Joint IOBE– Bank of Greece Seminar
Solving the Productivity Conundrum
Athens, 25 April 2016

THE FUTURE OF PRODUCTIVITY: WHAT CAN POLICY DO?

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OECD
BETTER POLICIES FOR BETTER LIVES

The OECD report

Available at:

http://www.oecd.org/economy/the-future-of-productivity.htm

Book + 5 page policy note + technical papers + videos and ppt

Authors:

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Dan Andrews

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The four OECD papers I will mainly summarise here (and later developments)

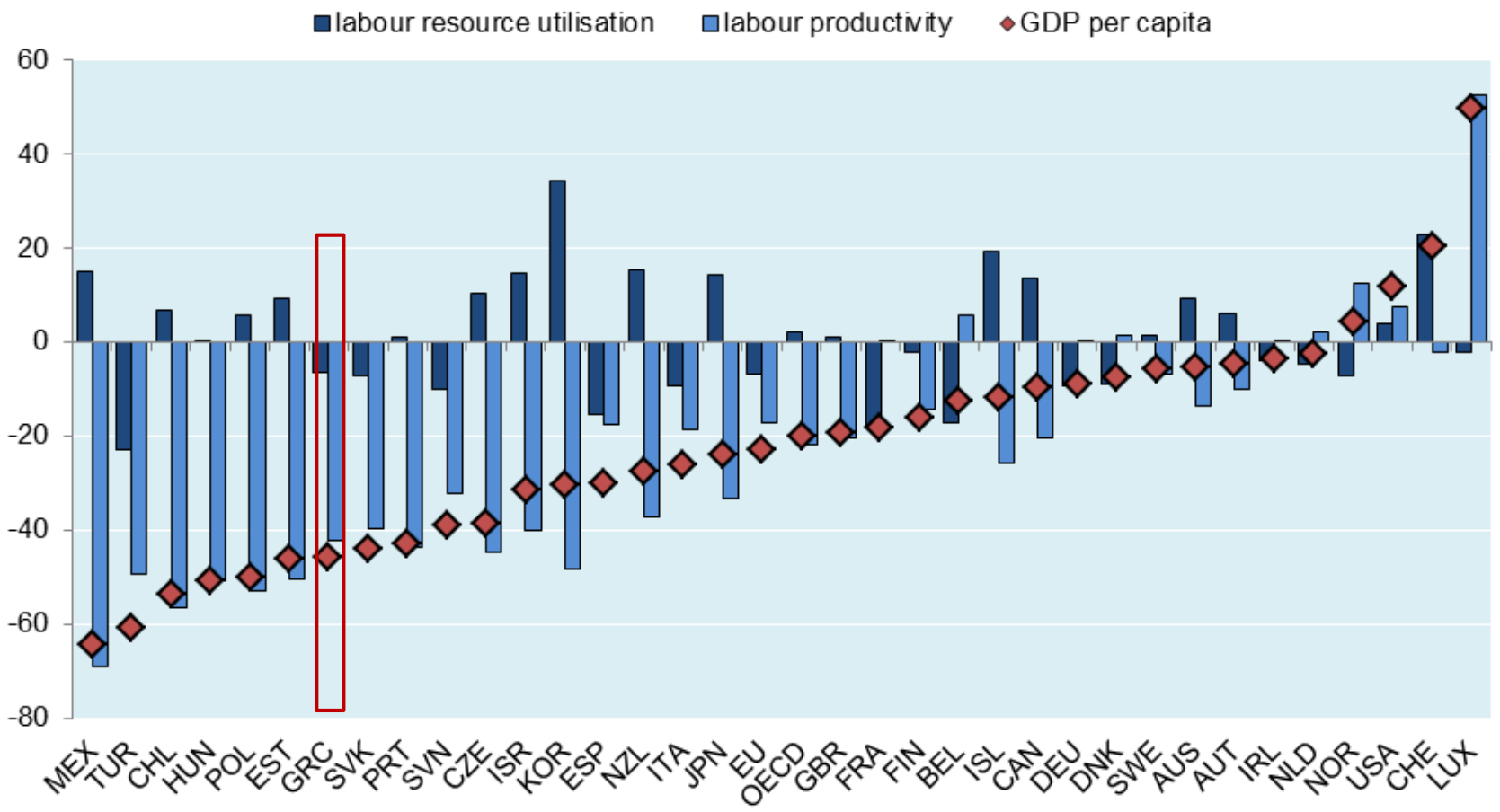
1. "Productivity spillovers from the global frontier and public policy: Industry-level evidence", by Saia, A., D. Andrews and S. Albrizio (2015)
2. Frontier firms, technology diffusion and public policy: Micro evidence from OECD countries, by Dan Andrews, Chiara Criscuolo and Peter N. Gal (2015)
3. "Labour market mismatch and labour productivity: Evidence from PIAAC Data", by Adalet McGowan, M. and D. Andrews (2015)
4. "Skill mismatch and public policy in OECD countries", by Adalet McGowan, M. and D. Andrews (2015)

Roadmap

- **Why bother about productivity?**
  - Slowdown seems structural and is driven by MFP
- **Where is the problem?**
  - The debate and our approach
  - Broken diffusion machine
  - Resource misallocation
- **What is role of structural reform?**
- **Conjectures and work ahead**
- **Take aways**

Differences in GDP per capita mostly reflect labour productivity gaps

Percentage differences compared with the upper half of OECD countries, 2013

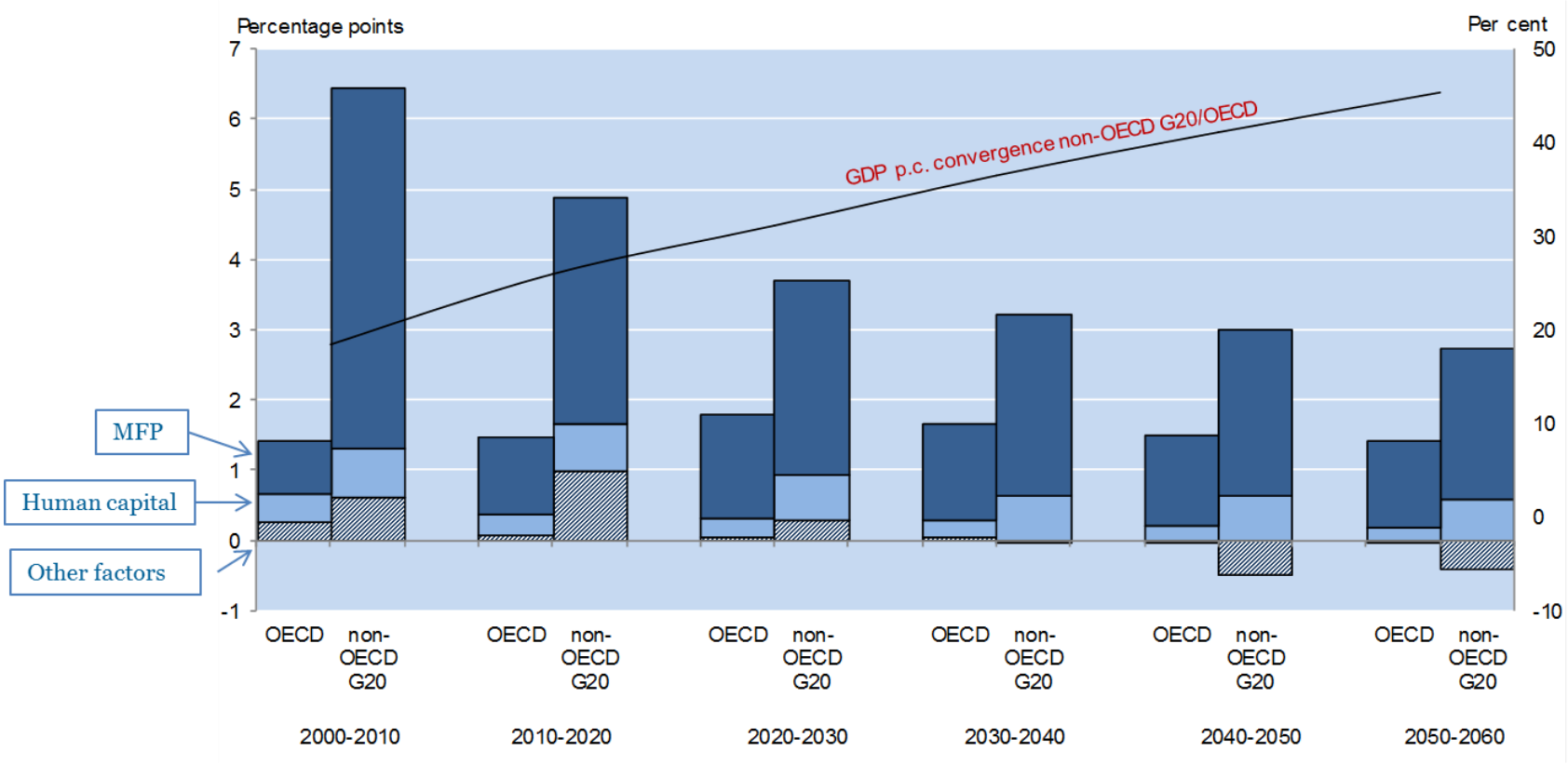


Source: OECD Going for Growth Database.

Productivity is likely to be the key driver of future growth

GDP per capita, 2000-2060

Contribution to growth and convergence in GDP per capita, 42 countries, 2000-2060

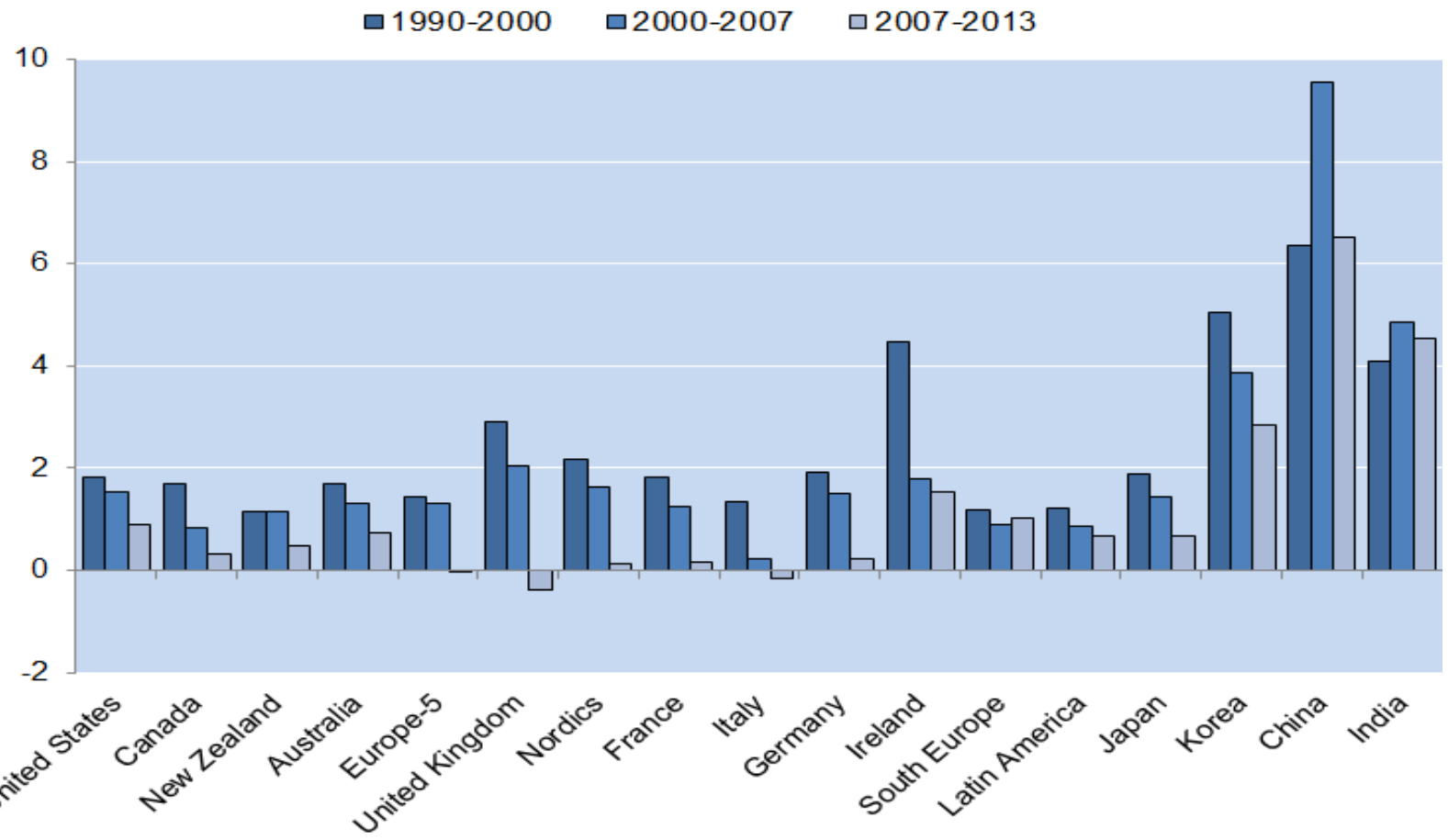


Source: Policy Challenges for the Next 50 Years, H. Braconier, G. Nicoletti and B. Westmore (2013) .

