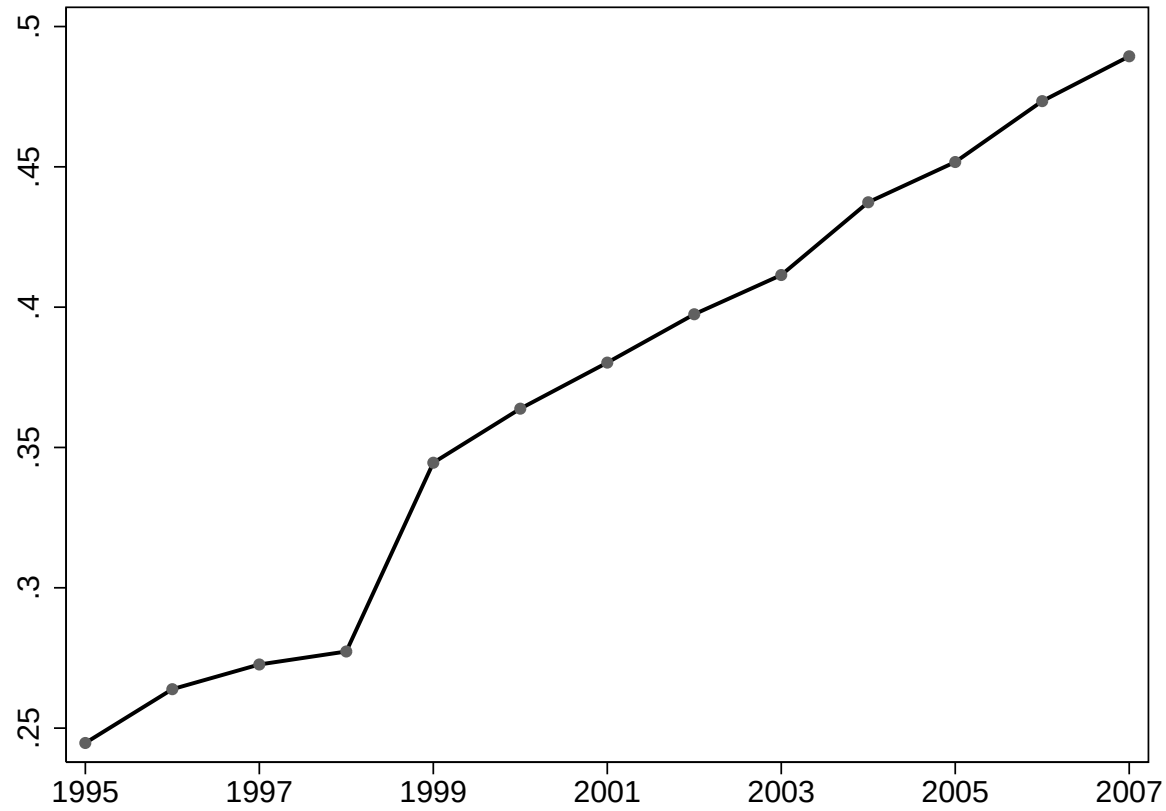
[Details]

- Our empirical exercise is based on Hsieh and Klenow (2009).
- A simple model to recover firm TFP and firm-level distortions from our data.
- Look at the dispersion of revenue TFP within 4-digit sectors.
  - In the absence distortions, firms with higher TFP operate at larger capacity and command a lower price such that their revenue TFP is the same as in low TFP firms. Thus, revenue TFP should be equal for all firms in a given 4-digit industry
- Taking 1995 as the baseline year, the larger dispersion in subsequent years points to a deterioration in allocative efficiency.
- The simple model can be used to recover the potential aggregate productivity gains of eliminating firm-level distortions ($\frac{\text{TFP}^*}{\text{TFP}} - 1$).

Misallocation during the Spanish boom

- Within-sector misallocation substantially increased during the boom.
  [Counterfactual] [Robustness] [By sector] [By type of τ] [By region] [Other]

Figure: TFP gains from reallocation



Sources of misallocation's evolution (I)

- The influence of the public sector appears to be relevant. [Robustness]

	Dep. Variable: ΔTFP Gain					
	(1) OLS	(2) OLS	(3) OLS	(4) OLS	(5) OLS	(6) WALS
High-skill intensity (US share)	0.064				-0.008	-0.008
	(0.219)				(0.271)	(0.210)
Innovative content (US IT intensity)		0.284			0.333	0.188
		(0.445)			(0.501)	(0.408)
Financial dependence (US financial intensity)			0.044		0.033	0.025
			(0.029)		(0.032)	(0.027)
Public sector influence (crony dummy)				0.226***	0.209**	0.150**
				(0.081)	(0.086)	(0.077)
Constant	0.219***	0.216***	0.148**	0.197***	0.112	0.149**
	(0.069)	(0.046)	(0.066)	(0.034)	(0.078)	(0.068)
Observations	58	58	58	58	58	58
R-squared	0.00	0.01	0.04	0.12	0.15	-

