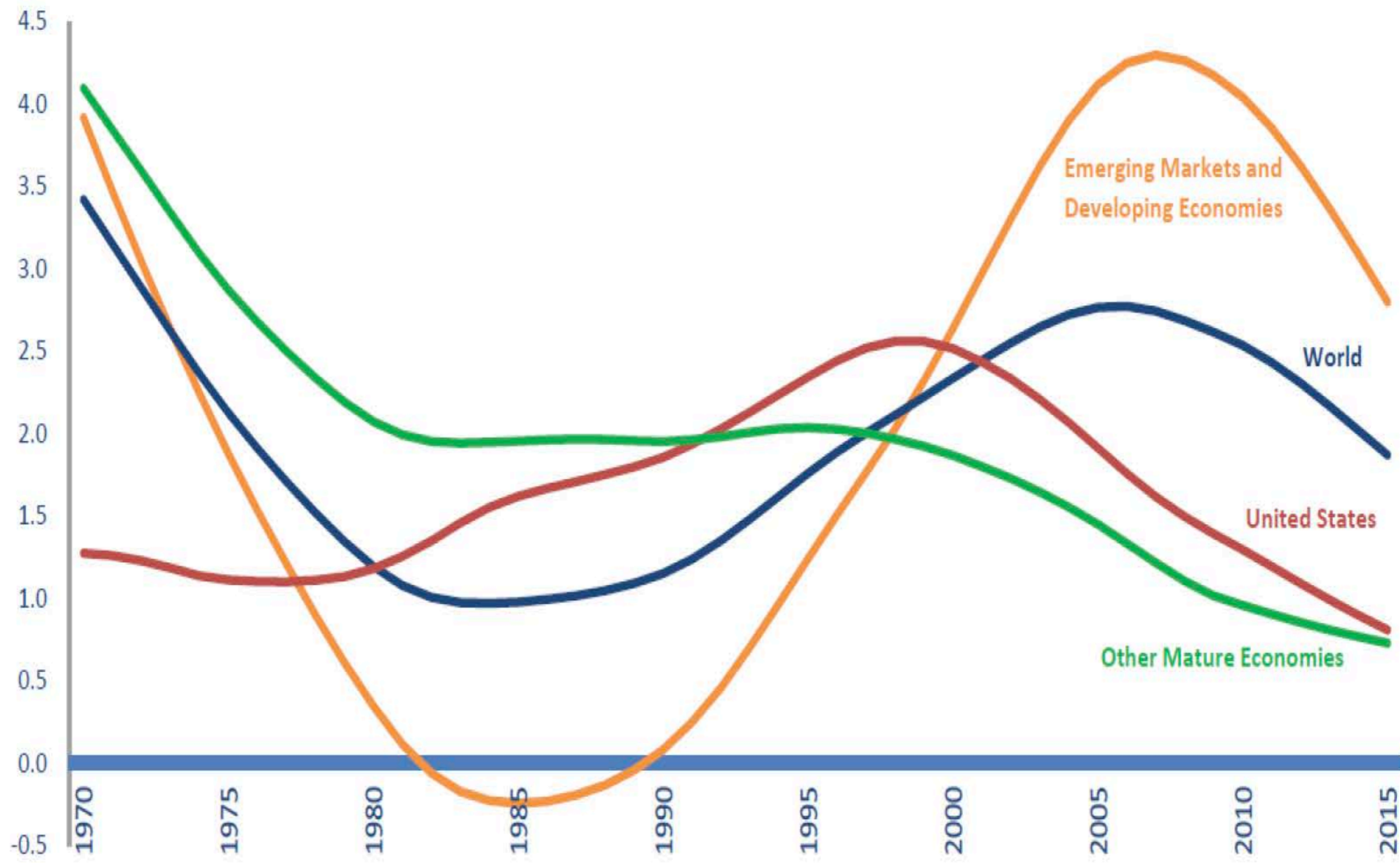# TFP and the Quality of Social Institutions.

## Institutional complementarities as key drivers of balanced innovation

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### With support of Isabella Picui

# Big Picture



Source: The Conference Board Total Economy Database™ (Adjusted version), November 2016.

Notes: Trend growth rates are obtained using HP filter, assuming a l=100.

