BANCA D'ITALIA
EUROSISTEMA

Long-run trends in Italian productivity

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Outline of the Presentation

1) Motivation
2) Define the contours of Italy's economic growth (GDP per capita, labour productivity, TFP) in a (very) long term horizon
3) Italy's long-run productivity performance in an international perspective
4) Candidate explanations of the recent productivity slowdown in Italy
5) Concluding remarks

1. Motivation

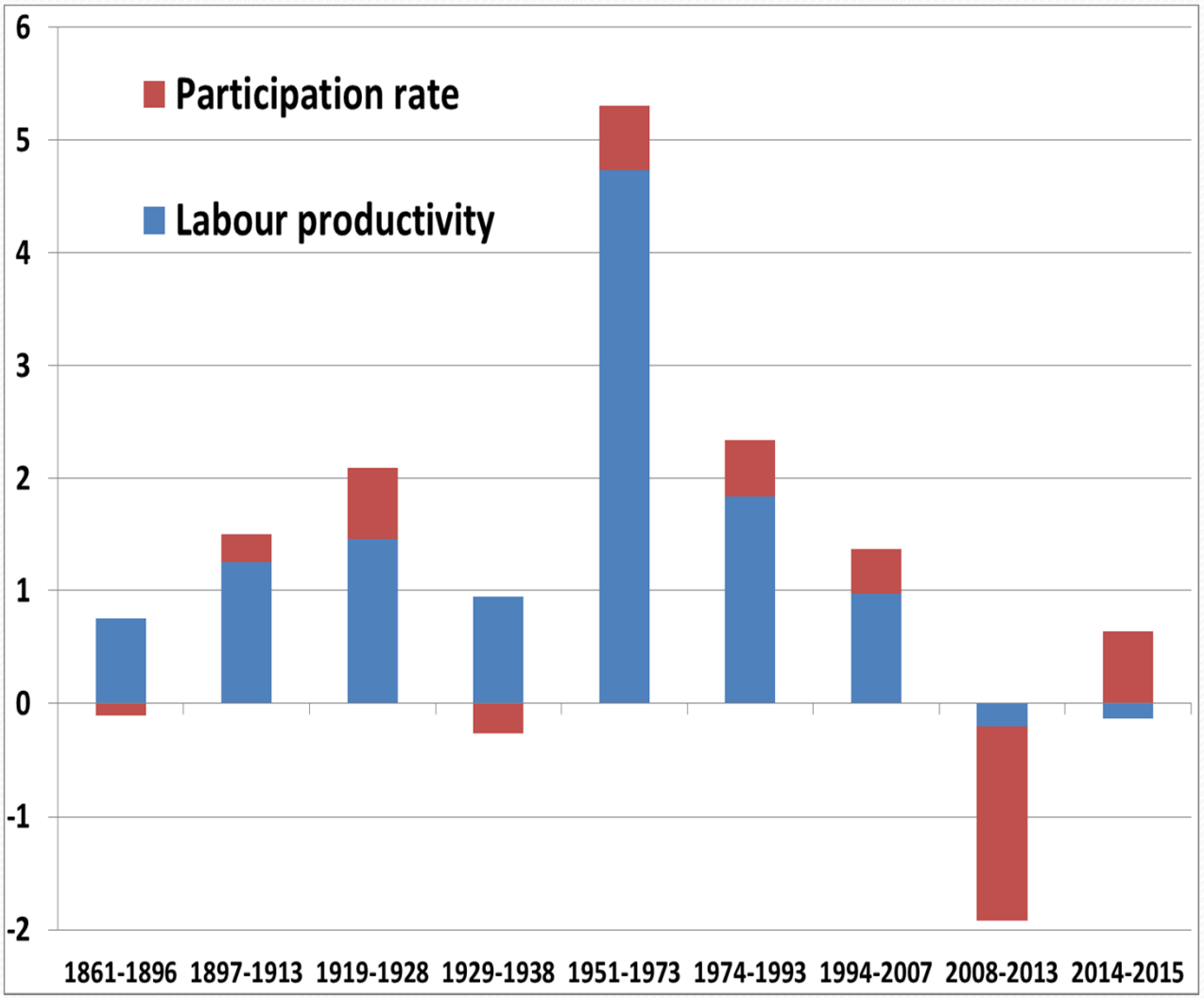
- Analyse macro developments in Italy's **labour productivity and TFP since 1861** from both a **sectoral** viewpoint and an **international** comparative perspective in order to:
  - ….better define the **stages of Italy's economic development** and
  - ….understand the **proximate drivers** of current productivity malaise
  - … [as a by product] deliver **update data on labour and capital inputs** in a historical perspective (based on previous work by the authors)