Notes: ΔTFP Gain refers to the change over the 1995-2007 period in the ratio of optimal TFP in the absence of misallocation to observed TFP. Crony sectors are defined as those sectors susceptible to monopoly or requiring licensing or highly dependent on government regulation: casinos, coal, palm oil and timber, defence, deposit-taking banking and investment banking, infrastructure and pipelines, ports, airports, real estate and construction, steel, other metals, mining and commodities, utilities and telecoms services. In our sample, we label as crony the following 2-digit sectors: 24, 35, 37, 38, 39, 41, 42, 50, 51, 61, and 68.

Sources of misallocation's evolution (II)

- Young and small firms were the most affected.

	Dep. Variable: $\Delta \ln(1+\tau_{K_{i,t}})$				Dep. Variable: $\Delta \ln(1-\tau_{Y_{i,t}})$			
	(1) OLS	(2) OLS	(3) OLS	(4) OLS	(5) OLS	(6) OLS	(7) OLS	(8) OLS
Size	-0.00007***				0.00009***			
	(0.00002)				(0.00002)			
Small dummy		0.085***				-0.113***		
		(0.004)				(0.004)		
Age			-0.0013***				0.0017***	
			(0.0001)				(0.0001)	
Young dummy				0.017***				-0.025***
				(0.003)				(0.001)
Productivity	0.072***	0.074***	0.083***	0.083***	-0.082***	-0.085***	-0.097***	-0.097***
	(0.002)	(0.002)	(0.003)	(0.003)	(0.002)	(0.002)	(0.003)	(0.003)
Size dummies	NO	NO	YES	YES	NO	NO	YES	YES
Age dummies	YES	YES	NO	NO	YES	YES	NO	NO
Industry dummies	YES	YES	YES	YES	YES	YES	YES	YES
Time dummies	YES	YES	YES	YES	YES	YES	YES	YES
R-squared	0.02	0.02	0.02	0.02	0.05	0.05	0.06	0.06
Observations	1,682,056	1,682,056	1,682,056	1,682,056	1,682,056	1,682,056	1,682,056	1,682,056

Notes: Standard errors are clustered at NACE rev. 2 4-digit level. Firms with less than 50 employees are labeled as small. Young firms are less than 10 years old (see Haltiwanger et al. 2013). Four groups are considered for the size dummies, 1-10 employees, 10-50 employees, 50-250 employees, and more than 250 employees. Age dummies are based on age groups divided by year-specific quartiles. Estimation sample covers the period 1995-2007.

Final comments

- A recent strand of the literature emphasizes the role of within-sector misallocation in explaining cross-country differences in TFP.
- We find that the evolution of within-sector misallocation may also explain the evolution of TFP growth in Spain.
- We provide empirical evidence that crony sectors and small and young firms are the most affected.
- The challenge now is to identify the sources that are at the root of these patterns.
- Two ongoing projects:
  1. García-Santana, Moral-Benito, Pijoan-Mas, Ramos
     Public Procurement and Allocative Efficiency in the Private Sector.
  2. Alfaro, García-Santana, Moral-Benito:
     Austerity and Regional Misallocation.

The Spanish Boom - Micro Evidence

Misallocation during the Spanish boom — By sector and other measures

PANEL A: Total Economy					
		HK	STD TFP	OP LPR	OP TFP
1995-2000		0.29	0.42	0.30	1.59
2001-2007		0.43	0.47	0.21	1.35
PANEL B: By sector					
		HK	STD TFP	OP LPR	OP TFP
1995-2000	Manufacturing	0.23	0.42	0.32	1.43
2001-2007		0.32	0.45	0.27	1.13
1995-2000	Construction	0.36	0.38	0.15	1.61
2001-2007		0.62	0.42	0.10	1.28
1995-2000	Trade	0.38	0.43	0.31	1.73
2001-2007		0.48	0.48	0.25	1.39
1995-2000	Services	0.40	0.44	0.37	1.72
2001-2007		0.54	0.50	0.19	1.58

Notes: HK refers to the potential TFP gains if resources were allocated efficiently as proposed by Hsieh and Klenow (2009). OP refers to the Olley and Pakes (1996) covariance term. STD refers to standard deviation as a measure of dispersion. LPR refers to log labor productivity and TFP to log total factor productivity.