Figure 2. Smoothed Average Annual Labor Productivity Growth (Percent) by Region

# TFP Slowdown…

- ●Not uniform across the EU member states

- ● We distinguish three clusters:

- ● Falling Behind

- ● Stagnant

- Moving Along

**Falling Back**
- Greece
- Croatia
- Finland
- Portugal
- Cyprus
- Belgium
- Spain
- France
- Czech Republic

**Moving Along**
- Poland
- Germany
- Luxembourg
- Slovenia
- Hungary
- Malta
- Ireland
- Bulgaria
- Romania
- Lithuania
- Latvia
- Estonia
- Slovakia

**Stagnant**
- Austria
- Italy
- Denmark
- Netherlands
- UK
- Sweden

- Quite heterogenous grouping that indicates different economic constellations

- Further puzzle given by assessments of quality of national innovation systems…

- …where quality ranking does not automatically map productivity performance

## Figure 3: Performance of EU Member States' innovation systems
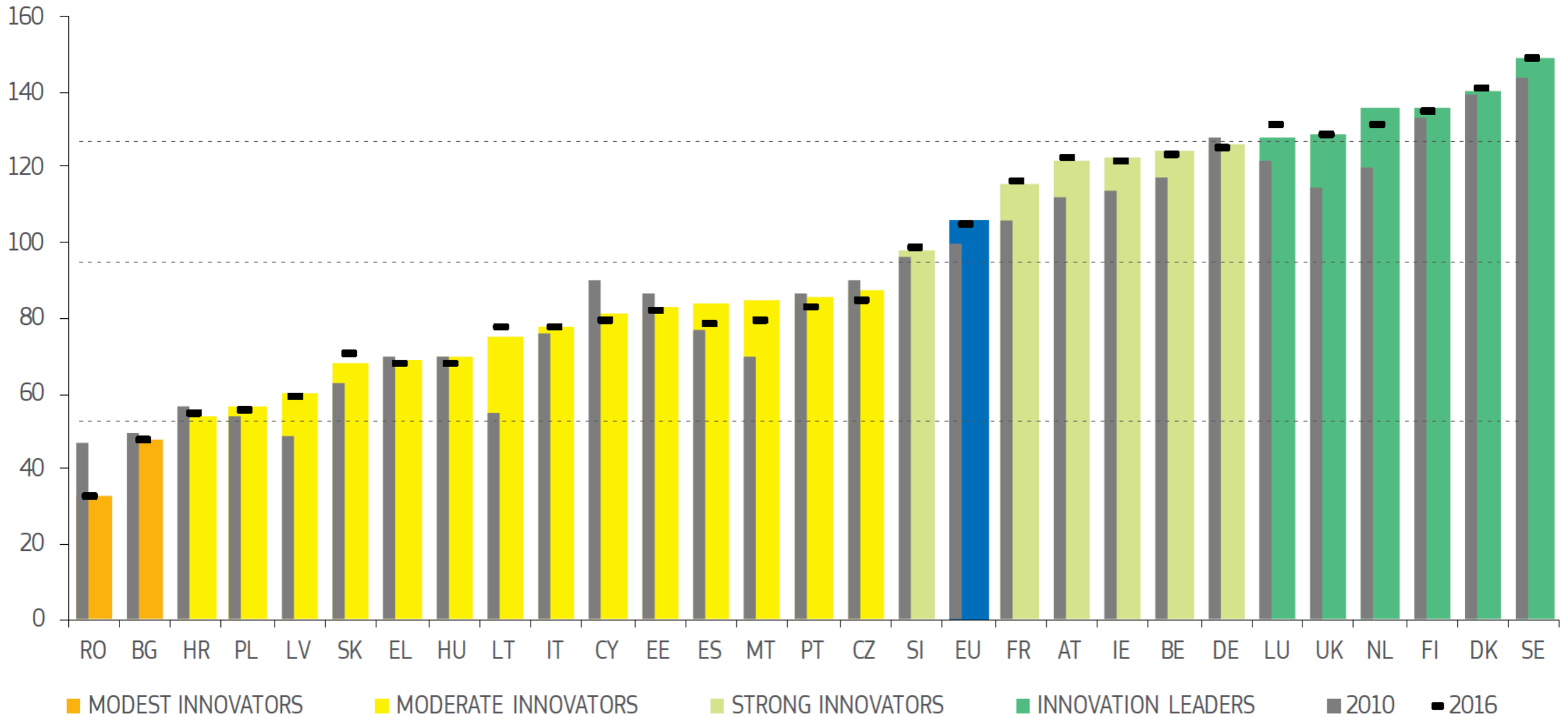


Coloured columns show Member States' performance in 2017, using the most recent data for 27 indicators, relative to that of the EU in 2010. The horizontal hyphens show performance in 2016, using the next most recent data for 27 indicators, relative to that of the EU in 2010. Grey columns show Member States' performance in 2010 relative to that of the EU in 2010. For all years, the same measurement methodology has been used. The dashed lines show the threshold values between the performance groups in 2017, comparing Member States' performance in 2017 relative to that of the EU in 2017.