But aggregate labour productivity growth slowed, even before the crisis…

Labour productivity growth since 1990

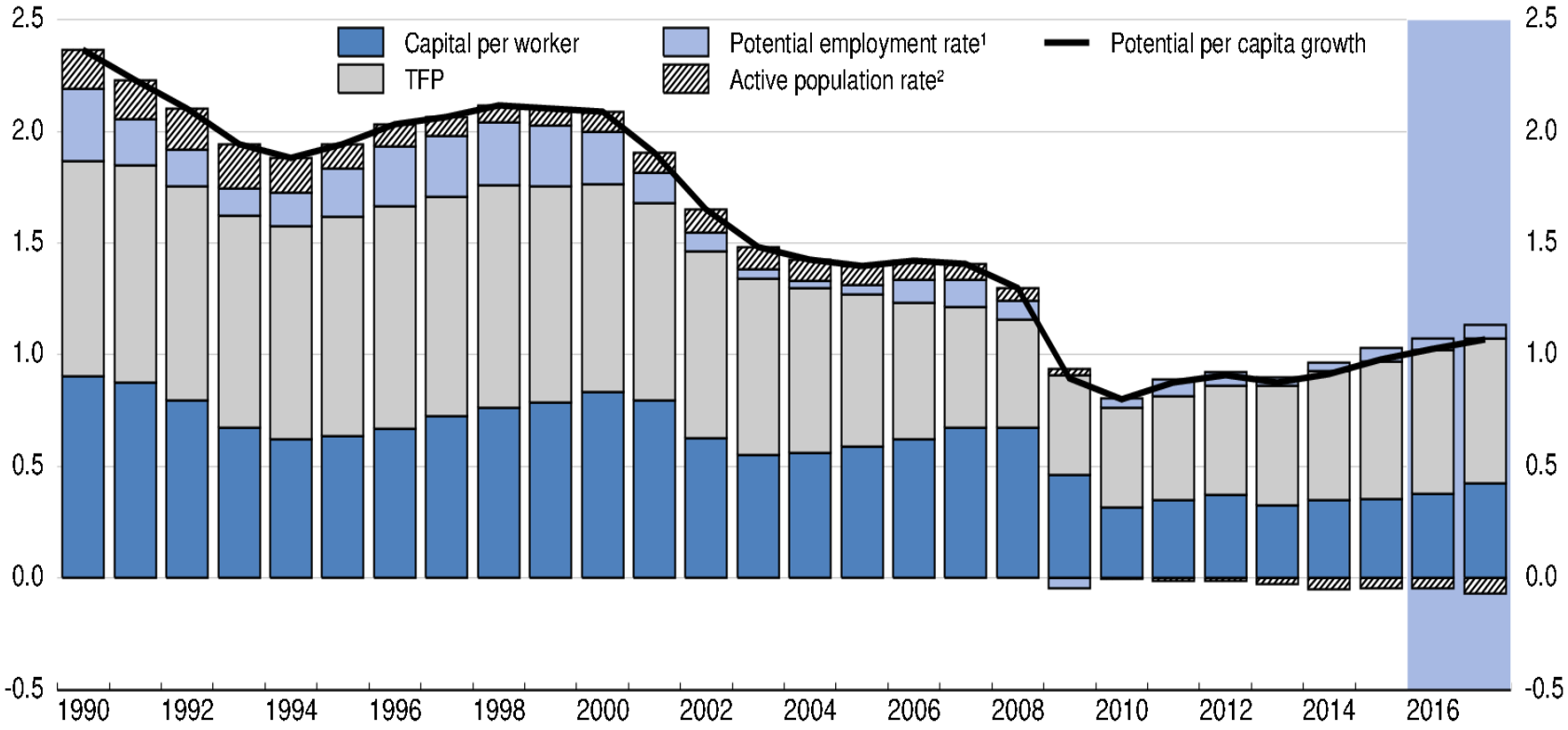
GDP per hour worked (China and India refer to GDP per worker)



OECD calculations based on The Conference Board (2015)

…driving the decline in potential output…

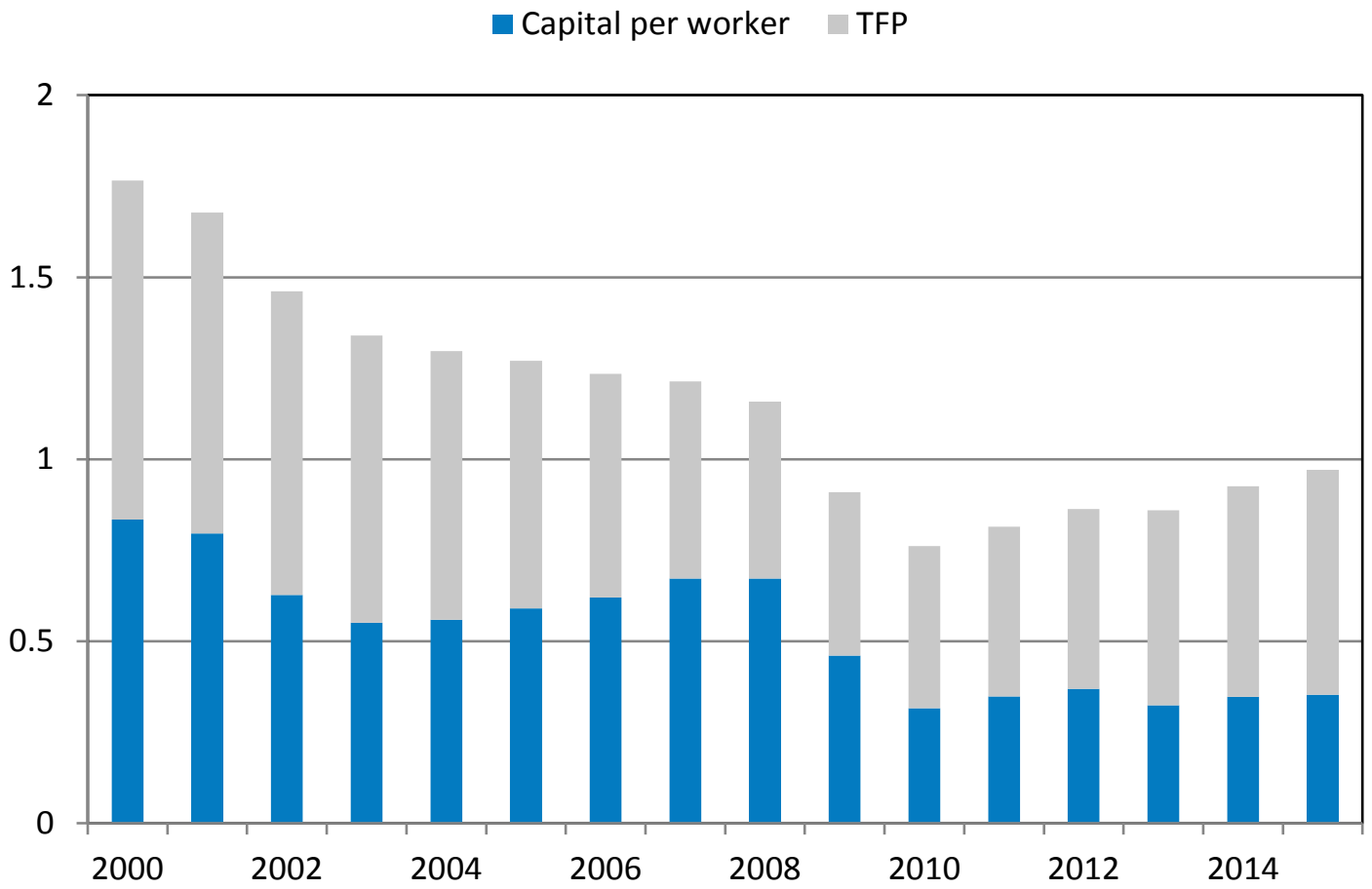
Contributions to potential per capita growth (OECD average)



Source: OECD Economic Outlook n. 98.

… with MFP declining pre-crisis and capital deepening weakening post-crisis…

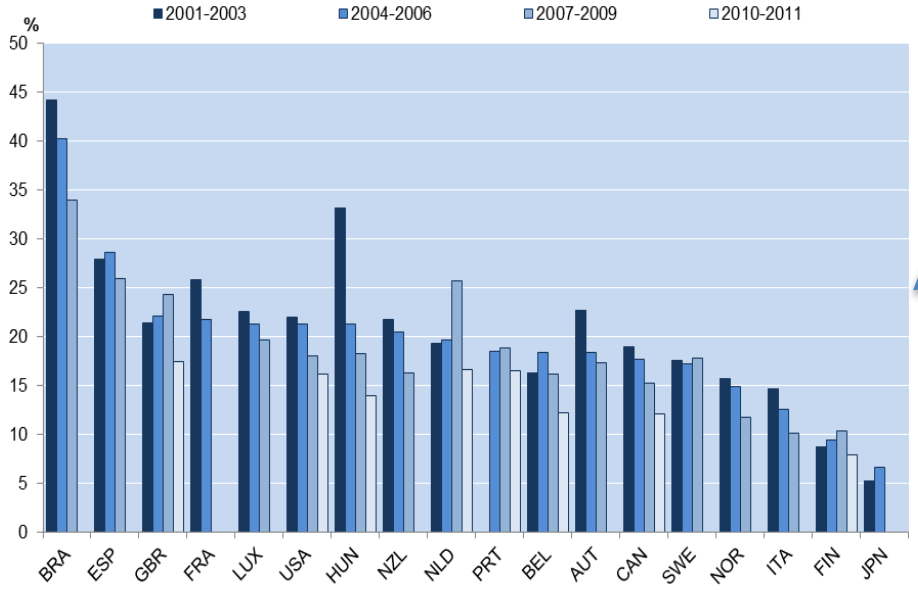
Contributions to trend labour productivity growth in percentage points



Why focus on decline in MFP growth?

- Decline in capital deepening is worrying but at least partly cyclical
  - Gap between current and steady state levels of investment ratios around 2.5 points of GDP in a third of OECD countries (7 points in Greece)
- Moreover:
  - Capital has diminishing returns, ideas do not
  - The very extent of steady state capital deepening depends on developments in MFP
  - It is not only the sheer amount of capital and labour that matters for growth but the way it is allocated, which affects MFP
- There are signs that the decline in MFP growth may be structural

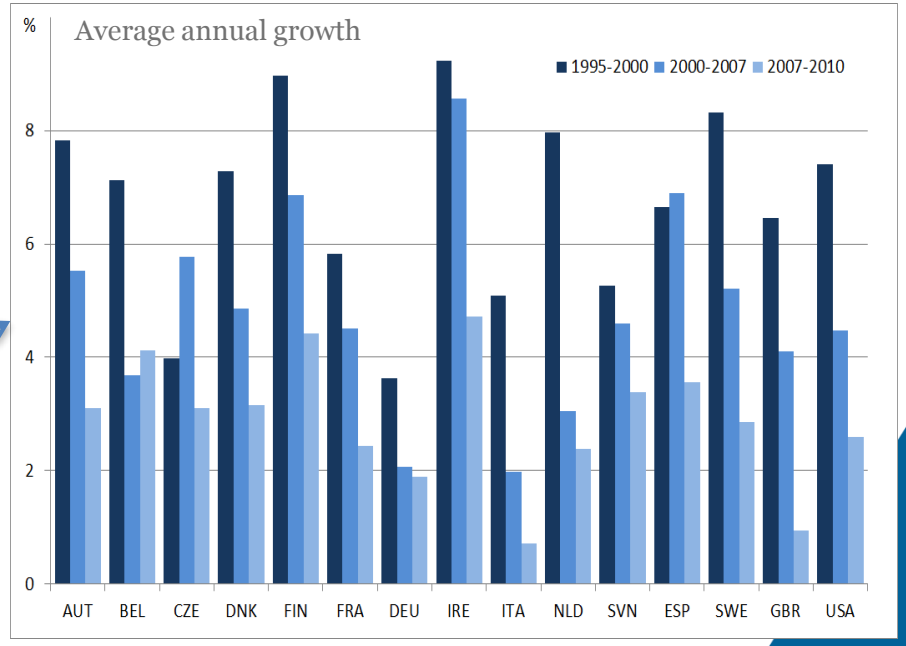
There are signs that the slowdown is structural



Source: C. Criscuolo, P. N. Gal and C. Menon (2014), "The Dynamics of Employment Growth: New Evidence from 18 Countries", *OECD Science, Technology and Industry Policy Papers,* No. 14.

Start-up rates have been declining

Investment in KBC has slowed down significantly



Source: OECD calculations based on Corrado et al., (2012).

The debate is not settled…

Pessimists:

Gordon

Fernald

Cowen (?)