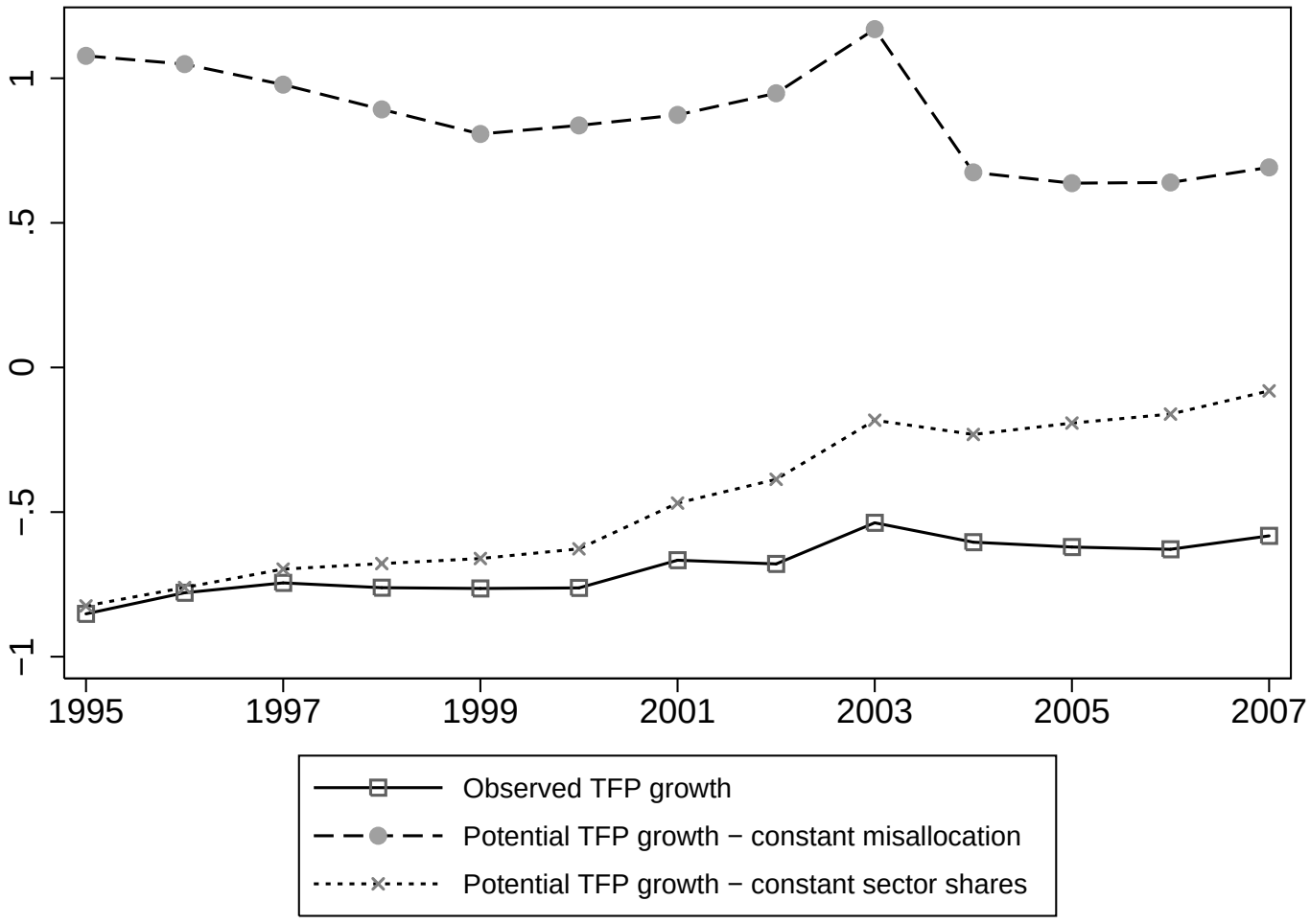
Misallocation during the Spanish boom — Robustness

	TFP gain from reallocation				
	Baseline (1)	3-digit (2)	2-digit (3)	Balanced (4)	$\sigma = 5$ (5)
1995	0.24	0.27	0.33	0.20	0.23
1996	0.26	0.28	0.37	0.20	0.25
1997	0.27	0.31	0.38	0.22	0.28
1998	0.28	0.32	0.41	0.20	0.29
1999	0.34	0.39	0.45	0.23	0.35
2000	0.36	0.39	0.46	0.23	0.34
2001	0.38	0.40	0.46	0.23	0.37
2002	0.40	0.42	0.48	0.23	0.36
2003	0.41	0.44	0.51	0.24	0.37
2004	0.44	0.46	0.54	0.25	0.42
2005	0.45	0.48	0.58	0.27	0.43
2006	0.47	0.51	0.62	0.29	0.48
2007	0.49	0.52	0.62	0.28	0.47

Notes: Baseline in column (1) refers to our benchmark results based on misallocation within 4-digit industries, σ=3, and the unbalanced panel. Columns (2) and (3) report the results when considering indutries at 3- and 2-digit classifications (NACE 2 rev. 2). Column (4) is based on the balanced version of our panel. Finally, column (5) reports the TFP gains when considering σ=5 instead of σ=3.