- **Strong innovation systems do not automatically translate in strong TFP growth**:

- Innovation Leaders are Denmark, Finland, Luxembourg, the Netherlands, Sweden, and the United Kingdom;

- The second group of Strong Innovators includes Member States with a performance between 90% and 120% of the EU average: Austria, Belgium, France, Germany, Ireland, and Slovenia

- Mismatch performance and quality of innovation regime

# Study Overview

- **Goal**: To understand whether institutional settings and the quality of social institutions have an effect on productivity growth (or a lack thereof) in the EU and how social institutions shape innovations

- **Proposed Method**: Mixed sets which incorporate fuzzy (Boolean) and crisp (Bayesian) sets of data to meaningfully measure variation in the EU-28

- This method is useful in determining whether certain combinations of economic factors, institutional settings, and policies shape subsequent productivity outcomes in a socially balanced ways

- Balanced innovations understood as 'embedded' market outcomes

# TFP driven by..

- My project puts General Purpose Technologies into centre

- That need institutional complimentary settings to generate sustainable growth rates of TFP

- Hypothesis: Complimentary institutional settings are incomplete and unevenly distributed across the sample

- Even though the slow down is real it must not be permanent, depending from complimentary institutional settings

# Slow down of productivity

- ..finds a large number of explanations

- Literature review identifies a number of leading hypotheses that inform my project

# Causes for Slow Down

- **Mismeasurement hypothesis**: national accounting systems are not up to include all economic effects of digitalization. There is evidence but there is also a consensus that mismeasurement is not explaining the slow down of TFP

- **Frontier firm hypothesis**: Frontier firms show superior performance ( Andrews/Crisculo/Gal 2018): labor productivity gap mainly driven by gap in TFP

- Poses the question: why no strong spillover effects exist?