2. Defining the contours of Italy's economic growth

a) GDP per capita, labour productivity and labour participation

Decomposing GDP per capita growth

GDP per capita growth decomposition
(annual average percentage changes)



Source: Authors' estimations.

- Labour productivity main driver of GDP per capita growth for **the whole period until 2008**, as FTE participation explained nearly all GDP per capita trends
- **In 2008-2013** drag from FTE participation larger than negative productivity [the loss in participation rate even worse than in the Great Depression]
- The **recent recovery** driven by recovering participation
- No long-run series on **working-age population** to further investigate demographics

Developments in Italy's labour productivity (1)

Full-time equivalent labour productivity growth rates
(annual average percentage changes)

	Labour productivity				
	Agriculture	Industry	Private services	Private total economy	GDP per capita
1861-1896	0.6	1.5	0.6	0.8	0.6
1897-1913	1.3	0.9	2.2	1.5	1.5
1919-1928	0.9	1.3	0.1	1.1	1.4
1929-1938	1.7	0.9	-0.3	1.1	0.5
1951-1973	4.7	5.9	4.5	6.0	5.4
1974-1993	5.0	3.1	0.6	2.1	2.4
1994-2007	2.9	1.2	0.4	1.1	1.4
2008-2013	1.5	0.2	-1.2	-0.3	-1.9
2014-2015	-1.5	0.6	-1.0	-0.5	0.5
1861-2015	2.1	1.8	1.0	1.6	1.8

Source: Authors' estimations.

- Low LP growth **in first 20 years** but industry already a driver
- All sectors contributed to the first **Giolitti** spurt; services were the only drag in the booming **1920s**
- Stalling effect of fascist policies and Great Depression in **1930s**, with exception of agriculture
- Italy's **Golden Age** broad-based but particularly driven by industry

Developments in Italy's labour productivity (2)

Full-time equivalent labour productivity growth rates
(annual average percentage changes)

	Labour productivity				
	Agriculture	Industry	Private services	Private total economy	GDP per capita
1861-1896	0.6	1.5	0.6	0.8	0.6
1897-1913	1.3	0.9	2.2	1.5	1.5
1919-1928	0.9	1.3	0.1	1.1	1.4
1929-1938	1.7	0.9	-0.3	1.1	0.5
1951-1973	4.7	5.9	4.5	6.0	5.4
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1994-2007	2.9	1.2	0.4	1.1	1.4
2008-2013	1.5	0.2	-1.2	-0.3	-1.9
2014-2015	-1.5	0.6	-1.0	-0.5	0.5
1861-2015	2.1	1.8	1.0	1.6	1.8