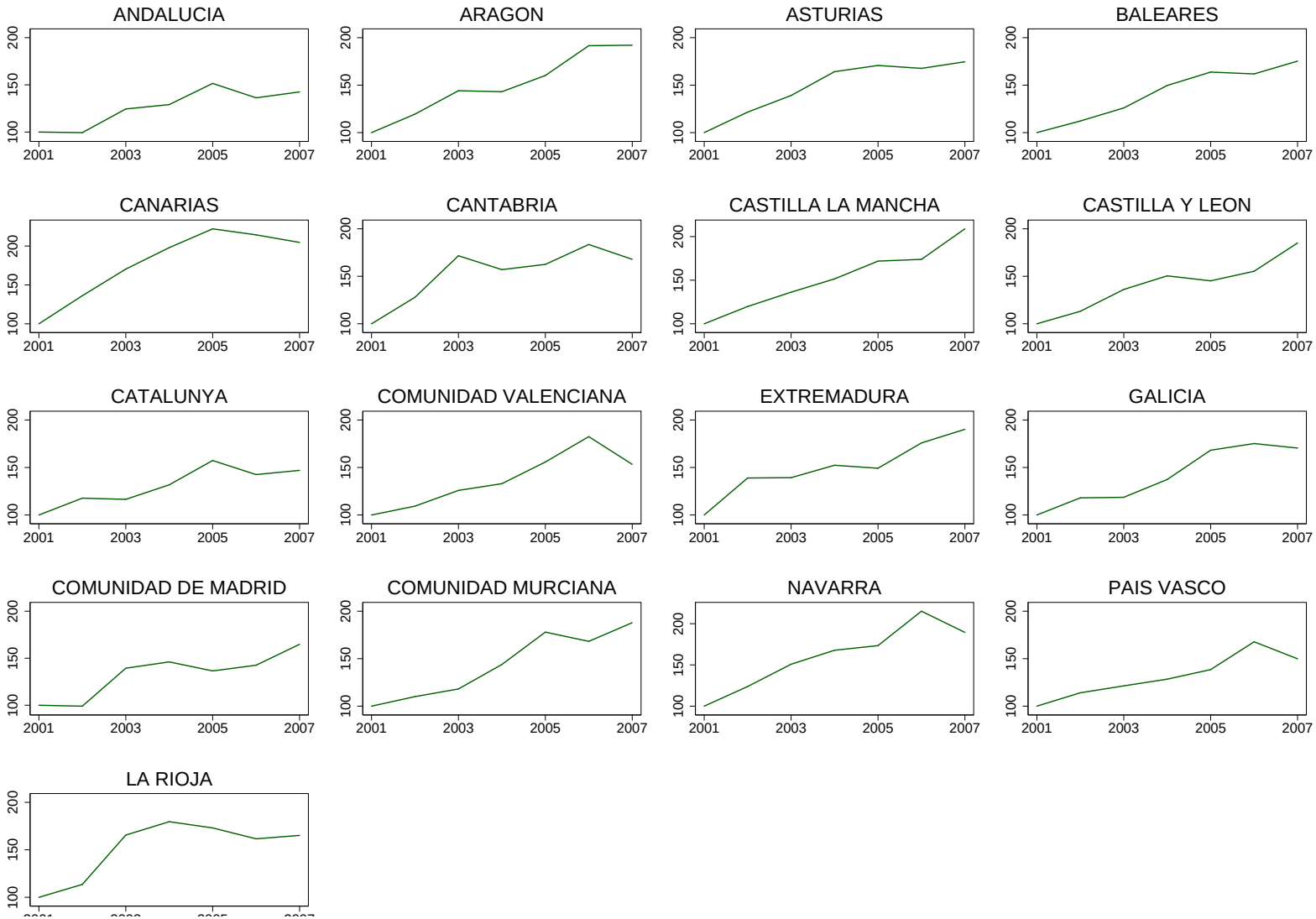
Misallocation during the Spanish boom — Counterfactual

- In the absence of the misallocation increase, TFP growth would have been around 0.8% per year.