# Figure 2.  The widening labour productivity gap is mainly driven by MFP divergence



A: Labour Productivity

B: Multi-Factor Productivity (MFPR)
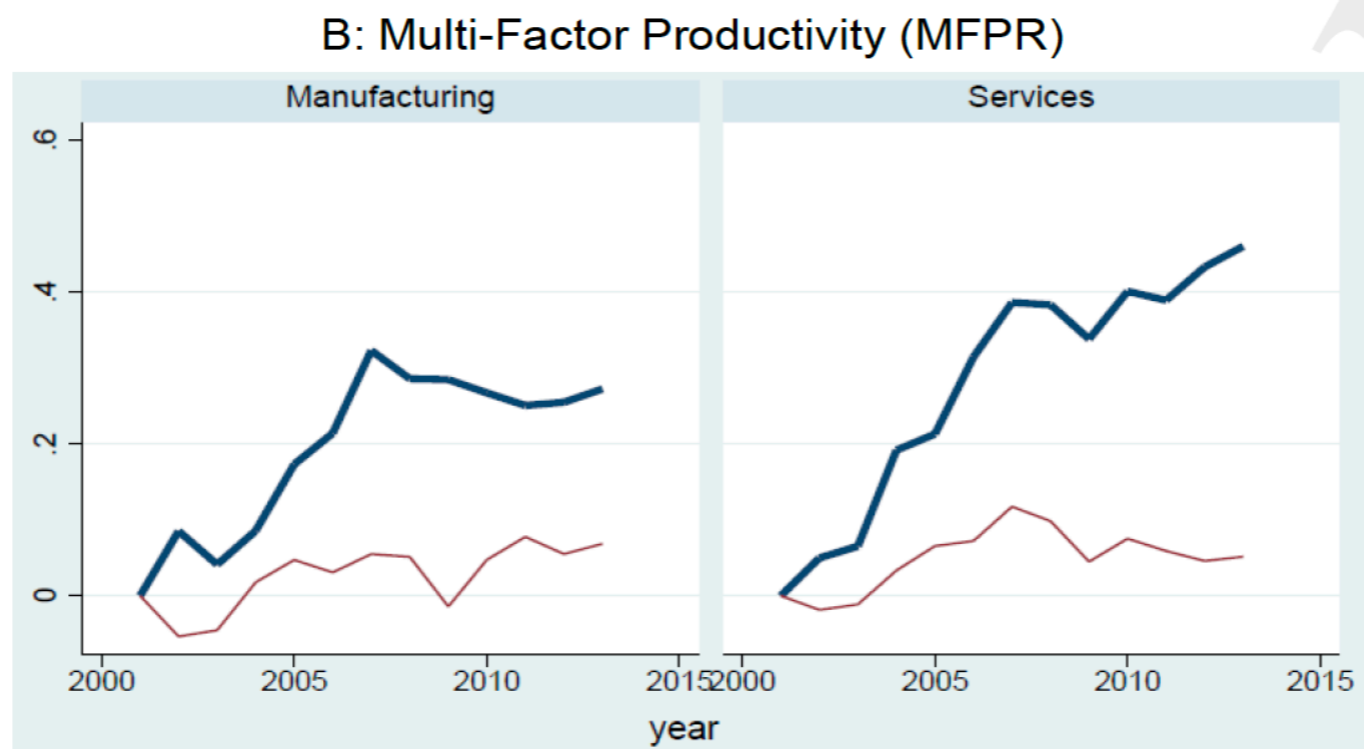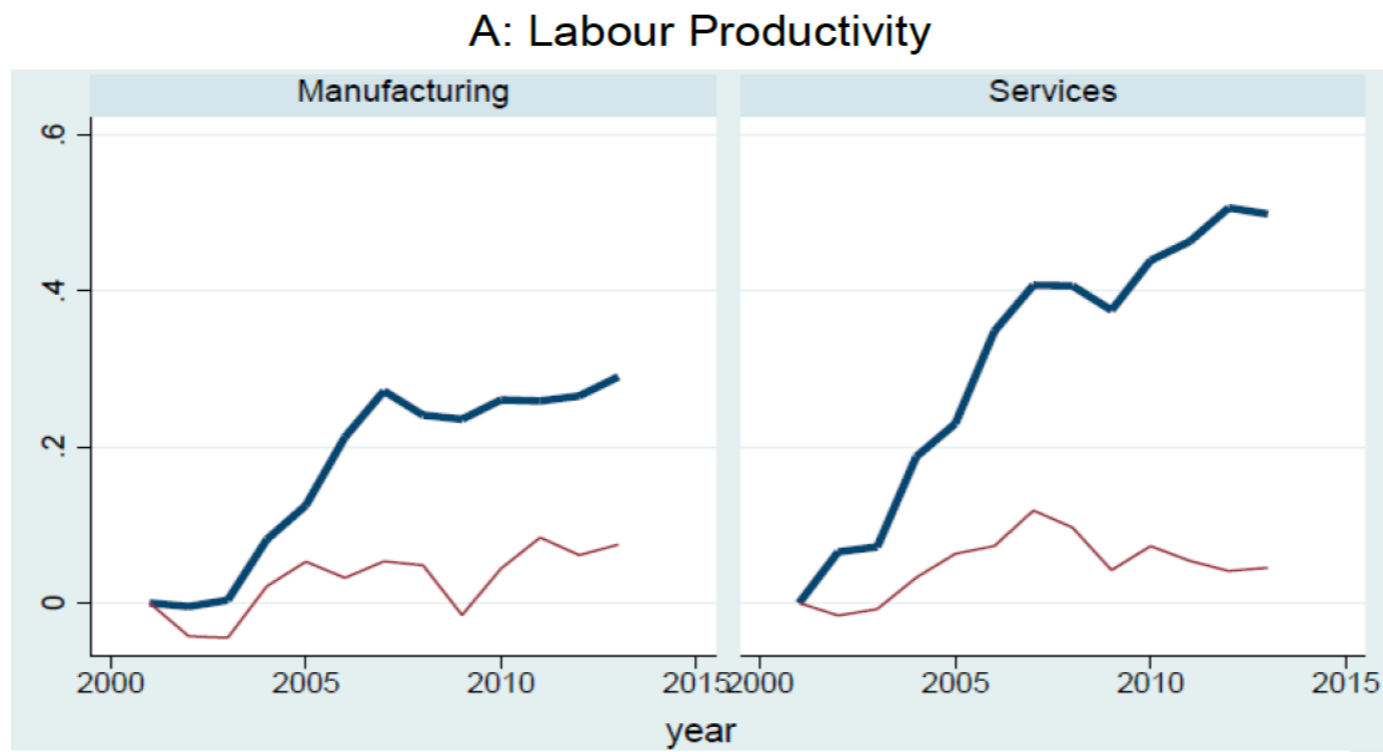
- **Superfirm hypothesis:** Advantages in TFP growth translates into higher market shares and creates winner-takes-all constellations**..**

- …and leads to a stall of innovation spillovers

- However, R&D expenditure concentration rather stable over time (Veugelers)

- **Implementation and restructuring hypothesis**: Brynjolfsson/ Rock/Syverson (2017): it takes a considerable time to be able to sufficiently harness new technologies. This holds in particular for major new technologies (GPT) that ultimately have an important effect on aggregate statistics and welfare

- Time lag mainly due to lack of complimentary investments, in particular of public investments..

- …and due to weak private investment activity

- Case studies of previous GPT illustrate time horizon argument.. but this is an inconclusive argument

- Restructuring delay due to presence of 'zombie firms' (OECD 2017)

- Keeping weak firms in the market comes with negative aggregated productivity effects