…

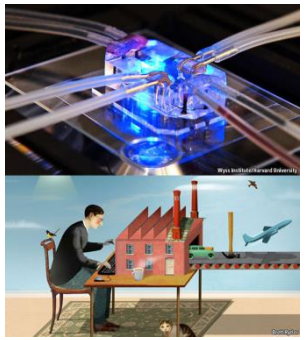
Optimists:

Brynjolffson/McAfee

Mokyr

Jovanovic

…



…and there are alternative explanations

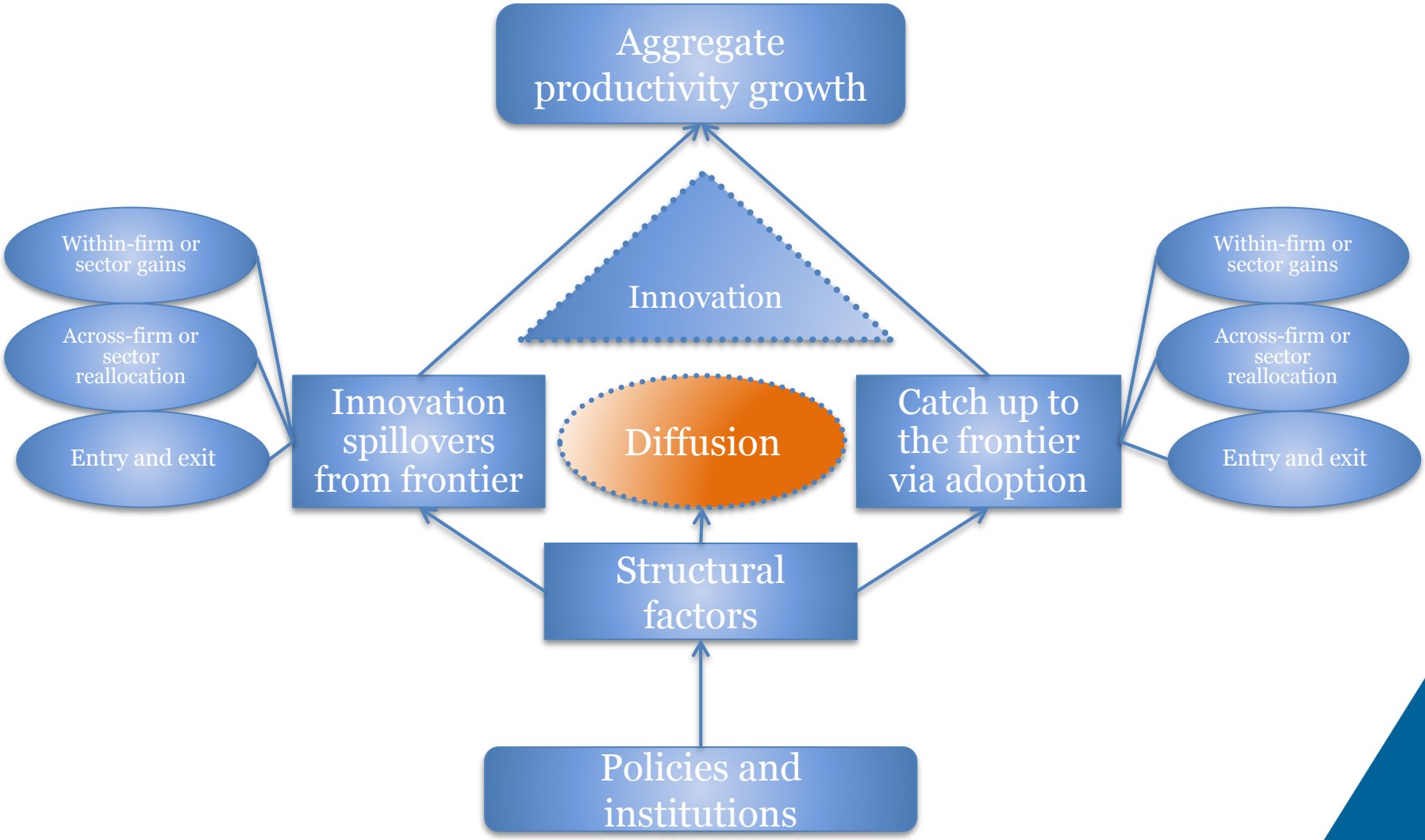
1. Technological factors
   - Adoption and diffusion of GPT (Griliches, 1957; David, 1991; Jovanovic and Rousseau, 2005)
2. A "return to normal" effect …after nearly a decade of exceptional IT-fueled gains (Fernald, 2014)
3. Transitional productivity growth dynamics due to rising resource misallocation (Gopinath et al., 2015):
4. Cyclical factors – e.g. demand conditions and monetary policy (Anzoategui,et al., 2016)
5. Measurement (Byrne, Fernald et al., 2016; Syverson, 2016)? (…or not)

Given this uncertainty, policy-makers need to find sources of productivity growth where there is large and sure scope for improvement.

The sources of MFP growth

- Three key sources of aggregate productivity growth:
  1. Innovation
  2. Diffusion (spillovers from frontier and catch up)
  3. Resource reallocation (capital, labour and skills)
- Effective diffusion and reallocation are also key for encouraging innovation
- Within-firm gains in productivity are magnified in the aggregate by effective resource reallocation towards high-productivity firms
- All these factors are strongly influenced by policy

A simplified framework



The issues

- Using the framework, did aggregate productivity slow because:
  1. Slowing growth at the global productivity frontier?
  2. Stalling diffusion: slowing productivity convergence to the global frontier?
  3. Rising resource misallocation? (ongoing work)

- We are focusing on **obstacles to diffusion and reallocation** because:
  - *They are closely related to widespread observed heterogeneity in firm performance*
  - *They offer the largest scope for improving aggregate productivity*
  - *They are most influenced by domestic policies*
  - *If improved they also give incentives for innovation*
  - *They have a link with inclusion (evidence of rising cross-firm wage inequality)*

Work-horse models to investigate diffusion and reallocation issues

1. **A spillovers from and catch-up to frontier specification**
   Regressing MFP growth on growth at the frontier and the distance from frontier (*Griffith et al 2004; Nicoletti and Scarpetta, 2003; Bourles et al 2013; Andrews et al. 2015)*

$$\Delta MFP_{i,s,c,t} = \beta^{Nat} Gap^{Nat}_{i,s,c,t-1} + \beta^{Glo} Gap^{Glo-Nat}_{s,c,t-1} + \\ + \gamma^{Nat} \Delta MFP^{Nat}_{i,s,c,t-1} + \gamma^{Glo} \Delta MFP^{Glo}_{i,s,c,t-1} \\ + \eta X_{i,t-1} + \delta_s + \delta_{c,t} + \varepsilon_{i,s,c,t}$$

   The gap terms capture the distance from the frontier: $Gap_{i,s,c} = MFP_{F,s,c} - MFP_{i,s,c}$
   Policy effects are captured by adding interaction and Rajan-Zingales terms

2. **Using an Olley-Pakes decomposition of aggregate productivity**
   Regressing the gaps in O-P terms on interaction between policies and exposure Rajan-Zingales terms)

$$P = \sum_i \theta_i P_i = (1/N) \sum_i p_i + \sum_i (\theta_i - \bar{\theta})(p_i - \bar{P})$$

3. **Using the Haltiwanger dynamic approach to the efficiency of reallocation**
   Regressing changes in firm size on their initial level of MFP (ongoing work)

First issue: *what's happening at the global frontier?*

Innovation is implemented by a special kind of firm but we know little about global frontier firms

- What are the characteristics of firms at the global productivity frontier?
- How has the productivity performance of global frontier firms evolved over time?
- Have characteristics of global frontier firms changed over time?

The globally most productive firms – who are they?

Mean firm characteristics: frontier firms and non-frontier firms

Selected OECD Countries, 2005 (unless otherwise noted)

	Global Frontier Firms			Non-Frontier Firms			Difference in means
	Mean	Std Dev	Number	Mean	Std Dev	Number	
			Multi Factor Productivity (Solow)				
Productivity	4.06	1.04	3657	2.51	0.91	294031	1.5 ***
Employment	309	3770	3657	229	4119	294031	81
Capital stock (€m)	31	355	3657	19	343	294031	12 **
Turnover (€m)	250	1731	3657	59	754	294031	191 ***
Profit rate	0.57	0.33	3657	0.13	6.33	294031	0.45 ***
Age	21.5	20.3	3657	23.2	18.6	294031	-1.7 ***
MNE status*							
Probability	0.47	0.50	3450	0.28	0.45	310765	0.19 ***
Patenting status							
Depreciated patent stock	3.71	45.15	3657	0.90	56.17	294031	2.8 ***

Source: Andrews, D. C. Criscuolo and P. Gal (2015), "Frontier firms, technology diffusion and public policy: micro evidence from OECD countries", OECD.

"Frontier firms" corresponds to the average of the 100 globally most productive (Solow MFP) firms in each 2-digit sector. "Non-frontier firms" is the average of all other firms.

The globally most productive firms – who are they?

Mean characteristics: frontier and non-frontier firms, Multi Factor Productivity

Selected OECD Countries, 2005 (unless otherwise noted)

	Global Frontier Firms		Non-Frontier Firms		Difference in means
	Mean	Std Dev	Mean	Std Dev	
Manufacturing					
MFP	3.73	*0.87*	2.35	*0.79*	1.4***
Employment	414	*4996*	231	*2006*	183*
Capital stock (€m)	32	*376*	17	*187*	15*
Turnover (€m)	308	*2192*	66	*745*	241***
Profit rate	0.57	*0.30*	0.13	*8.54*	0.45***
Age	24.4	*21.5*	24.9	*20.1*	-0.5
MNE status*	0.467	*0.499*	0.272	*0.445*	0.195 ***
Probability					
Depreciated patent stock	2.23	*23.26*	1.28	*53.16*	0.9*
Services					
Labour Productivity	4.57	*1.05*	2.61	*1.01*	2.0***
Employment	171	*677*	263	*5655*	-92***
Capital stock (€m)	31	*345*	19	*322*	11
Turnover (€m)	152	*657*	60	*848*	92***
Profit rate	0.57	*0.37*	0.12	*5.16*	0.45***
Age	17.4	*17.2*	21.8	*17.8*	-4.4***
MNE status*	0.478	*0.5*	0.312	*0.463*	0.166 ***
Probability					
Depreciated patent stock	2.21	*33.95*	0.12	*5.74*	2.1**

Note: Frontier: 100 globally most productive firms within each 2-digit sector MFP definition based on Solow-residual using industry-specific but country- and time-invariant factor shares. N = 297,688. *Source:* see previous slide

The globally most productive firms -- coming from various countries

	Manufacturing			Business services	Total market sector
	Total	ICT producing	ICT using		
Austria		x	x	x	
Belgium	x	x	x	x	x
Czech Republic					
Germany	x	x	x	x	x
Denmark	x	x	x		
Estonia					
Spain	x	x	x	x	x
Finland		x	x		
France	x	x	x	x	x
Great Britain	x	x	x	x	x
Greece				x	
Hungary					
Italy	x	x	x	x	x
Japan	x	x	x	x	x
Korea	x	x	x	x	x
Netherlands	x	x	x	x	x
Norway					
Poland				x	
Portugal					
Sweden	x	x	x	x	x
Slovenia					
Slovakia					
United States	x	x	x	x	x
Number of countries (Total: 23)	12	14	14	14	11

Source: Andrews, D. C. Criscuolo and P. Gal (2015), **"**Frontier firms, technology diffusion and public policy: micro evidence from OECD countries**",** OECD Productivity Working Paper No. 2.

The globally most productive firms -- other characteristics

- Frontier firms belong to a variety of industries
- Selection at frontier is harsh (less than 1/5 of them stay at the frontier after 4 years)
- Frontier firms are getting older (consistent with decline in startups)
- Frontier firms are getting larger (consistent with increasing market concentration)

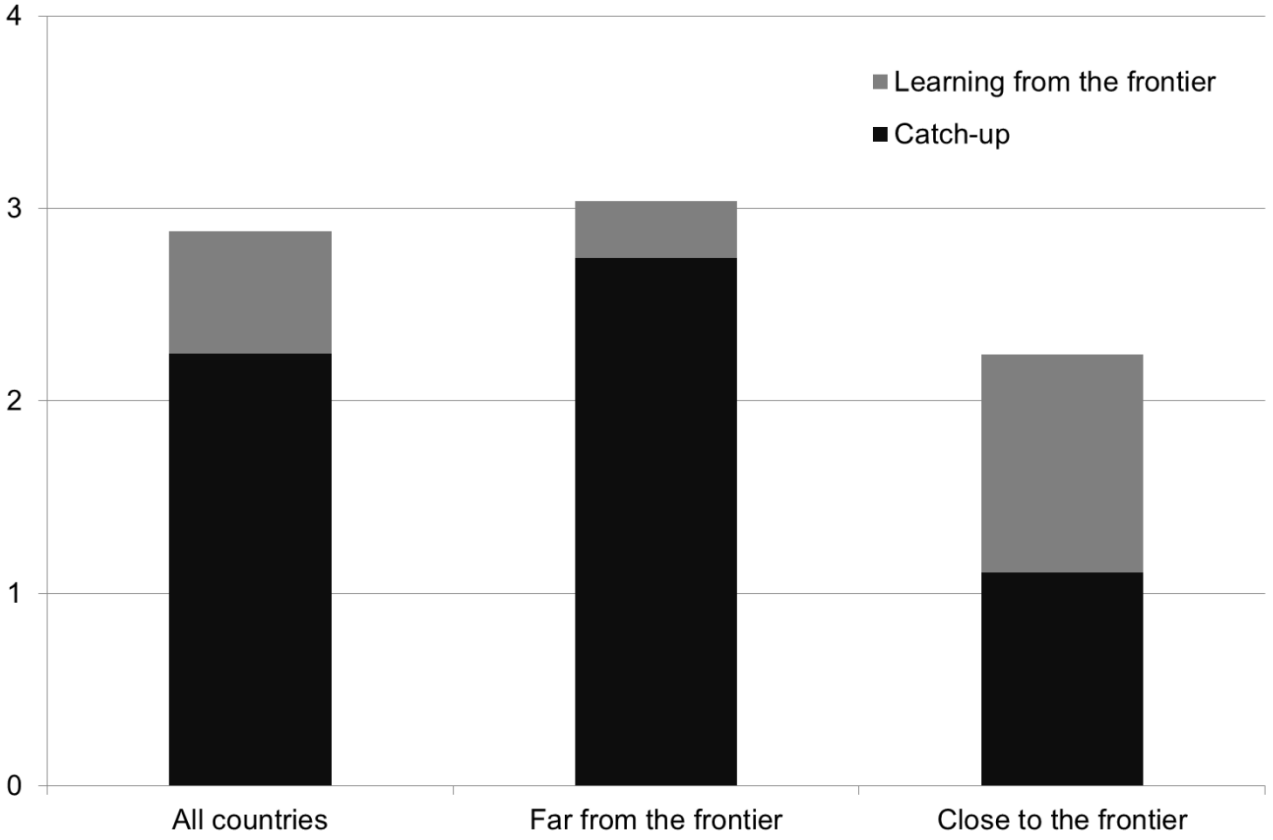
Second issue: *Is the diffusion machine sputtering?*

Productivity research emphasizes widespread heterogeneity within narrowly-defined sectors (Syverson, 2004).