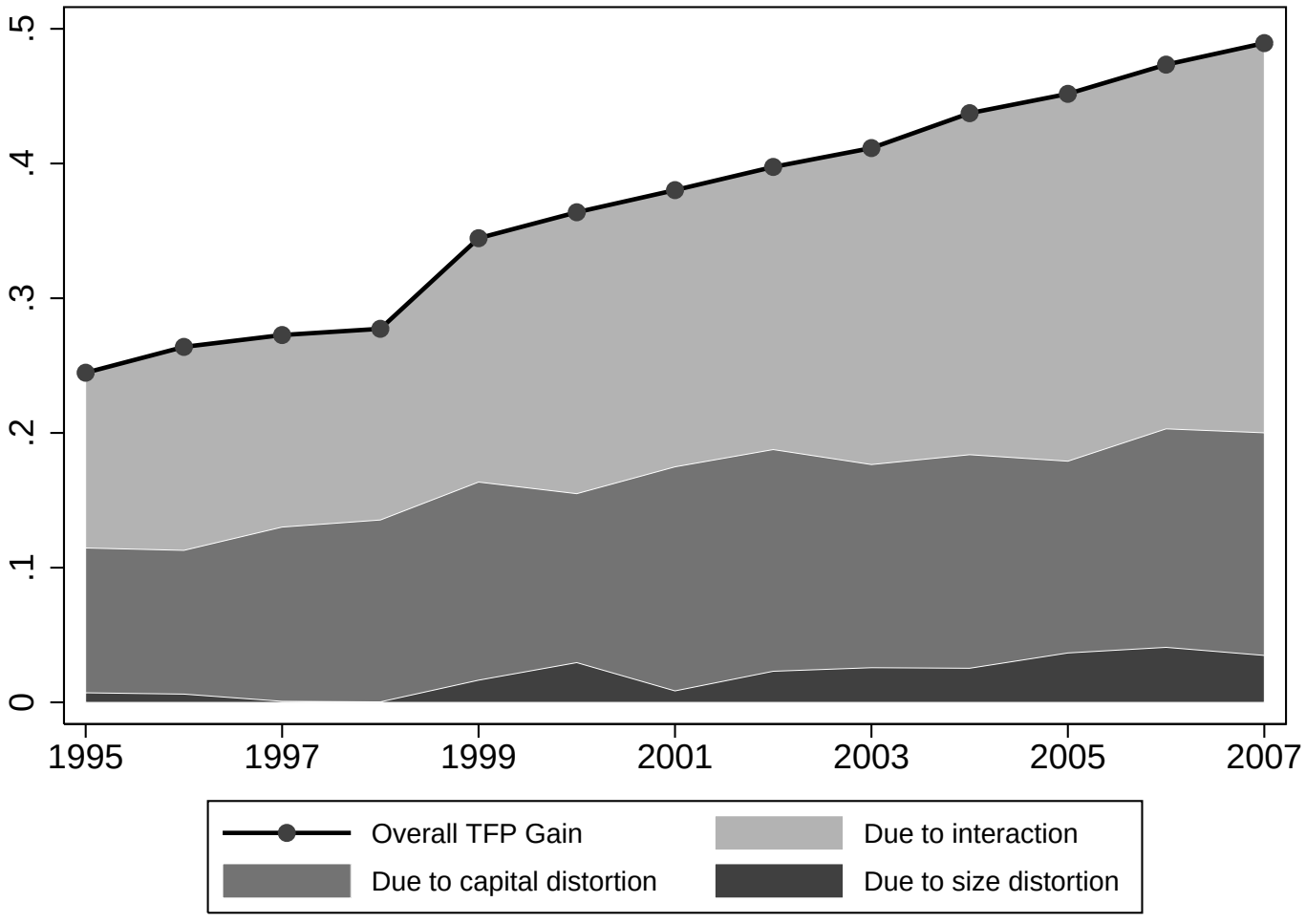
Misallocation during the Spanish boom — By region

- Misallocation increases are caused by nationwide forces.



Misallocation during the Spanish boom — By type of τ

- Distortions to the capital-labor ratio seem to be the most important.