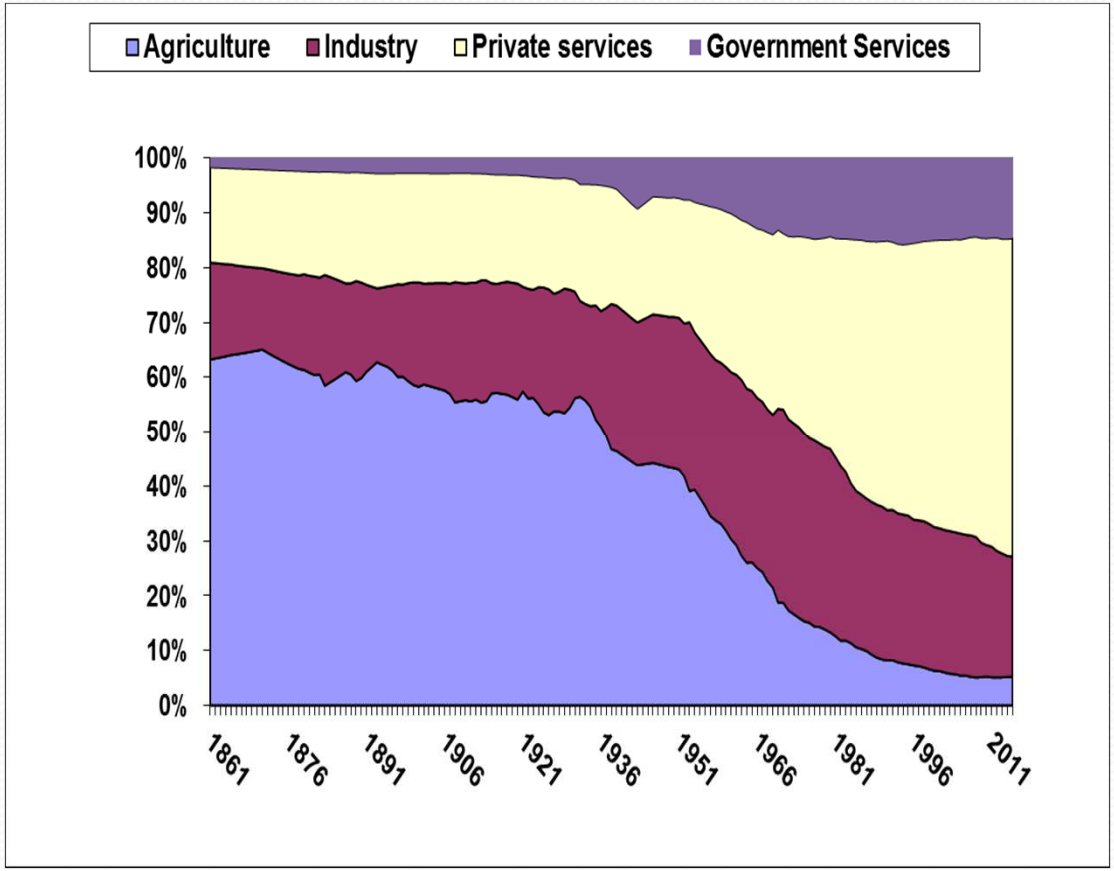
Source: Authors' estimations.

- Private services main culprit of slowdown **since 1970s**
- Productivity performance during **recent double recession** even worse than in Great Depression
- **Recent productivity recovery** slowed down by services (and agriculture)

Changes in Italy's employment composition

FTE labour shares, 1861-2015

(percentage shares)