- How do frontier productivity gains spread out?
- Have non-frontier firms kept pace with the global frontier?
- What factors might explain productivity divergence over time? (**ongoing work**)

Learning from the frontier is a more important source of growth closer to the frontier

Average contribution of catch-up and learning to average annual growth in labour productivity, 1950-2013



Notes: The figure shows how the average contribution from catch-up and learning from the frontier varies with an economy's distance from the frontier. *Close to the frontier* is defined as those country*year observations in the bottom quartile of the distance from the frontier distribution, while *Far from the frontier* refers to all other country*year observations. The estimates are calculated from a regression of growth in labour productivity on frontier growth and lagged distance from the frontier, where the United States is the frontier economy and is thus excluded from the regression. The data are averages over 5-year intervals and the regression also controls for country fixed effects and 5-year time fixed effects. The estimation is based on an unbalanced panel of 60 countries over the period 1950-2013.

Source: Saia, A., D. Andrews and S. Albrizio (2015)

The pull of the global frontier is less than that of the national one

Regressing MFP growth on the distance from the national and global frontier

Explanatory variables	(1) Top 5%	(2) Top 10%
Distance from national frontier (t-1)	0.289***	0.311***
	(0.001)	(0.002)
Distance between national and global frontier (t-1)	0.086***	0.054***
	(0.002)	(0.002)
Growth at the national frontier	0.270***	0.399***
	(0.003)	(0.005)
Growth at the global frontier	0.279***	0.296***
	(0.008)	(0.009)
Control variables	Yes	Yes
Country * year fixed effects	Yes	Yes
Industry fixed effects	Yes	Yes
Observations	2,325,842	2,325,787
R-squared	0.144	0.148

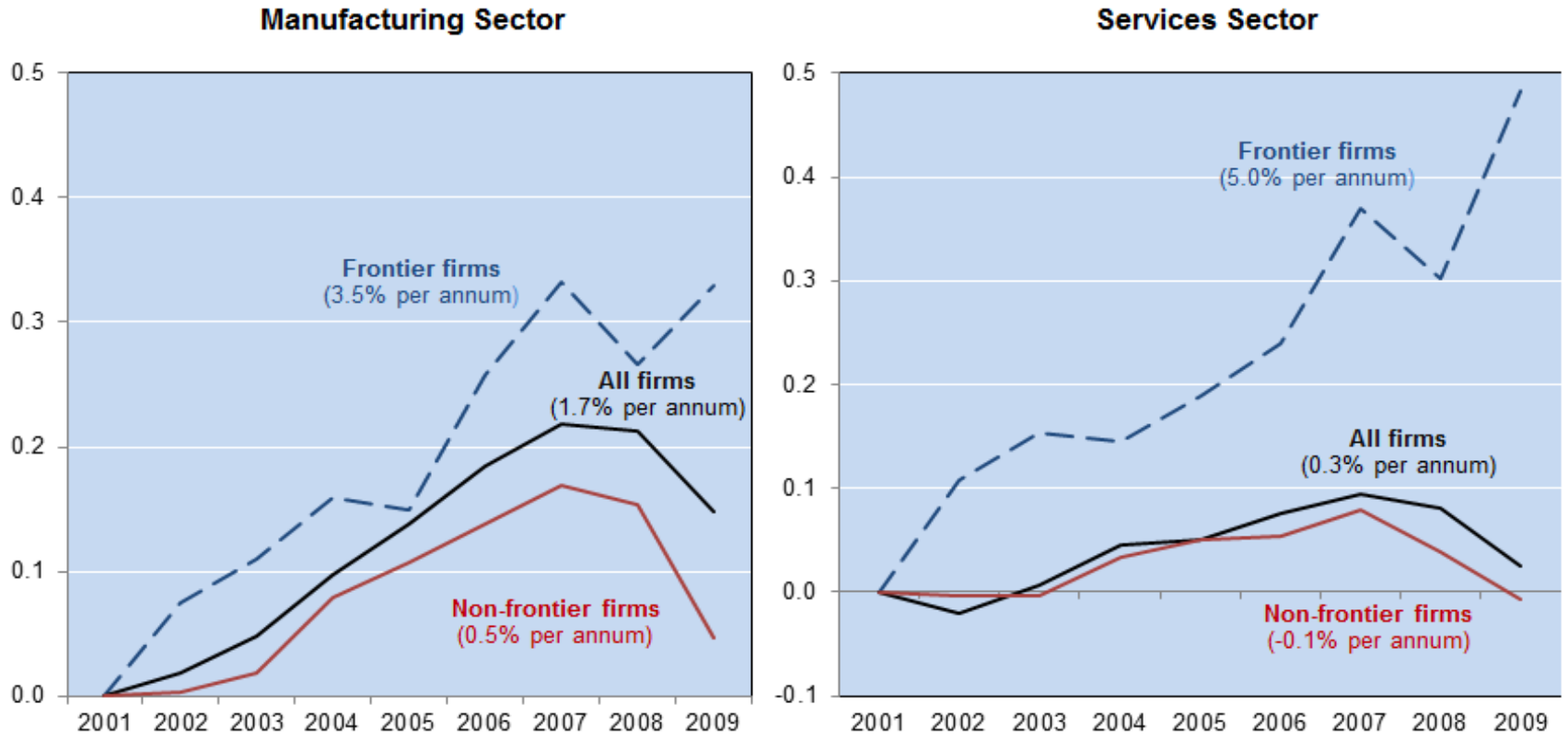
*** p<0.01, ** p<0.05, * p<0.1

Source: Andrews, D. C. Criscuolo and P. Gal (2015), **"**Frontier firms, technology diffusion and public policy: micro evidence from OECD countries**",** OECD Productivity Working Paper No. 2.

The breakdown of the diffusion machine

The global frontier has kept growing but spillovers to other firms declined

Labour productivity; index 2001=0

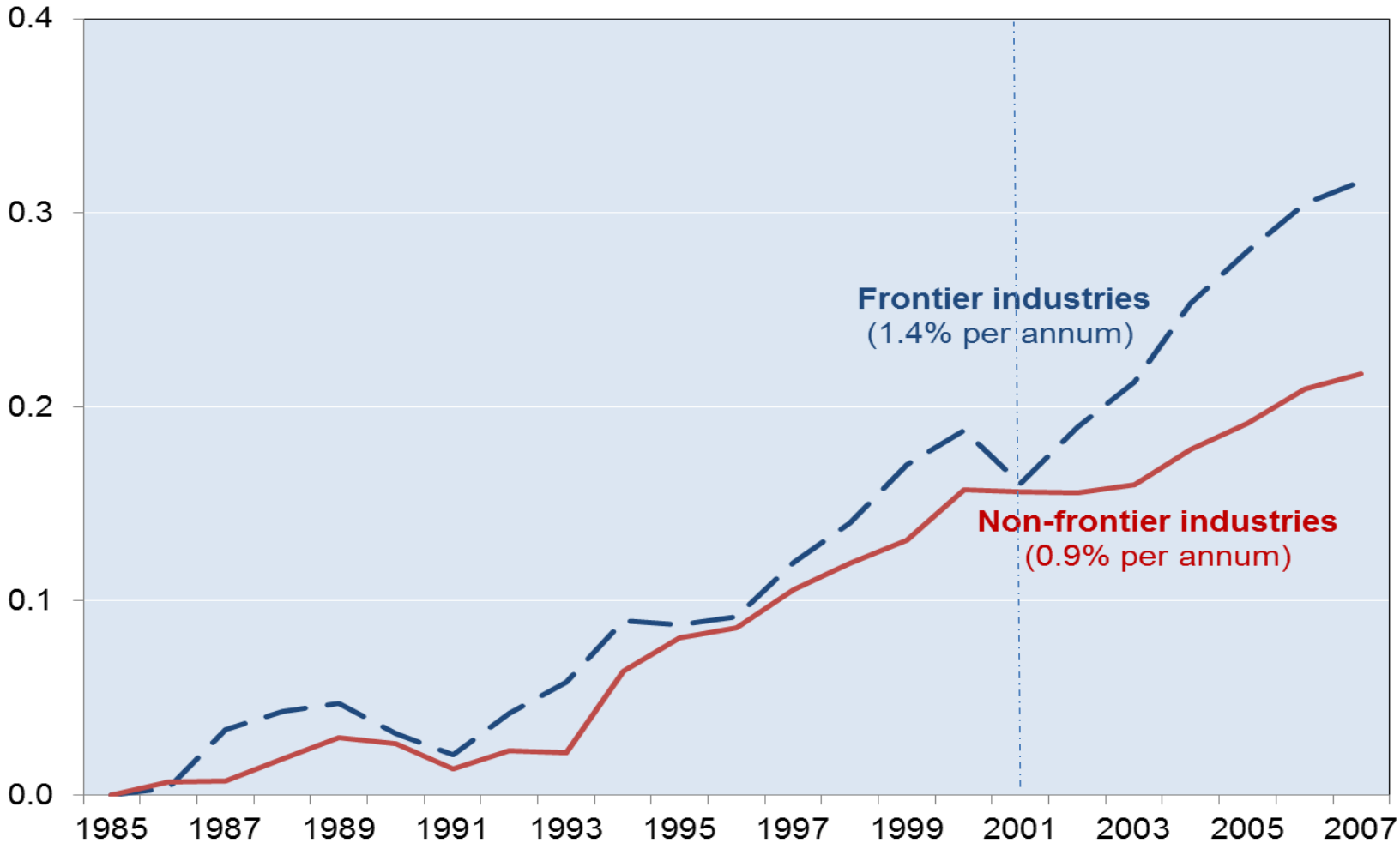


Source: Andrews, D. C. Criscuolo and P. Gal (2015), **"**Frontier firms, technology diffusion and public policy: micro evidence from OECD countries**",** *forthcoming* OECD.

"Frontier firms" corresponds to the average labour productivity (value added per worker) of the 100 globally most productive firms in each 2-digit sector in 2001. "Non-frontier firms" is the average of all other firms. "All firms" is the sector total. Robust to: *i*) using different measures of productivity (e.g. TFP); *ii*) following a fixed group of frontier firms over time; and *iii*) excluding firms that are part of a multi-national group (i.e. headquarters or subsidiaries) where profit shifting activity may be relevant.

Industry-level data also show divergence from early 2000s

Unweighted average of TFP in the non-farm business sector; index 1985=0



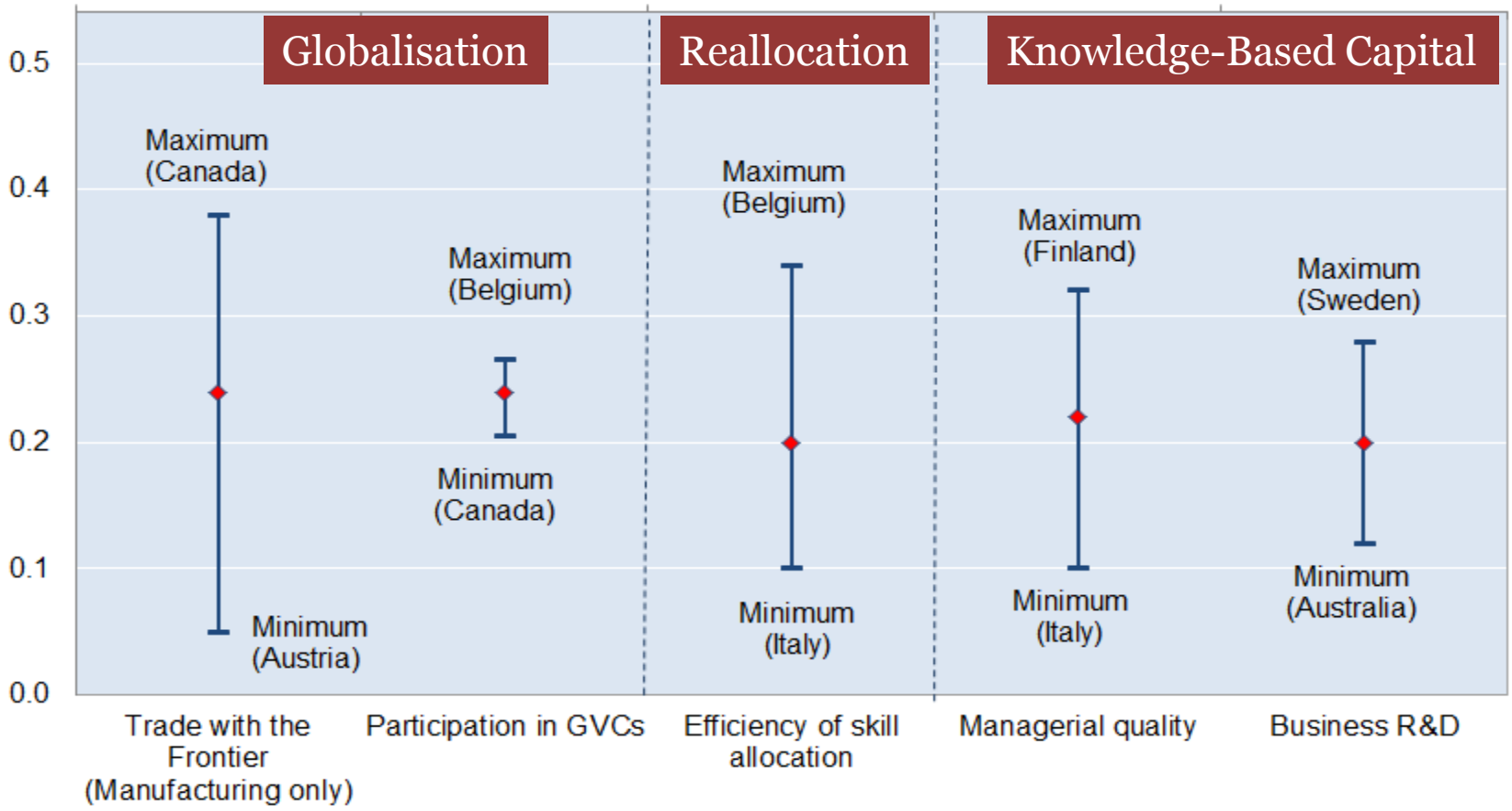
Source: OECD calculations based on Bourles et al (2013) dataset.