Sources of misallocation's evolution (I) — Robustness

	Dep. Variable: ΔTFP Gain					
	(1) OLS	(2) OLS	(3) OLS	(4) OLS	(5) OLS	(6) WALS
High-skill intensity (Spain share)	0.163				0.149	0.083
	(0.155)				(0.157)	(0.131)
Innovative content (Spain R&D share)		-0.303			-0.475*	-0.339
		(0.249)			(0.249)	(0.215)
Financial dependence (Spain debt burden)			0.021		-0.025	-0.022
			(0.097)		(0.092)	(0.086)
Public sector influence (BPI index)				-0.264***	-0.266***	-0.194**
				(0.086)	(0.090)	(0.084)
Constant	0.187***	0.257***	0.228***	2.015***	2.033***	1.553***
	(0.053)	(0.040)	(0.051)	(0.058)	(0.623)	(0.585)
Observations	58	58	58	58	58	58
R-squared	0.02	0.03	0.00	0.14	0.21	-

Notes: ΔTFP Gain refers to the change over the 1995-2007 period in the ratio of optimal TFP in the absence of misallocation to observed TFP..

HK09: Production functions

[Comments]

- Canonical model of monopolistic competition with heterogeneous firms
- Final output Y is the aggregation of the output Y_s in several industries:

$$Y = \prod_{s=1}^{S} Y_s^{\theta_s} \qquad \text{with} \quad \theta_s > 0 \quad \text{and} \quad \sum_{s=1}^{S} \theta_s = 1$$

- Industry output is the aggregation of M_s differentiated products:

$$Y_s = \left(\sum_{i=1}^{M_s} Y_{si}^{\frac{\sigma-1}{\sigma}} \right)^{\frac{\sigma}{\sigma-1}} \qquad \text{with} \quad \sigma > 1$$

(where σ is the elasticity of substitution)

- Output of each differentiated product is given by,

$$Y_{si} = A_{si} K_{si}^{\alpha_s} L_{si}^{1-\alpha_s}$$

HK09: Firm i optimization problem

[Relative factor use] [Total production] [Common parameters] [Firm-level demands]

- Firm i in sector s:
  - hires capital and labor in competitive markets (takes r and w as given)
  - sells output through monopolistic competition (affects own price P_{si})
- Optimization problem:

$$\max_{L_{si},K_{si}} \left\{ (1-\tau_{Ysi})\, P_{si} Y_{si} - w\, L_{si} - (1+\tau_{Ksi})\, r\, K_{si} \right\}$$
$$\text{subject to} \quad Y_{si} = A_{si} K_{si}^{\alpha_s} L_{si}^{1-\alpha_s}$$
$$P_{si} = \bar{Y}_s Y_{si}^{-1/\sigma}$$

- This yields FOC

$$P_{si} \left(\frac{\sigma-1}{\sigma}\right) \alpha_s A_{si} \left(\frac{K_{si}}{L_{si}}\right)^{\alpha_s - 1} = r \frac{(1+\tau_{Ksi})}{(1-\tau_{Ysi})}$$
$$P_{si} \left(\frac{\sigma-1}{\sigma}\right) (1-\alpha_s) A_{si} \left(\frac{K_{si}}{L_{si}}\right)^{\alpha_s} = \frac{w}{(1-\tau_{Ysi})}$$

- Firm size is determined through the fall of P_{si} with Y_{si}

HK09: TFP Revenue at the firm level

[Measuring τ_{Ksi}] [Measuring τ_{Ysi}] [Measuring A_{si}]

- A_{si} is the firm physical *Total Factor Productivity* (TFP$_{si}$)
- We can define *Total Factor Productivity Revenue* of firm i (TFPR$_{si}$):

$$\text{TFPR}_{si} \equiv P_{si} A_{si}$$

- Because firm si price is given by,

$$P_{si} = \frac{\sigma}{\sigma - 1} \frac{c_s(w, r)}{A_{si}} \frac{(1 + \tau_{Ksi})^{\alpha_s}}{(1 - \tau_{Ysi})}$$

- Then TFPR$_{si}$ must be

$$\text{TFPR}_{si} = \frac{\sigma}{\sigma - 1} c_s(w, r) \frac{(1 + \tau_{Ksi})^{\alpha_s}}{(1 - \tau_{Ysi})}$$

  - In the absence of idiosyncratic distortions the TFPR$_{si}$ would be equalized across all firms operating in the same industry
  - High TFP$_{si}$ firms will operate at larger capacity and command a lower price P_{si} such that TFPR$_{si}$ is the same as in low TFP$_{si}$ firms
  - With distortions, there will be heterogeneity in TFPR$_{si}$, which will be higher for firms with higher values of their distortions τ_{Ysi} and τ_{Ksi}

HK09: Aggregation

- The expression for sectoral TFP_s is as follows,

$$\text{TFP}_s = \left[\sum_{i=1}^{M_s} \left(A_{si} \frac{\overline{\text{TFPR}}_s}{\text{TFPR}_{si}} \right)^{\sigma-1} \right]^{\frac{1}{\sigma-1}}$$

  with $\overline{\text{TFPR}}_s$ being the weighted average of the TFP revenue of firms in sector s.