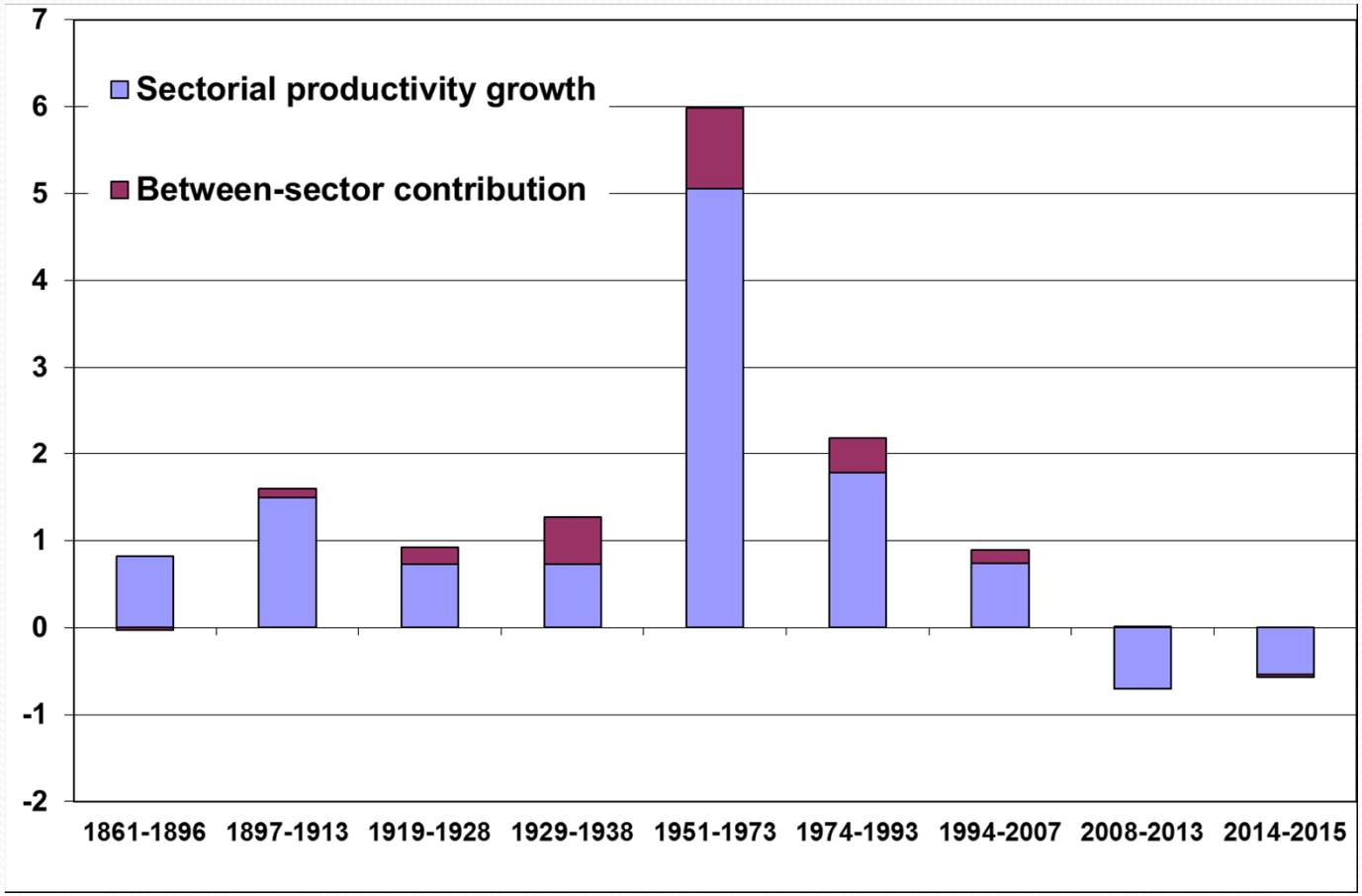
Source: Authors' estimations.

Standard development pattern *à la* Kuznets-Clark:

- employment contraction in agriculture;
- steady increase in private services, especially after WWII;
- mild hump-shaped pattern in industry

The contribution of structural change to labour productivity growth

Labour productivity growth decomposition
(annual average percentage changes)



Note: Author's calculations based on a shift-share analysis derived from Nordhaus (1972) and modified as in Broadberry (1998).

- The **between-sector labour shifts** account on average for **one fifth** of aggregate LP growth
- In absolute terms, positive contribution of structural change **large in 1919-1993**
- Scope for (broad) between-sector reallocation effect **fading in recent periods**