Diffusion comes easier to some economies than others

- Three major structural factors were identified by OECD research:
  - Connectedness to markets where frontier firms operate, via trade
  - Efficiency of the reallocation mechanism
  - Quantity and quality of the knowledge-based capital stock (e.g. managerial capital, R&D stock)
- Each of these factors increases significantly the ability to benefit from frontier growth

Diffusion comes easier to some economies than others

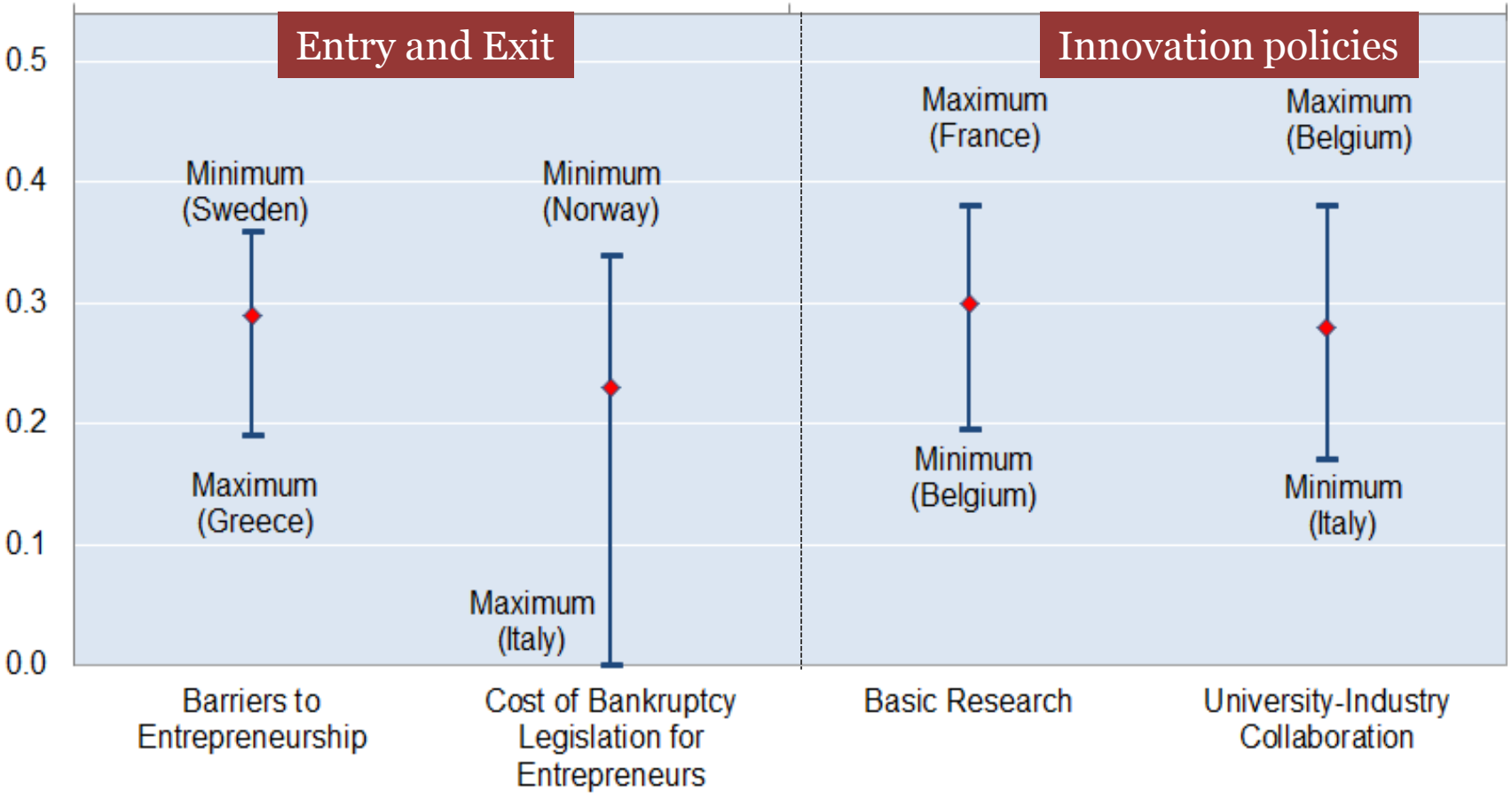
Estimated frontier spillover (% pa) associated with a 2% point increase in MFP growth at the global productivity frontier



Source: Saia, A., D. Andrews and S. Albrizio (2015), "Public Policy and Spillovers From the Global Productivity Frontier: Industry Level Evidence", OECD Economics Department Working Papers, No. 1238.

…and policies help explain why

Estimated frontier spillover (% pa) associated with a 2% point increase in MFP growth at the global productivity frontier

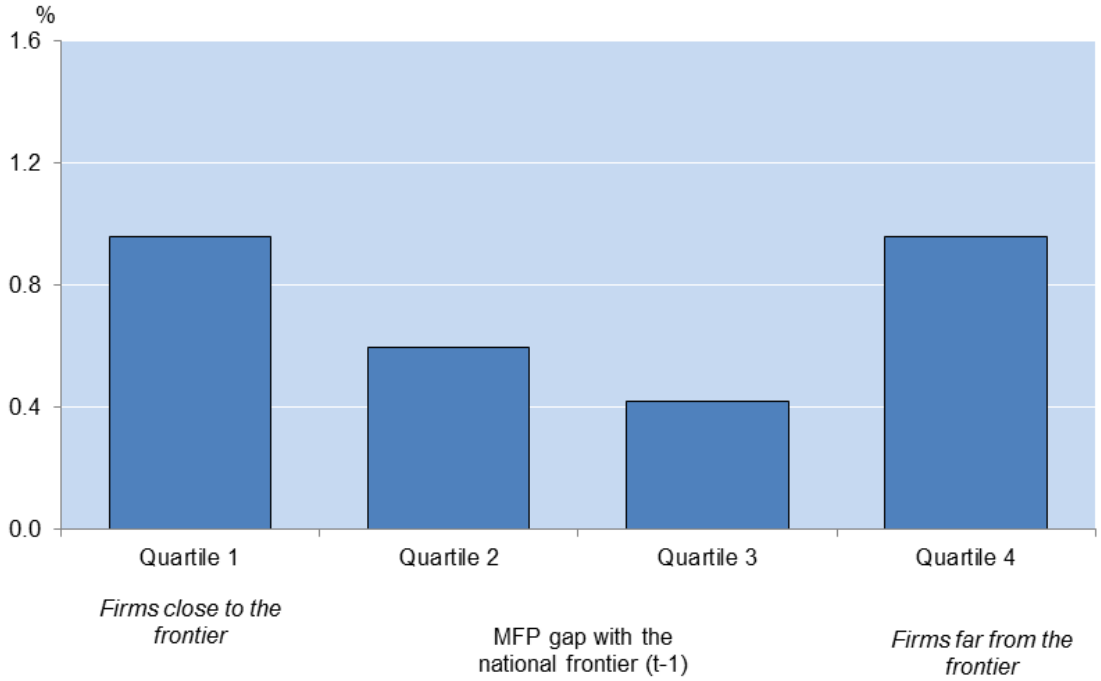


Source: Saia, A., D. Andrews and S. Albrizio (2015), "Public Policy and Spillovers From the Global Productivity Frontier: Industry Level Evidence", *OECD Economics Department Working Papers*, No. 1238.

Much scope for national policies to influence catch-up

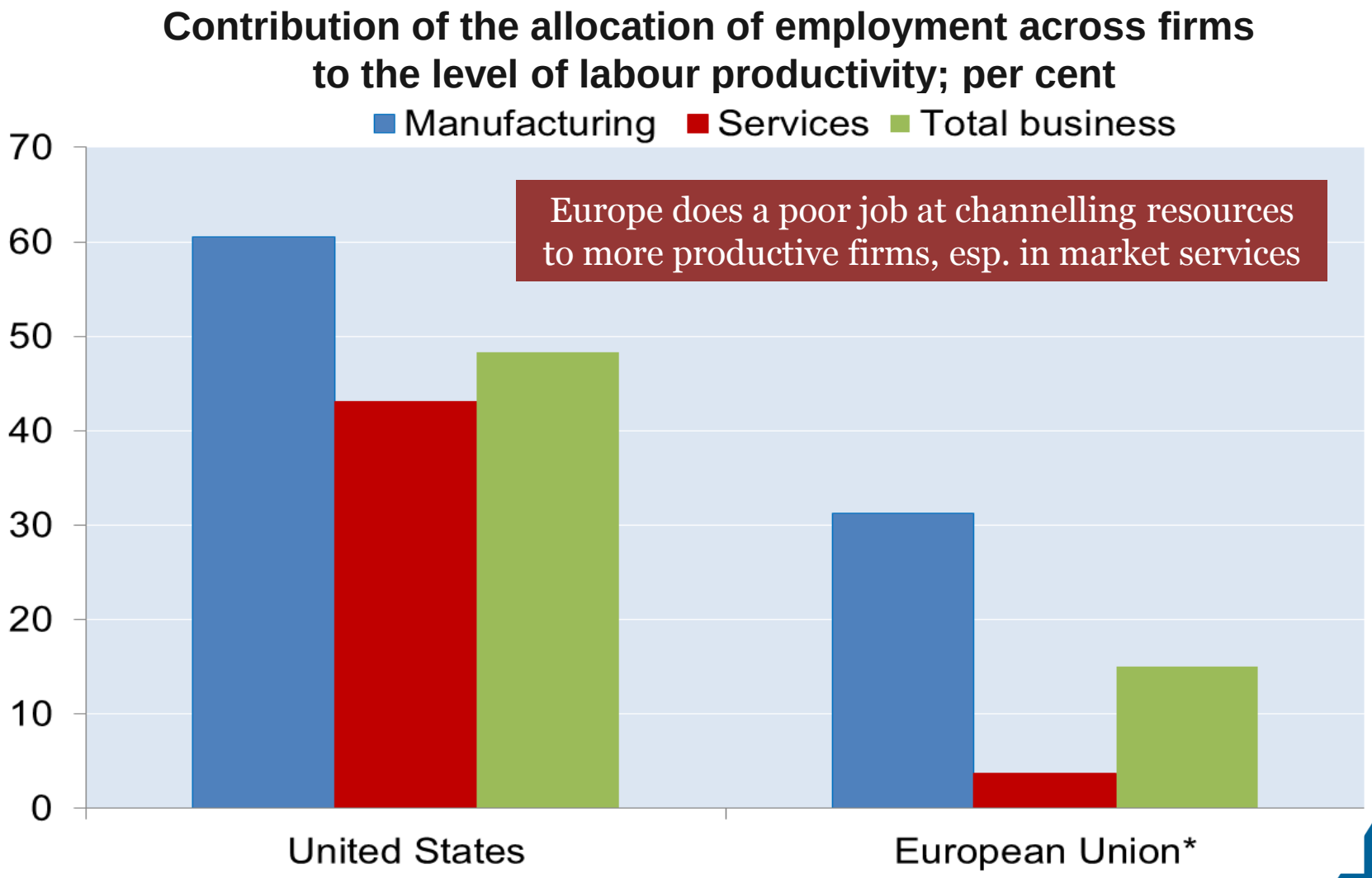
- Catch-up to the national frontier is easier in countries with less stringent product market regulations (PMR) and higher business-university collaboration.

Impact of policy reforms on the MFP growth of laggard firms, 2005
Reducing PMR from high level in Greece to the OECD average
% difference between industries with high and low firm churning



Source: Andrews, D. C. Criscuolo and P. Gal (2015), "Frontier firms, technology diffusion and public policy: micro evidence from OECD countries", OECD Productivity Working Paper No. 2.