- Without distortions TFPR_{si} is equalised across firms:

$$\text{TFP}_s^* = \left[\sum_{i=1}^{M_s} (A_{si})^{\sigma-1} \right]^{\frac{1}{\sigma-1}}$$

- Aggregating across sectors we obtain measures of aggregate TFPs:

$$\text{TFP} = \prod_{s=1}^{S} \text{TFP}_s^{\theta} \qquad \text{TFP}^* = \prod_{s=1}^{S} \text{TFP}_s^{*\theta}$$

- Then, $\text{TFP Gain} = \frac{\text{TFP}^*}{\text{TFP}} - 1$ gives the potential aggregate TFP gains of removing all distortions

Comments

- Note that the elasticity of substitution:
  - Between industries is one (Cobb-Douglas)
  - Between varieties within an industry is $\sigma > 1$
  - Between capital and labor within a variety is one (Cobb-Douglas)
- Capital and labor shares α_s vary across industries
- This production structure allows to introduce two types of reduced-form firm-level distortions
  - Output distortion (τ_Y): it distorts the marginal product of both production factors in the same proportion

    (Think of firms with output subsidies or with high transportation costs)
  - Capital distortion (τ_K): it distorts the marginal product of capital relative to labor

    (Think of firms with privileged access to credit, or with specific labor market regulations)

Obtaining firm-level demands

- In each sector s there is a representative competitive firm that produces sectoral output Y_s by aggregating output from each variety:

$$\max_{Y_{si}} \left\{ P_s \left(\sum_{i=1}^{M_s} Y_{si}^{\frac{\sigma-1}{\sigma}} \right)^{\frac{\sigma}{\sigma-1}} - \sum_{i=1}^{M_s} P_{si} Y_{si} \right\}$$

- This gives the standard FOC for each good Y_{si},

$$P_s \left(\sum_{i=1}^{M_s} Y_{si}^{\frac{\sigma-1}{\sigma}} \right)^{\frac{\sigma}{\sigma-1}-1} Y_{si}^{\frac{\sigma-1}{\sigma}-1} = P_{si}$$

- Dividing two such equations,

$$\frac{P_{si}}{P_{sj}} = \left(\frac{Y_{sj}}{Y_{si}} \right)^{1/\sigma} \quad \Rightarrow \quad \frac{P_{si} Y_{si}}{P_{sj} Y_{sj}} = \left(\frac{P_{si}}{P_{sj}} \right)^{1-\sigma}$$

we obtain the standard condition stating that the ratio of expenditure shares depends on the relative price between the goods and the elasticity of substitution

Obtaining firm-level demands

- Since the firm has CRS it must be the case that,

$$\sum_{i=1}^{M_s} P_{si} Y_{si} = P_s Y_s$$

- And substituting the previous equation for every P_{si}:

$$\frac{P_{sj} Y_{sj}}{P_s Y_s} = \left(\frac{P_{sj}}{P_s} \right)^{1-\sigma} \quad \Rightarrow \quad P_{sj} Y_{sj} = \theta_s Y \left(\frac{P_{sj}}{P_s} \right)^{1-\sigma}$$

  which states that the expenditure for variety sj depends on the demand for sector s ($\theta_s Y$), the relative price of variety sj ($\frac{P_{sj}}{P_s}$), and the elasticity of substitution (σ)

▷ Now, we can derive a demand curve for the firm producing variety sj:

$$P_{sj} = \left(\frac{\theta_s Y}{Y_{sj}} \right)^{1/\sigma} P_s^{\frac{\sigma-1}{\sigma}} \quad \Rightarrow \quad P_{sj} = \bar{Y}_s Y_{sj}^{-1/\sigma}$$

where we have defined $\bar{Y}_s \equiv (\theta_s Y)^{1/\sigma} P_s^{\frac{\sigma-1}{\sigma}}$ to save on notation

Relative factor use

- Dividing both FOC conditions we obtain:

$$\frac{K_{si}}{L_{si}} = \frac{\alpha_s}{1-\alpha_s}\frac{w}{r}\frac{1}{(1+\tau_{Ksi})}$$

- Hence, within-firm relative factor use only depends on
  - The economy-wide ratio of factor prices, w/r
  - The sectoral capital share, α_s
  - The firm-level capital distortion, τ_{Ksi}

- Instead,
  - firm productivity, A_{si}
  - the output distortion, τ_{Ysi}
  - the elasticity of demand, σ

  do not affect the ratio of factors

  (because they affect their demand symmetrically)