**Figure 11.     Counterfactual MFP gains from reducing zombie shares to industry minimum level**

Estimate gain to the level of aggregate business sector MFP in 2013 (percentage points)
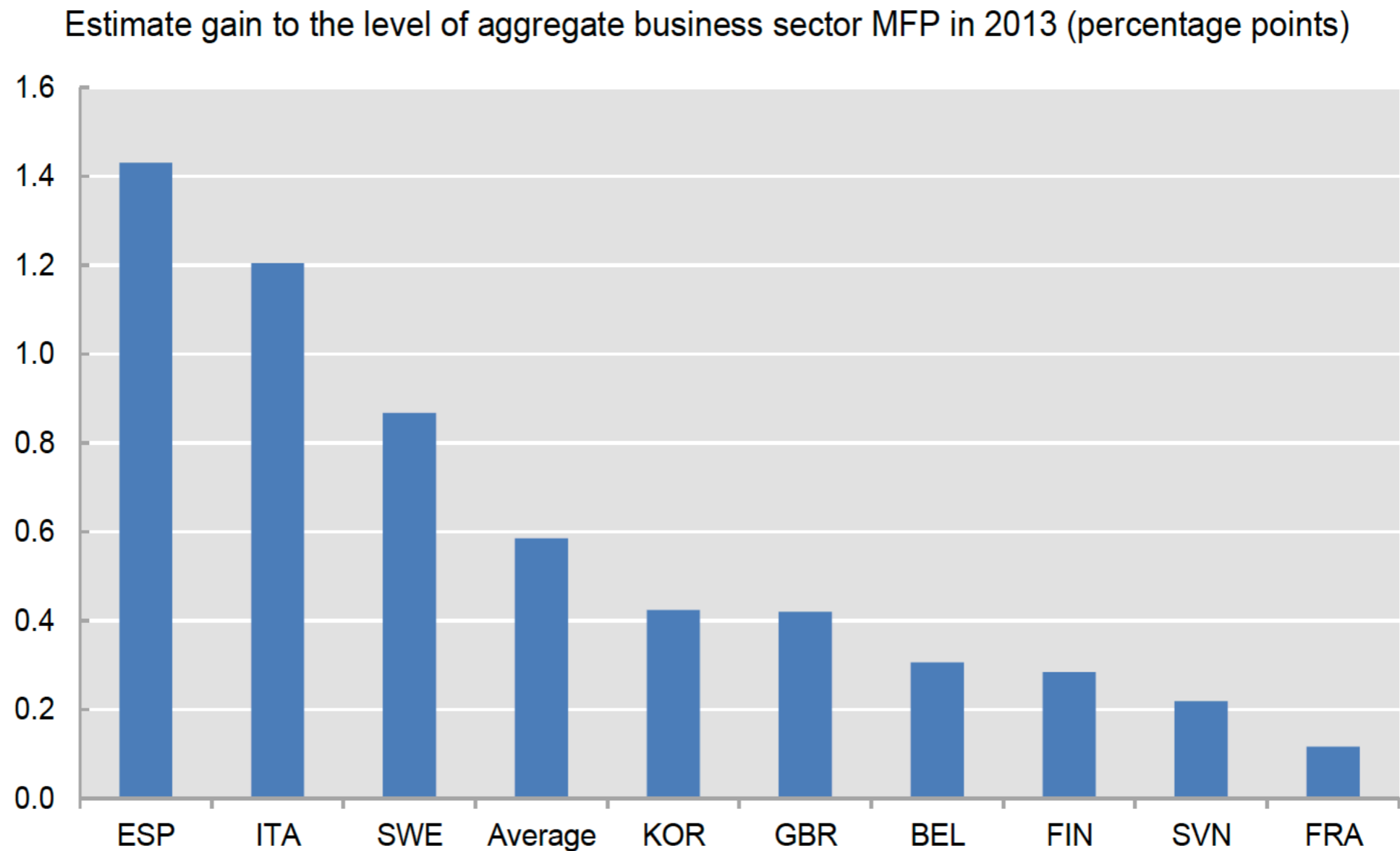


Note: This figure shows the counterfactual gains to MFP via higher capital reallocation from reducing the shares of zombies i country to the sample minimum level in each industry and year. The country level numbers are an unweighted average industries (2-digit level detail according to NACE Rev. 2, covering the non-farm non-financial business sector).