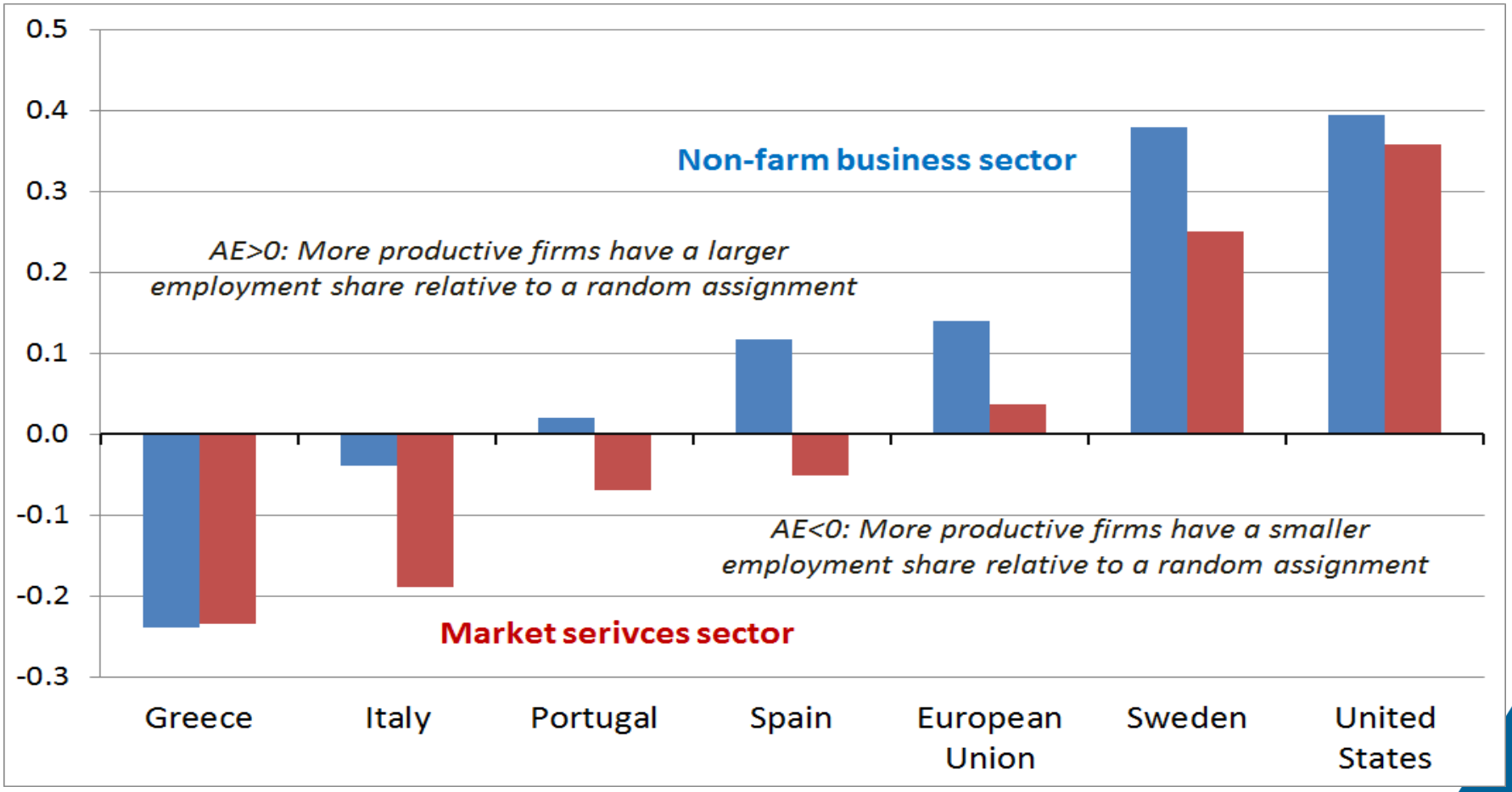
Third issue: *What is the role of misallocation?*



Source: Andrews, D. and F. Cingano (2014), "Public Policy and Resource Allocation: Evidence from Firms in OECD Countries", *Economic Policy*, No. 29(78), pp. 253-296.

Resource misallocation is widespread in Southern Europe

Static allocative efficiency: contribution of the allocation of employment across firms to labour productivity; log points



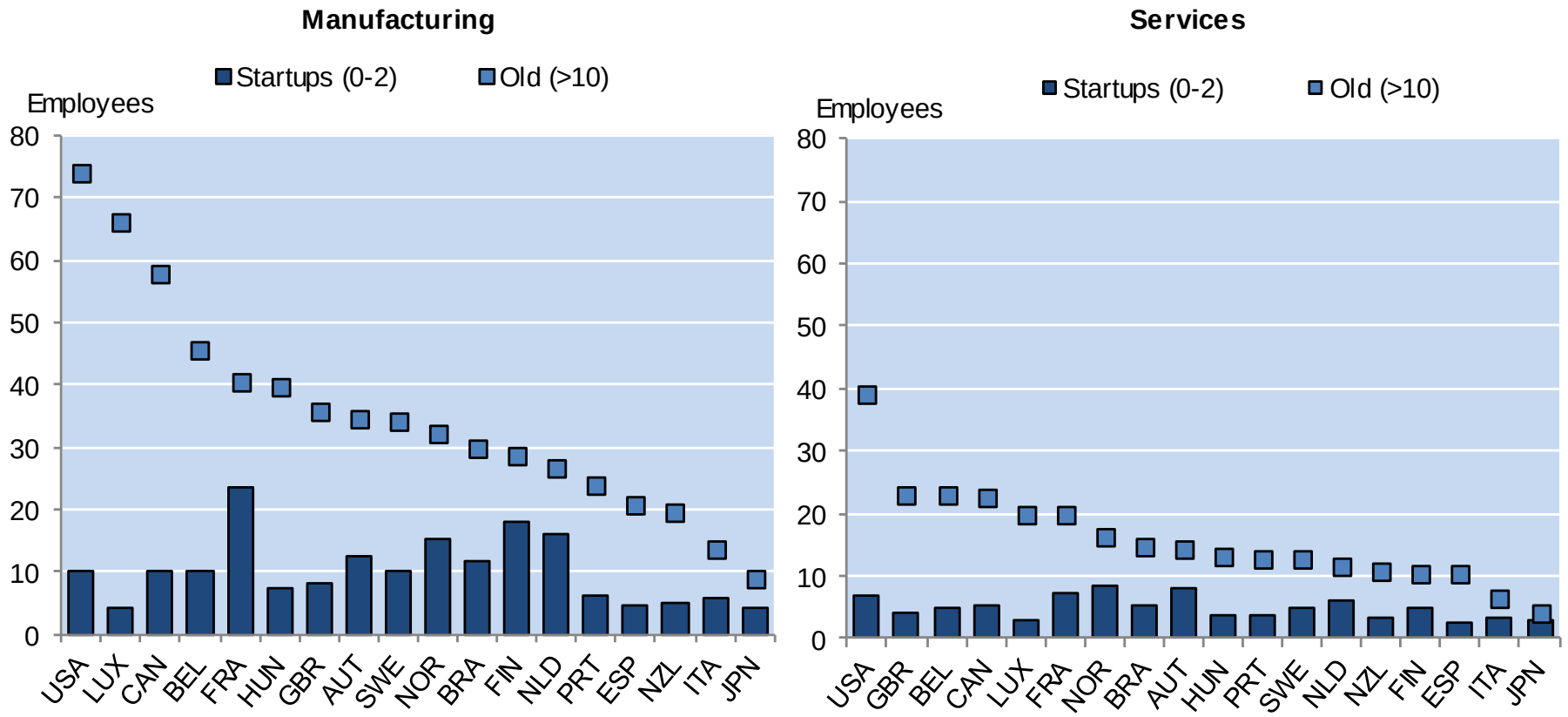
Source: Andrews and Cingano (2014), "Public Policy and Resource Allocation", *Economic Policy* 29(78), pp. 253-296.

Misallocation of resources may have increased since the early 2000s

- Preliminary evidence from OECD and other sources suggests that the efficiency of reallocation has declined in some countries before and during the recent crisis, e.g.:
  - The ability of directing investment towards the most productive firms appears to have decreased in Southern Europe (e.g. Spain, Italy)
  - The "creative destruction" process has become less effective, with startups declining (see above) and the share of "zombie firms" in many OECD economies increasing over time
  - The "cleansing" effect of the Great Recession has been more limited than in past recessions (e.g. US)

The ability of successful firms to grow differs across countries

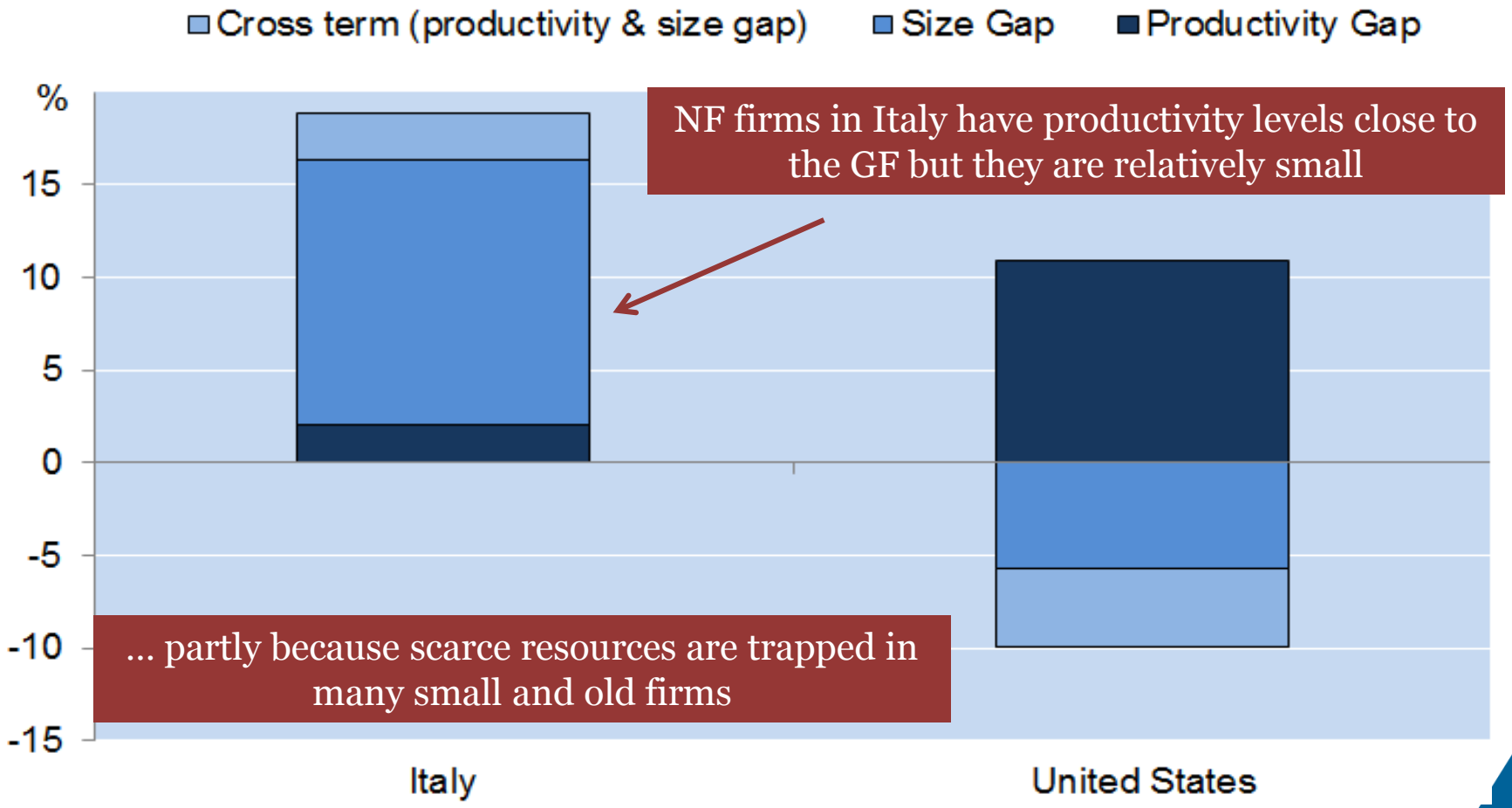
Post-entry growth - average size of young and old firms



Source: C. Criscuolo, P. N. Gal and C. Menon (2014), "The Dynamics of Employment Growth: New Evidence from 18 Countries", *OECD Science, Technology and Industry Policy Papers,* No. 14.