2. Defining the contours of Italy's economic growth

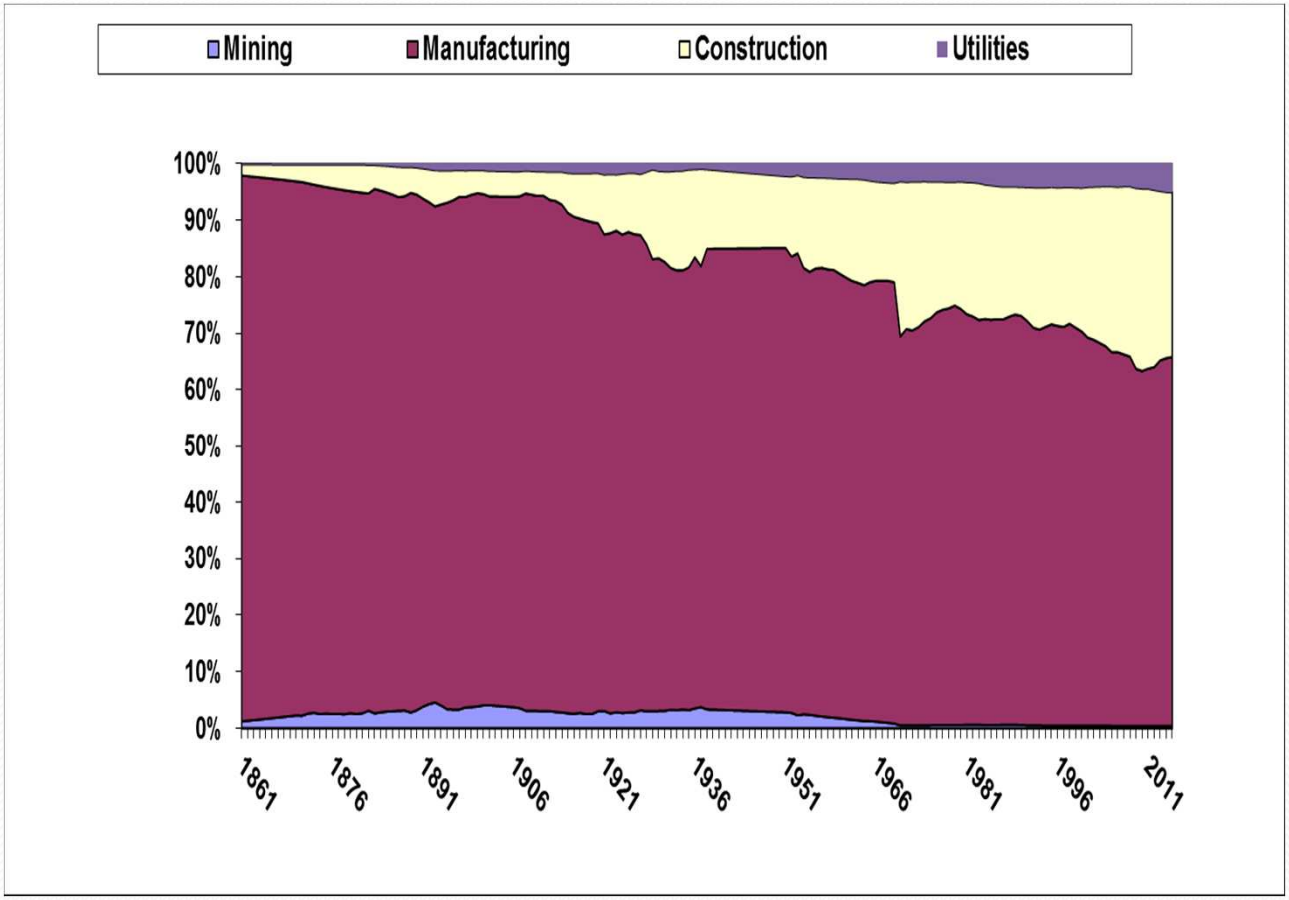
b) Labour productivity dynamics within

industry

services

Italy's industrial employment composition

FTE labour shares within industry, 1861-2015
(percentage shares)