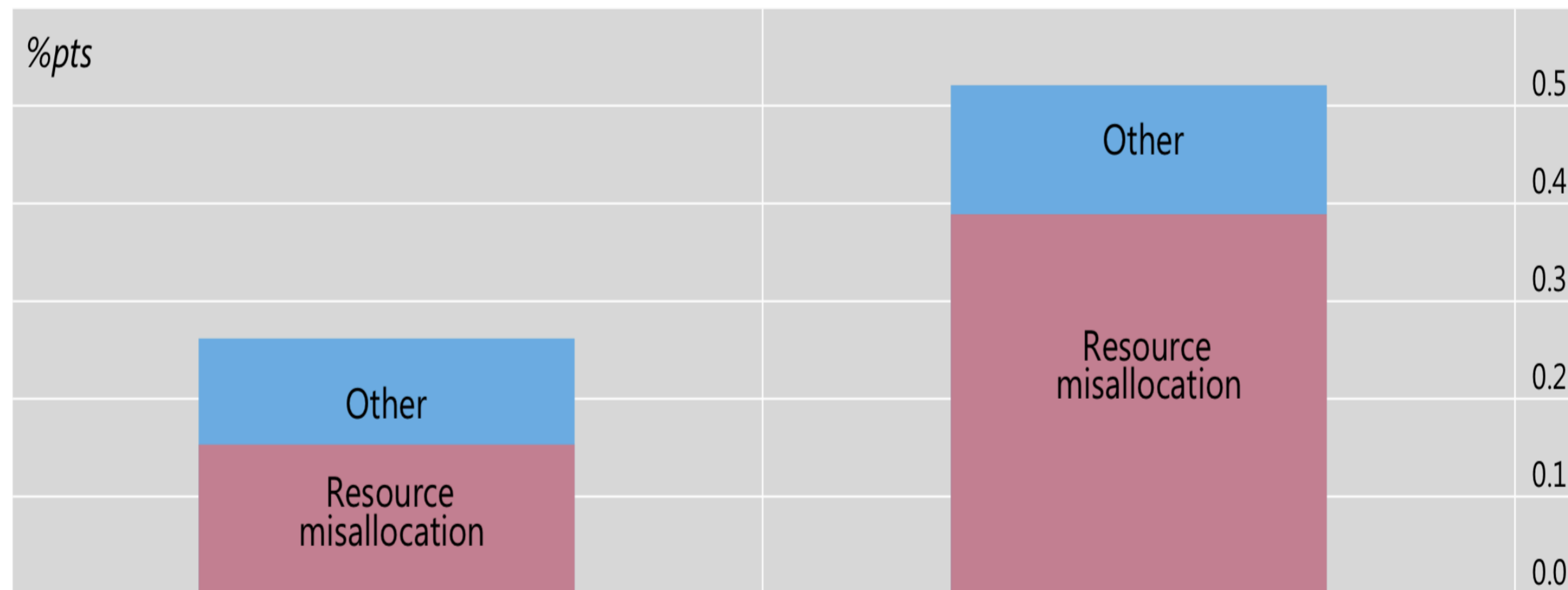Source: OECD calculations based on ORBIS.

- **Misallocation and capital inflows hypothesis**: (Cecchetti/Karroubhi; Bank of International Settlement 2015): Capital inflows that generate credit booms tend to allocate resources towards low productivity sectors (construction most prominent)

- Gopinath/Kalemli-Ozcan/Karabarbounis/Villegas-Sanchez (2015): In an environment with low interest rates, capital can be allocated to less efficient firms if financial markets remain underdeveloped. Financial market imperfections in Southern nations of the Eurozone bear some of the blame for their poor productivity performance

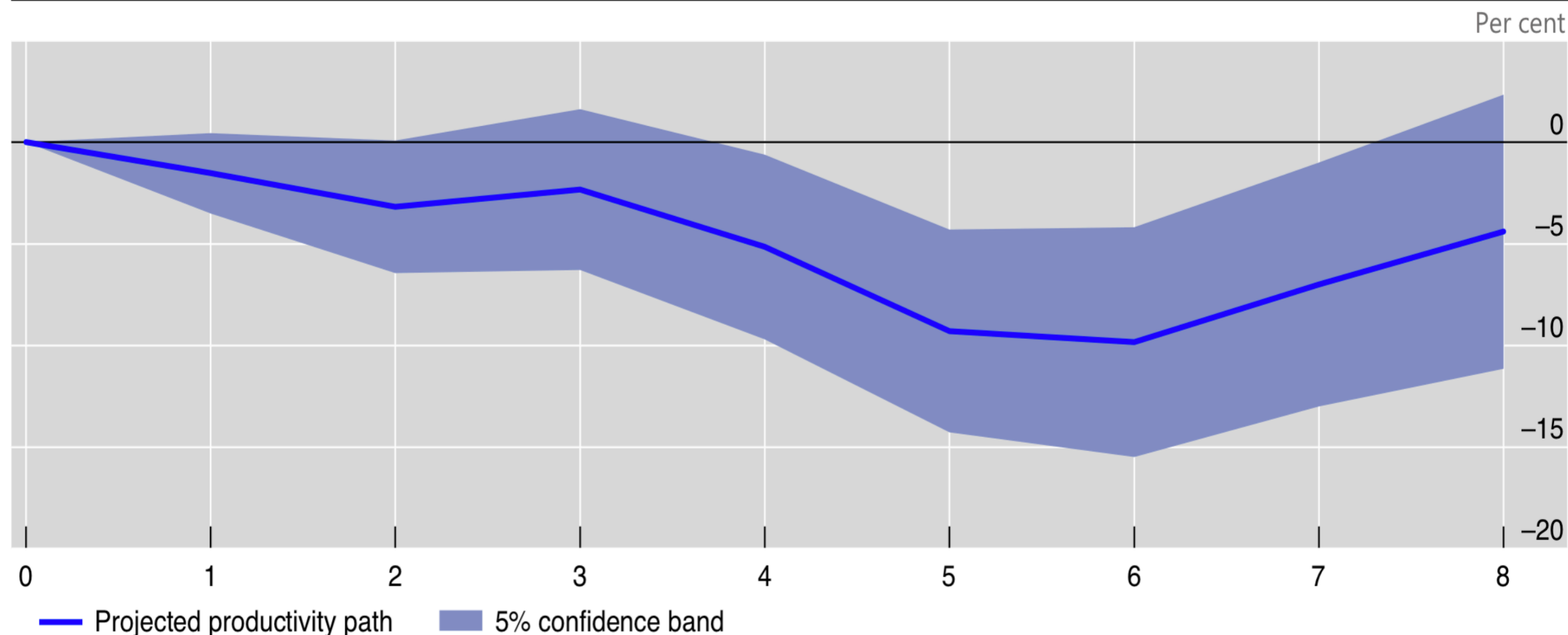## Financial booms sap productivity by misallocating resources