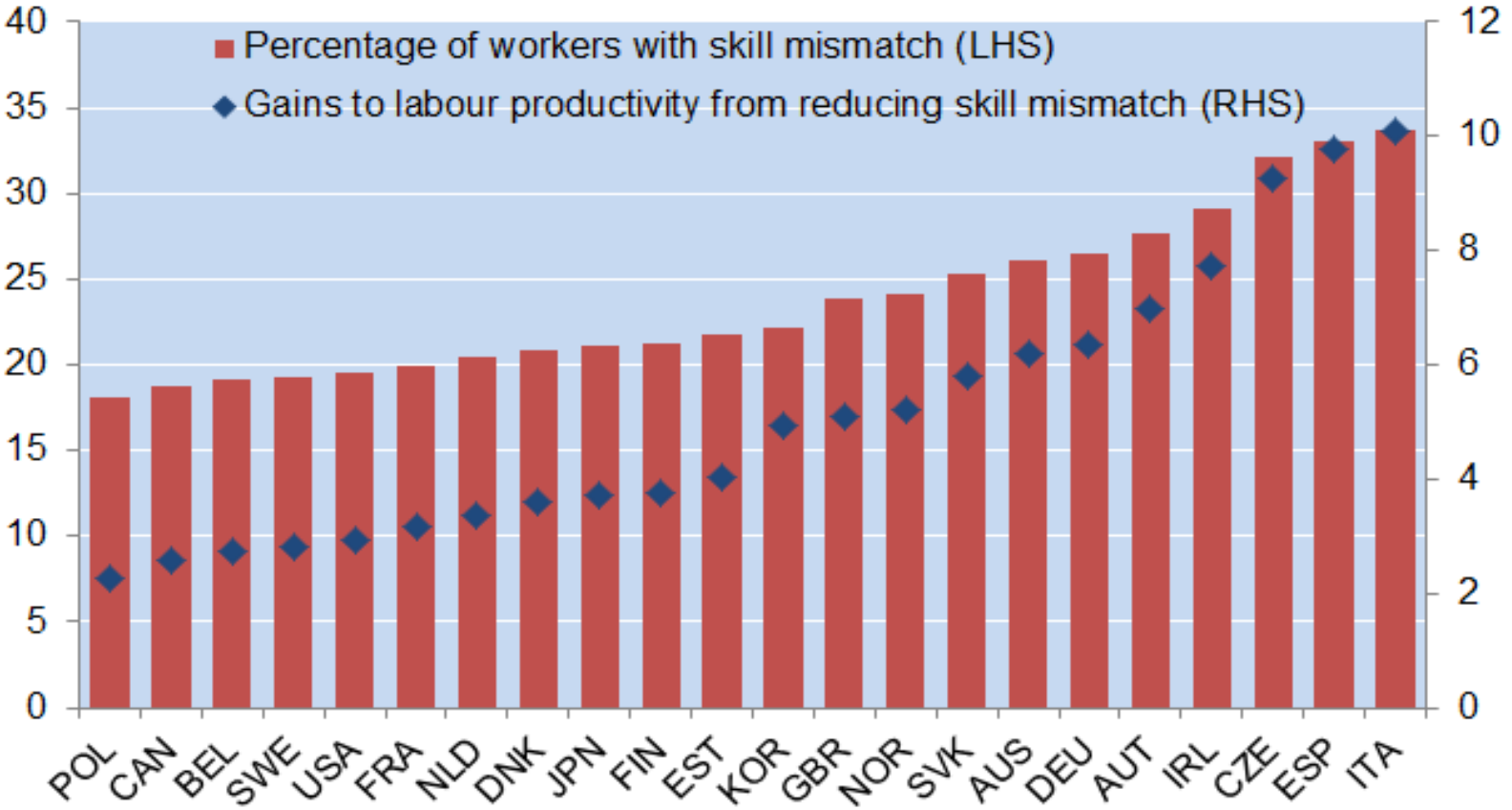
Allowing frontier firms to grow can have a strong impact on aggregate productivity

How much higher would overall manufacturing sector labour productivity be if national frontier firms were as productive and large as GF firms?



Source: Andrews, Criscuolo and Gal (2015), "Frontier firms, technology diffusion and public policy: micro evidence from OECD countries " OECD Mimeo.

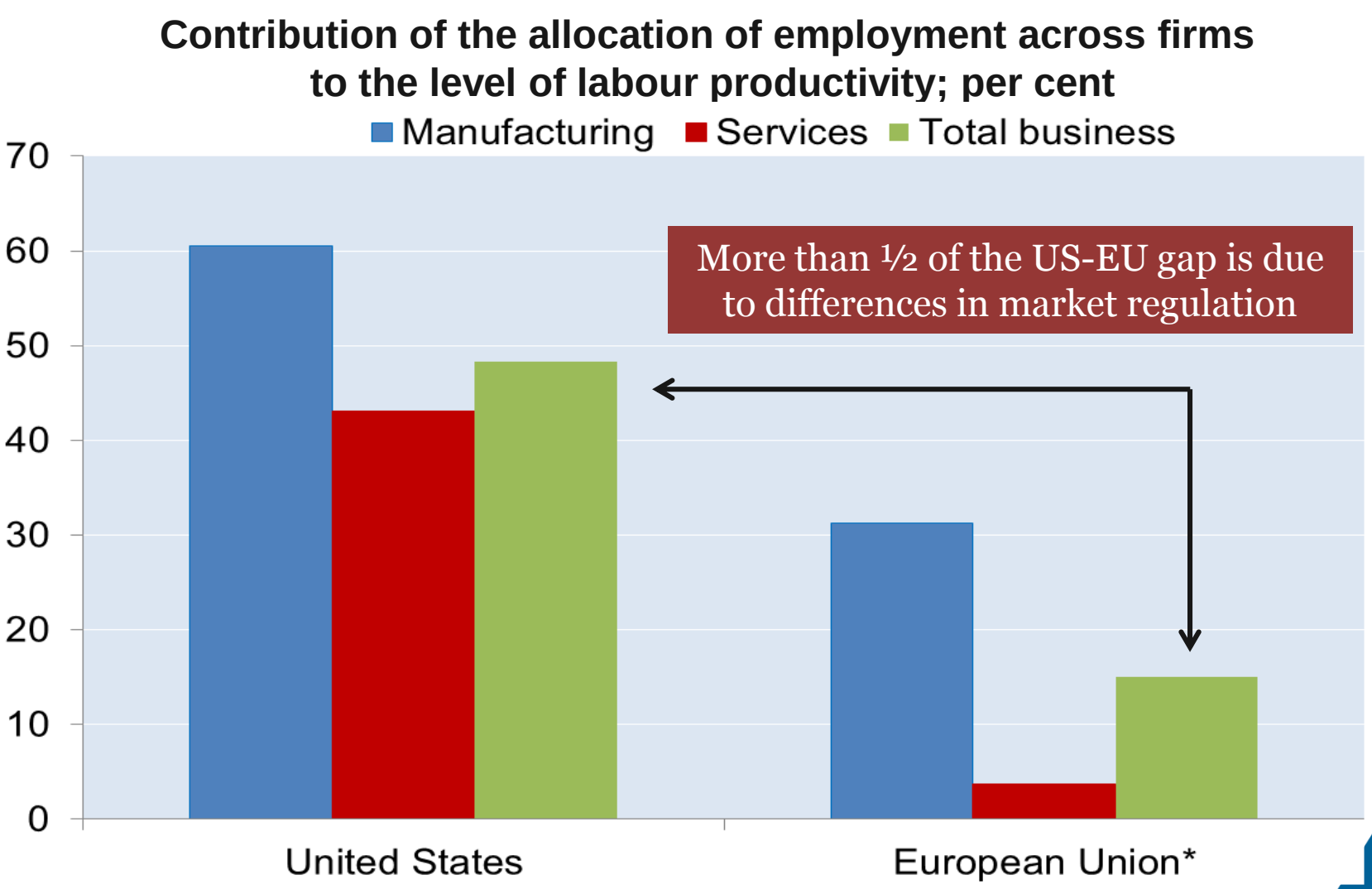
Skill mismatch constrains labour productivity



Source: Adalet McGowan, M and D. Andrews (2015), "Labour market mismatch and labour productivity: evidence from PIAAC data " *OECD Economics Department Working Paper,* No. 1209.

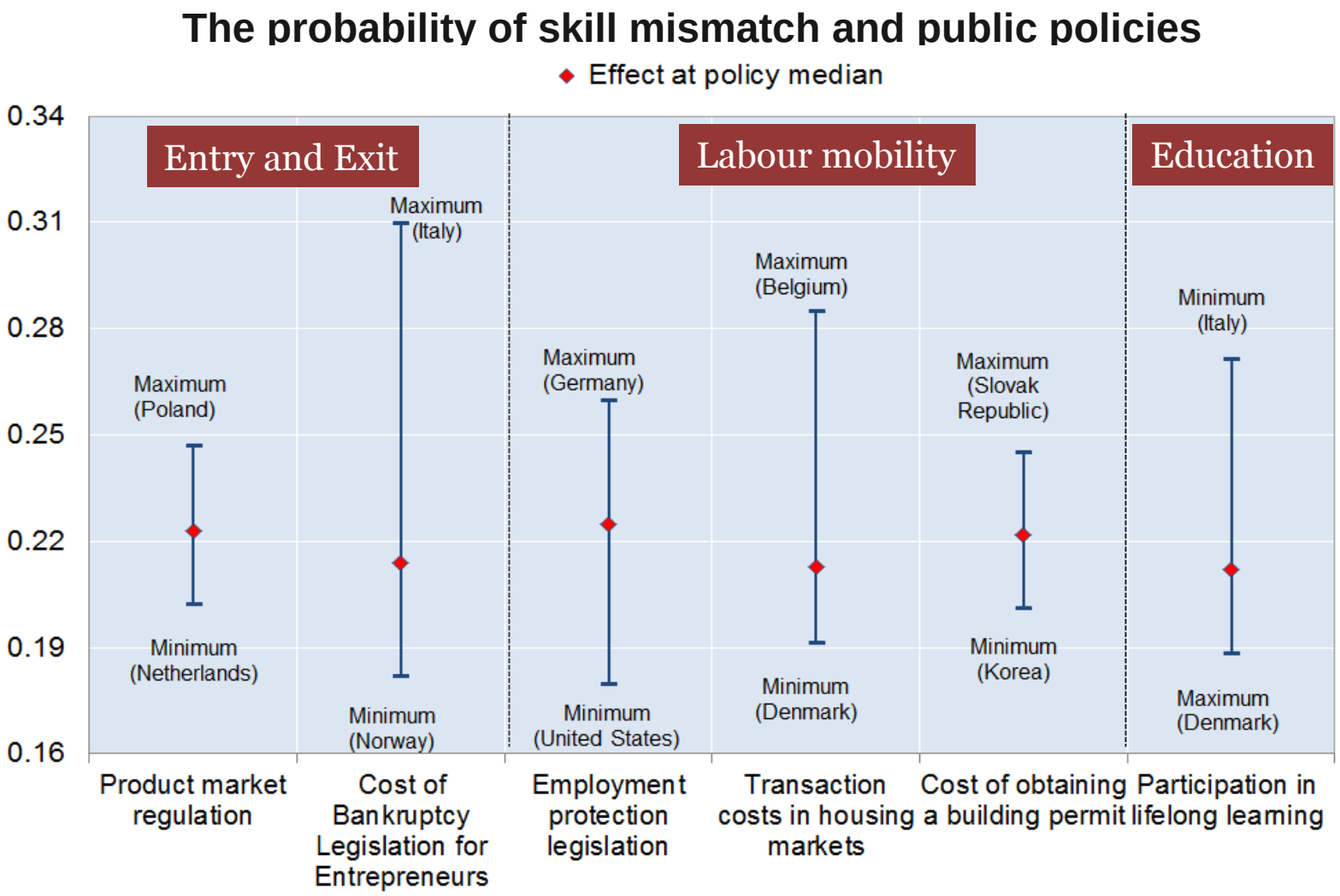
Skill mismatch, particularly over-skilling, is harmful for productivity because it constrains the ability of innovative firms to attract skilled workers and grow

Reallocation efficiency is influenced by policy…



Andrews, D. and F. Cingano (2014), "Public Policy and Resource Allocation: Evidence from Firms in OECD Countries", *Economic Policy*, No. 29(78), pp. 253-296.

… as is the degree of skill mismatch



Source: Adalet McGowan, M and D. Andrews (2015), "Skill mismatch and public policy in OECD countries" *OECD Economics Department Working Paper,* No. 1210.

Policy reforms that facilitate the growth of national frontier firms

Impact of policy reform to best practice on level of industry productivity

% difference between industries with high and low exposure to the policy

Source: Andrews, Criscuolo and Gal (2015), "Frontier firms, technology diffusion and public policy: micro evidence from OECD countries" OECD Mimeo.

Work ahead and some conjectures

- More accurate data and more work is needed to explore the **evolution** of diffusion and reallocation and the role of structural and policy factors
- Why would productivity spillovers and the efficiency of resource reallocation decline over the past decade or so?
  - *Technology-related factors?*
    - *"Winner takes all"*
    - *Replication and diffusion of the "magic bundle" (tech+skills) more difficult*
  - *Incentives and opportunities thwarted by inadequate institutions?*
    - *Inappropriate design of IPRs*
    - *Obsolete regulations and barriers to entry, especially in services, especially in Europe*
    - *Market size a limiting factor in some areas, e.g. EU internal market for services*
  - *Vested interests and lobbies resisted the penetration of new business models using new technologies, especially in services*
  - *Easy credit, bank forbearance (linked to NPLs) and inappropriate insolvency regimes contributed to capital misallocation and the survival of zombie firms*
  - *Declining competitive pressures in the most dynamic sectors*

Take aways

- The productivity slowdown is a serious structural issue that deserves the attention of researchers and policy-makers
- There are signs that slowing diffusion and rising misallocation of resources have played a role and may have been aggravated by the crisis
- As the causes and drivers of the slowdown are multifaceted, a panoply of structural (and perhaps macro) policies are needed
- There is evidence that a number of structural policies can help reverse the slowdown, independent of its precise causes
- But better understanding the nature and sources of the slowdown as well as the specific weaknesses in each country via a granular approach is essential to identify the most effective mix of policies