Total production

- Solving for each factor demand separately, we obtain

$$
\begin{aligned}
L_{si} &= \left(\frac{A_{si}}{c_s(w,r)}\right)^{\sigma-1} \frac{1-\alpha_s}{w} \left(\frac{\sigma-1}{\sigma}\right)^{\sigma} \bar{Y}_s \frac{(1-\tau_{Ysi})^{\sigma}}{(1+\tau_{Ksi})^{\alpha_s(\sigma-1)}} \\
K_{si} &= \left(\frac{A_{si}}{c_s(w,r)}\right)^{\sigma-1} \frac{\alpha_s}{r} \left(\frac{\sigma-1}{\sigma}\right)^{\sigma} \bar{Y}_s \frac{(1-\tau_{Ysi})^{\sigma}}{(1+\tau_{Ksi})^{1-\alpha_s(\sigma-1)}} \\
Y_{si} &= \left(\frac{A_{si}}{c_s(w,r)}\right)^{\sigma} \left(\frac{\sigma-1}{\sigma}\right)^{\sigma} \bar{Y}_s \frac{(1-\tau_{Ysi})^{\sigma}}{(1+\tau_{Ksi})^{\alpha_s\sigma}}
\end{aligned}
$$

where $c_s(w,r) \equiv \left(\frac{w}{1-\alpha_s}\right)^{1-\alpha_s} \left(\frac{r}{\alpha_s}\right)^{\alpha_s}$

- Therefore, the allocation of resources to each firm depends
  - Positively on their productivity, A_{si}
  - Negatively on the size of the output distortion, τ_{Ysi}
  - Negatively on the size of the capital distortion, τ_{Ksi}

Measuring the capital distortion

- Using the ratio of FOC

$$\frac{K_{si}}{L_{si}} = \frac{\alpha_s}{1-\alpha_s}\frac{w}{r}\frac{1}{(1+\tau_{Ksi})}$$

- we can obtain the capital distortion as

$$1+\tau_{Ksi} = \frac{\alpha_s}{1-\alpha_s}\frac{wL_{si}}{rK_{si}}$$

  - The only reason for (within-industry) heterogeneity in the ratio between the labor bill and the capital costs is the presence of distortion τ_{Ksi}
  - Firms with a large labor bill relative to its capital costs are inferred to face a large capital distortion τ_{Ksi}

Measuring the output distortion

- Using the FOC for labor

$$(1-\tau_{Ysi})\,P_{si}\left(\frac{\sigma-1}{\sigma}\right)(1-\alpha_s)\left(\frac{Y_{si}}{L_{si}}\right)=w$$

- We can obtain the output distortion:

$$1-\tau_{Ysi}=\frac{\sigma}{\sigma-1}\frac{1}{(1-\alpha_s)}\frac{wL_{si}}{P_{si}Y_{si}}$$

  - The only reason for (within-industry) heterogeneity in the labor share is the distortion τ_{Ysi}
  - Firms with smaller labor share are inferred to face larger output distortions τ_{Ysi}

- The logic: when the distortion τ_{Ysi} is large, firms need to keep the marginal product of labor large and this is obtained by hiring less labor.

Measuring firm TFP

We also need to measure A_{si}

- Ideally, we would like to use the production function,

$$Y_{si} = A_{si} K_{si}^{\alpha_s} L_{si}^{1-\alpha_s}$$

  but we cannot observe Y_{si} in the data, what we have is $P_{si}Y_{si}$

- We can recover Y_{si} from $P_{si}Y_{si}$ by use of the demand structure of the model:

$$P_{si} = \bar{Y}_s Y_{si}^{-1/\sigma} \quad \Rightarrow \quad P_{si}Y_{si} = \bar{Y}_s Y_{si}^{1-1/\sigma}$$

- This leads to firm TFP being:

$$A_{si} = \left[\bar{Y}_s^{1-1/\sigma}\right] \frac{(P_{si}Y_{si})^{\frac{\sigma}{\sigma-1}}}{K_{si}^{\alpha_s} L_{si}^{1-\alpha_s}}$$

  where the term in square brackets is an irrelevant sectoral-level constant.

Calibration of common parameters

Following Hsieh and Klenow (2009) we set

- Interest rate r to 10% (5% interest rate and 5% depreciation rate)
- The elasticity of substitution σ is set to 3. The gains from liberalisation increase in σ, and this is a conservative value given that industries are defined at the 4 digit level.
- The α_s are set to 1 minus the labor share in industry s in the US.
- Obtain the θ_s from sectoral value added in Spain