Graph 1

Annual cost during a typical boom...          ... and over a five-year window post-crisis

%pts

**Left panel:**
- Other (blue)
- Resource misallocation (pink)

**Right panel:**
- 0.5
- Other (blue)
- 0.4
- 0.3
- Resource misallocation (pink)
- 0.2
- 0.1
- 0.0

Estimates calculated over the period 1969–2013 for 21 advanced economies. Resource misallocation = annual impact on productivity growth of labour shifts into less productive sectors during a five-year credit boom and over the period shown. Other = annual impact in the absence of reallocations during the boom.

Source: Borio et al (2015).

# Productivity stagnates after a financial crisis due to previous labour misallocations

Graph 3

Per cent



— Projected productivity path    5% confidence band

This simulation is based on local projection regressions of the percentage deviation of labour productivity from the recession year. The independent variables include the allocation and the common components of productivity growth over the three-year period prior to the start of the recession. The blue line shows the projection of labour productivity conditional on the occurrence of a financial crisis and a positive allocation component contribution of 0.85 percentage points over three years prior to the recession (first quarter of the distribution of the allocation component contribution). The blue area around the blue line represents the 5% confidence interval around the projected productivity path.

Source: Borio et al (2015).

- **Declining research productivity hypothesis**:

- TFP determined by research productivity (# of new ideas/ # of researchers) (see: Bloom/Jones/van Reenen/Webb, 2017)