Other related and relevant OECD papers

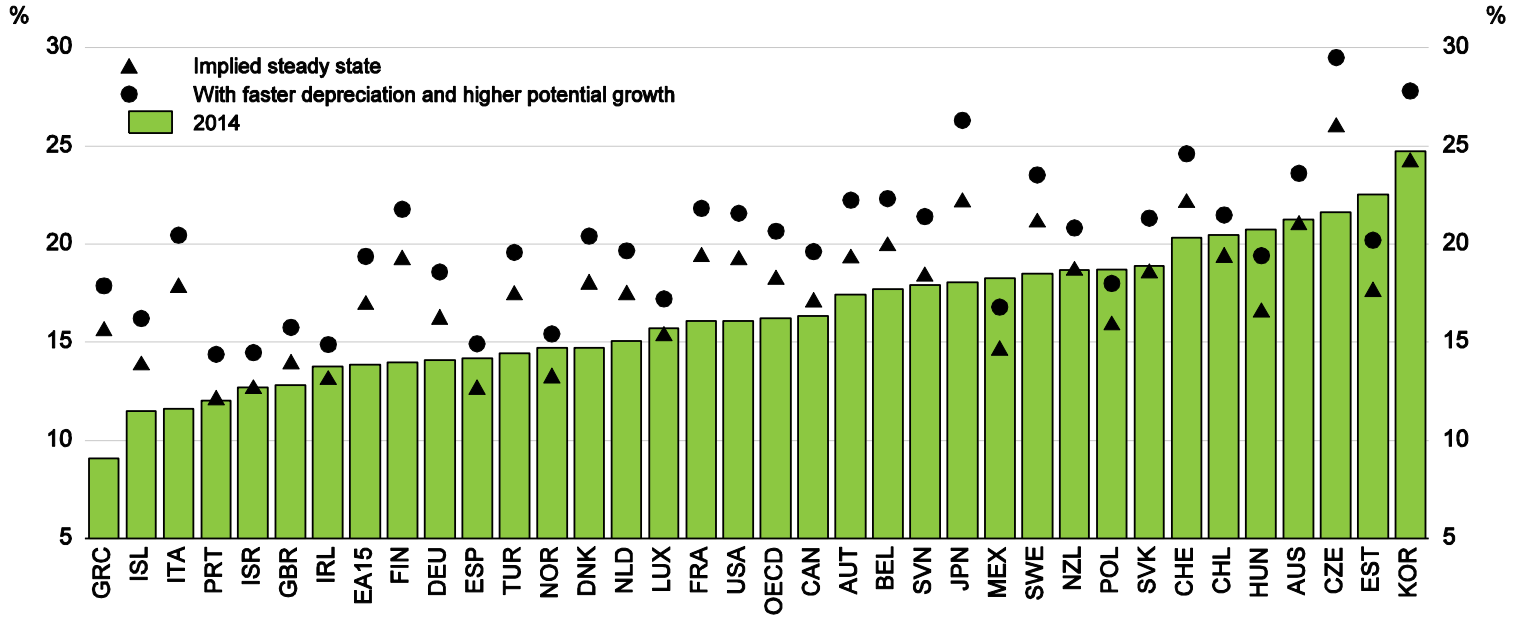
- "Public policy and resource allocation: Evidence from firms in OECD countries" by Andrews, D. and F. Cingano (2012)
- "Do resources flow to patenting firms? Cross-country evidence from firm level data" by Andrews, D., C. Criscuolo and C. Menon (2014)
- "Cross-country Evidence on Start-Up Dynamics" by Calvino, F., C. Criscuolo and C. Menon (2015)
- "The Dynamics of Employment Growth: New Evidence from 18 Countries" by Criscuolo, C., P. Gal and C. Menon (2014)
- "Knowledge-based capital, innovation and resource allocation" by Andrews, D. and C. Criscuolo (2013)

Spares

Current investment-GDP ratios are below what is needed to resume pre-crisis potential growth

Current and required steady-state levels of investment ratios

Non-residential investment as a percentage of potential GDP



Source: OECD Economic Outlook 97 database; Lewis et al. (2014); and OECD calculations

- The gap is more than 2.5 points of GDP in a third of OECD countries
- The rising role of fast-depreciating intangibles would require even stronger investment ratios
- And so would do raising potential growth above pre-crisis rates

Data (I)
Cross-country firm-level data Orbis

- The only source with a **wide coverage**
  - 23 OECD countries, 2001-2009
  - Both manufacturing and services, large and small firms
  - Balance sheets and income statements
  - Matched with **patenting data and ownership linkages**

- **Limitation**: coverage varies across countries and over time
  - Developed EU countries generally more complete

  → 20+ employees subsample to alleviate this

  → Extensive robustness checks
  (sample, measurement, etc.)

- **Ongoing** work using updated data from circa 1997-2014

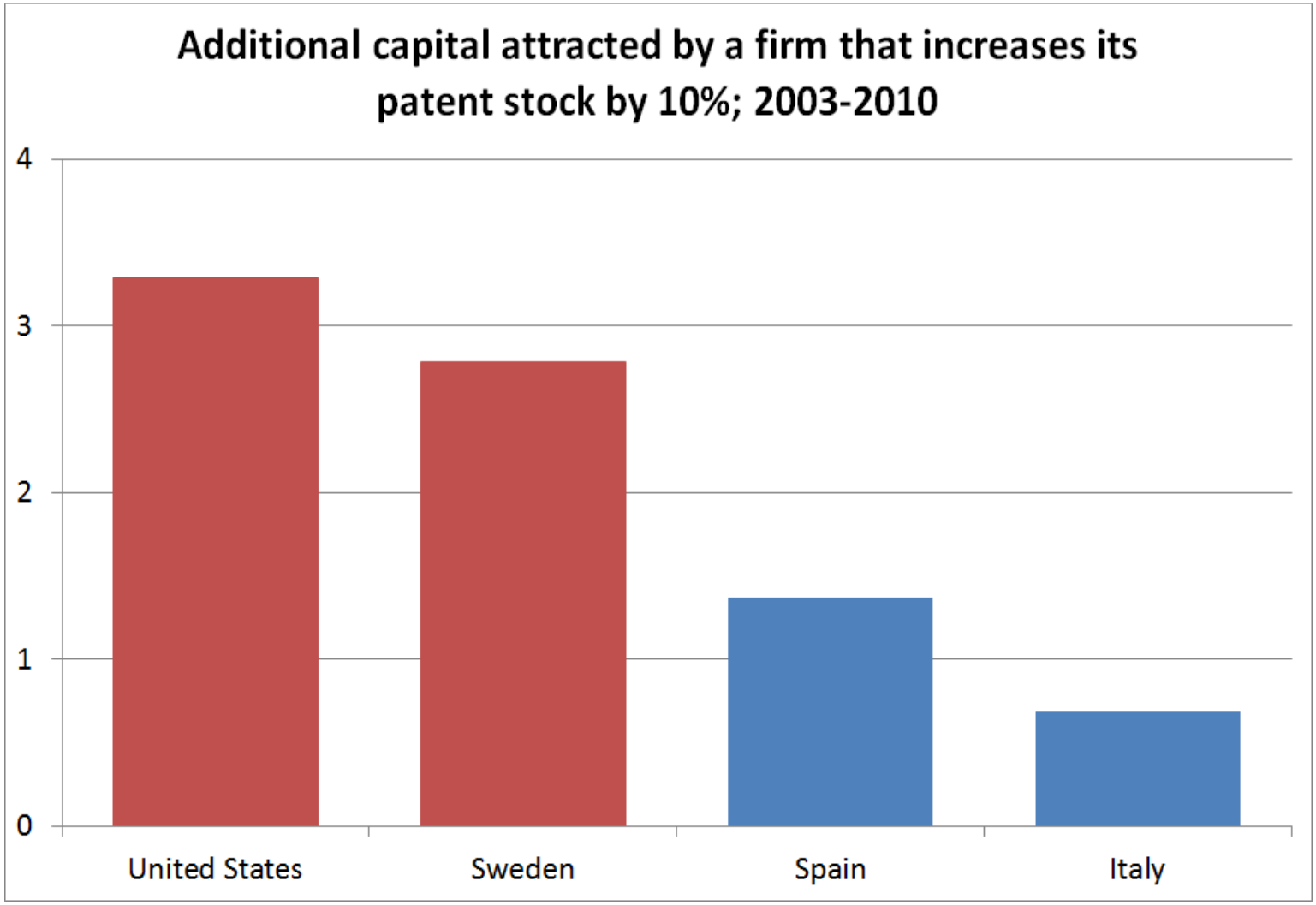
ORBIS coverage

Table 3: The average of resampling weights by country and sizeclass (2005)

	1-9	10-19	20-49	50-249	250+	Average
AUT	397.4	165.1	45.7	6.8	2.4	79.0
BEL	1.7	1.3	1.2	1.2	1.2	1.6
CZE	6.4	2.8	1.8	1.3	1.2	4.2
DEU	333.6	126.8	26.5	5.1	1.9	46.6
DNK	3.5	3.3	2.8	2.3	2.1	3.3
EST	1.5	1.6	1.5	1.8	2.1	1.6
ESP	2.4	1.7	1.5	1.4	1.2	2.1
FIN	1.4	1.3	1.3	1.3	1.6	1.4
FRA	2.1	2.0	1.7	1.6	1.6	2.0
GBR	46.6	24.2	6.2	1.9	1.1	18.2
FRC	16.2	2.7	1.5	1.4	1.8	7.7
HUN	95.2	25.3	11.4	5.6	2.7	39.7
ITA	17.7	6.0	2.3	1.3	1.2	9.4
JPN	91.5	22.6	8.4	3.6	1.1	15.7
KOR	36.0	7.7	3.1			11.7
NLD	101.8	49.0	10.1	3.0	1.1	40.8
NOR	39.2	48.6	63.5	67.0	19.0	41.7
POL	118.1	8.4	5.5	2.8	2.4	20.9
PRT	446.1	100.7	37.3	11.2	4.2	147.5
SWE	1.2	1.4	1.4	1.6	1.6	1.2
SVN	3.9	2.3	1.7	1.3	1.1	3.1
SVK	8.5	4.0	1.9	1.4	1.2	4.4
USA	51439.6	13690.8	1734.0	861.1	25.7	5192.4
Average	29.6	32.6	13.4	13.8	3.5	26.4

Peter N. Gal (2013), Measuring Total Factor Productivity at the Firm Level using OECD-ORBIS, OECD Economics Department Working Papers No. 1049

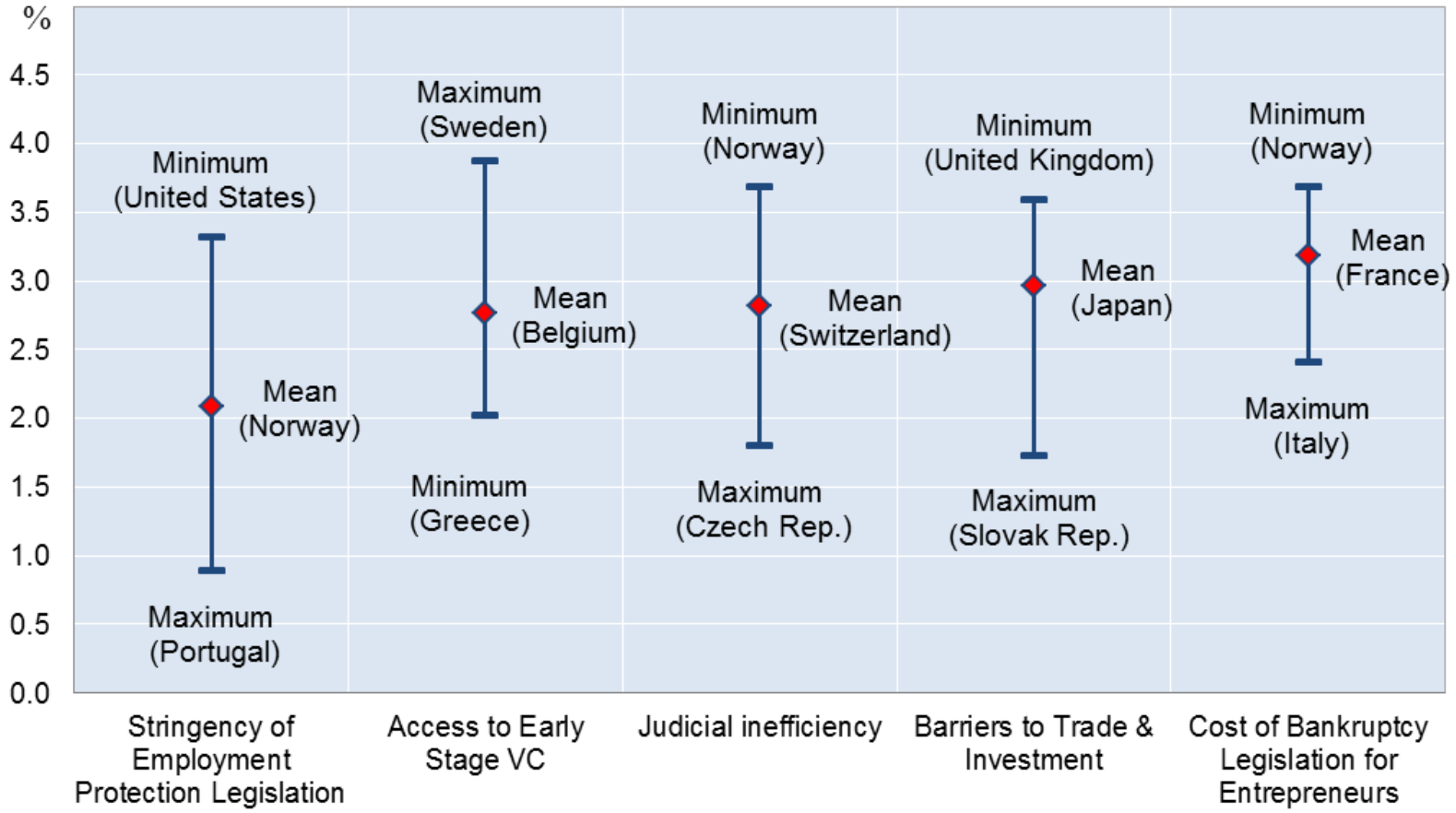
Capital reallocation to innovative firms



Source: Andrews D, C Criscuolo and C Menon (2014), 'Do Resources Flow to Patenting Firms? Cross-country Evidence from Firm Level Data', OECD Economics Department Working Papers No 1127.

Policy reforms and dynamic capital reallocation

Additional capital attracted by a firm that increases its patent stock by 10%



The estimated impact of various policies on the responsiveness of the firm investment to patenting

Source: Andrews D, C Criscuolo and C Menon (2014), 'Do Resources Flow to Patenting Firms? Cross-country Evidence from Firm Level Data', OECD Economics Department Working Papers No 1127.