- The result for the US shows that ideas are getting harder and harder to find

# Figure 2: Aggregate Evidence on Research Productivity
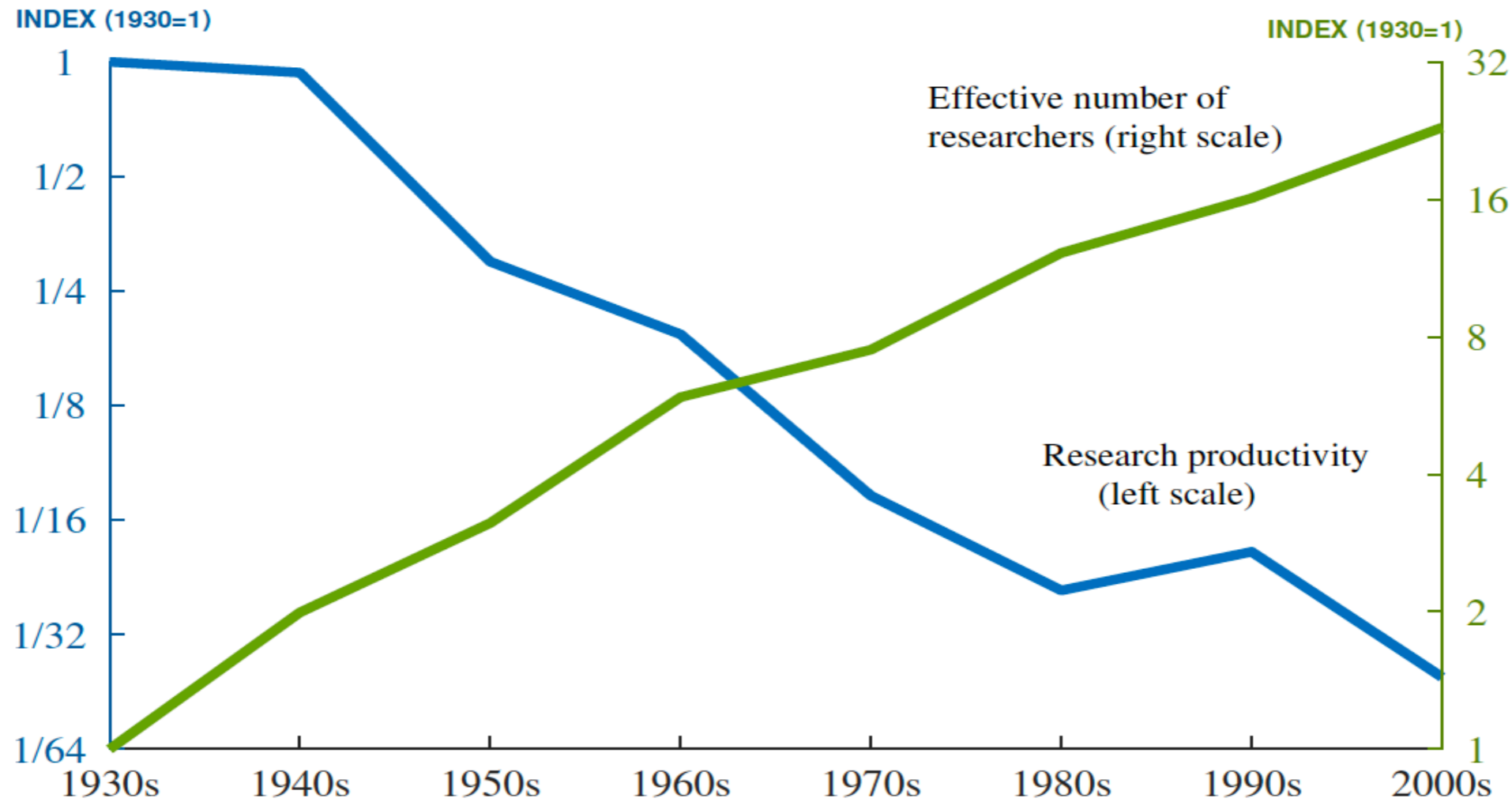


Note: Research productivity is the ratio of idea output, measured as TFP growth, to research effort. See notes to Figure 1 and the online data appendix. Both research productivity and research effort are normalized to the value of 1 in the 1930s.

# First Conclusions

- Wide range of hypotheses, some complimentary, some contradicting

- Heterogeneity of cases

- …provide window for alternative methodologies that dedicate attention to case sets

# Why FUZZY SETS AND QUALITATIVE COMPARATIVE ANALYSIS?

- Social Phenomena tends to vary in kind and degree and large N-analyses that use the same structural equations across a sample miss variations

- This holds for TFP-analyses where large N-analyses tend to lose sight of national varieties

- Fuzzy sets (FS) and Qualitative Comparative Analysis (QCA0 uses set-theoretic analysis in conjunction with gradations in set- membership, as determined by calibrated membership functions

- Relative position of cases is less important, because not all variation is treated as equal in FS/QCA

- By incorporating fuzzy sets with crisp sets into calibration, combinations of variables can be used to determine necessity/sufficiency in the dependent variable

# How do QCA/Fuzzy Sets Work?

- QCA allows us to determine the necessity and sufficiency of variables, as well as certain thresholds they may need to meet in order to have an effect

- QCA incorporates Truth Tables to illustrate when causes are present or not, and whether the outcome is present

- Fuzzy sets incorporate Boolean Notation, wherein we code for all values between and including 0,1

- Fuzzy Sets "provide a good platform for the development of calibrated measures" (Ragin, 2008)

- There are several approaches to calibration (the number of values that differentiate 0 and 1)

- This method considers how well a case meets the requirement to be included in a specific category, based on a specified membership function

# Method of Using QCA

- Learn as much as possible re: cases in order to refine the selection of cases

- Identify and Collect Data on Variables

- For each Case: Is the Variable Present?

- Create a Truth Table

- Analyze the Evidence using QCA

- Take the results back to the cases and look to identify any potential patterns

- As last step, we use Fuzzy Set Analysis to model the relations

# MEMBERSHIP FUNCTIONS

- A membership function specifies the degree to which a specific input belongs to a set

- This value is always between 0 and 1

- In this case, 0 is coded as fully outside of the set, and 1 is fully in. Anything in between is deemed as partly in, with values closer to 1 coded as being closer to considered fully in.

- In determining membership functions, we rely on the dataset and existing literature in order to determine how many categories the variable will have

- **Proposed Independent Variables (Tentative)**

- Employment protection indicators

- Growth rate GDP

- Trade Openness

- High tech import share

- High tech export share

- FDI: Incoming

- Number of Start Ups

- PISA scores

- Skill profile of workforce

- Share of Post-secondary students

- Dual Education Systems/Vocational and Apprenticeship Programs

- Public Investment as Share of GDP

- Research and Development: Private and Public

- Patents

- Tangible Investments

- Intangible Investments

- Digitalization indicators

- Social policy indicators (worker retraining…)

- Venture capital share

- Tax regime re innovation-stipulating

- Proxy for  insolvency regimes

# Tentative Expectations

- First test run with small number of independent variables

- Total Factor Productivity (TFP) = log of  Trade openness * FDI Inflow share * intangible share * private R&D share * public R&D share * PISA score * market access indicators * market exit indicators * venture capital access * employment protection indicators (OECD) * worker retraining

- …indicates that embedded growth regimes tend to support TFP-growth