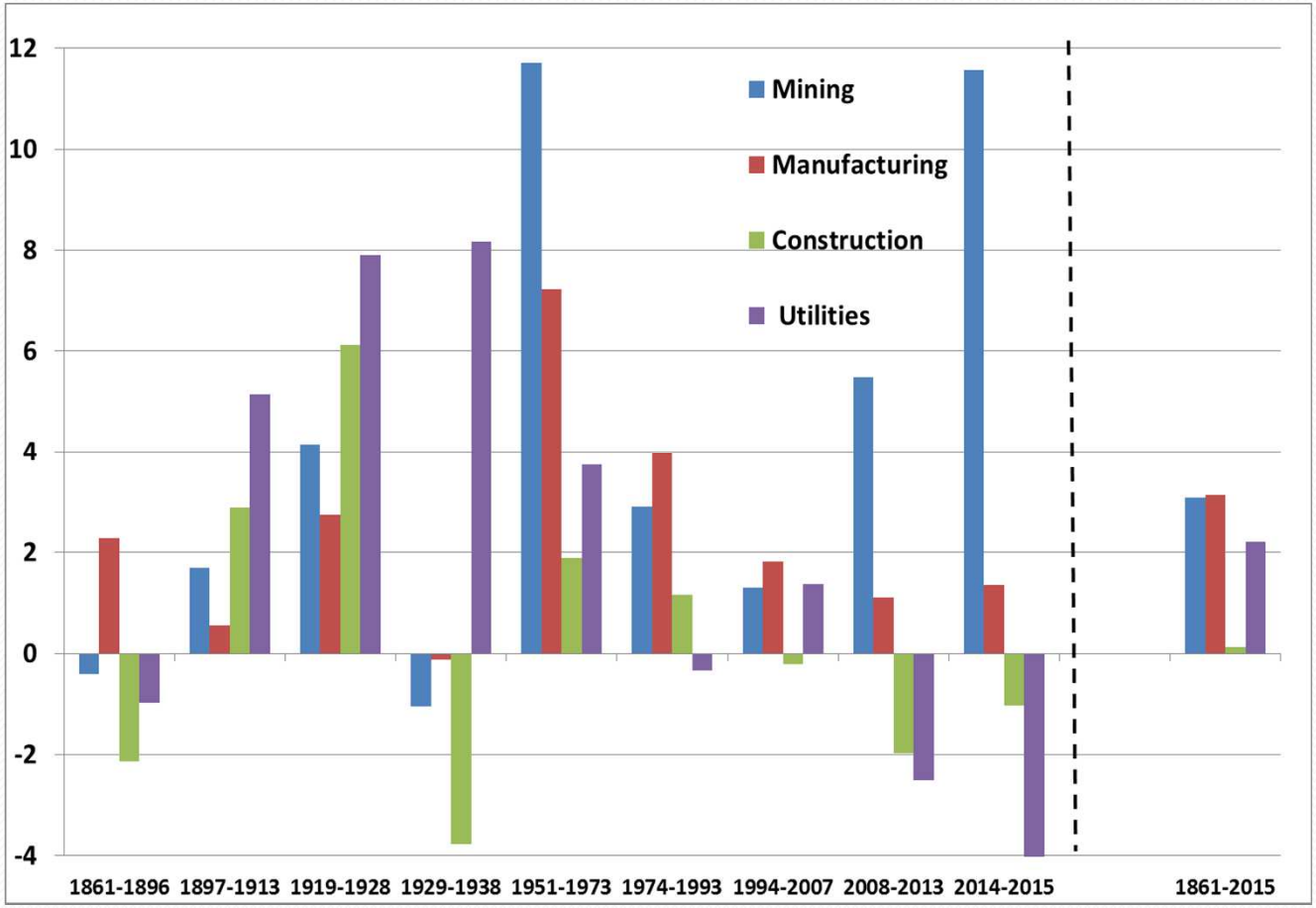


- **Manufacturing** dominant sector
- **Construction** increasing in size, in particular after 1920s, currently accounting for about 30% of total industry
- **Mining and utilities** small, with opposite trends

Source: Authors' estimations.

Industrial labour productivity dynamics

Full-time equivalent labour productivity growth rates within industry
(annual average percentage changes)



Source: Authors' estimations.

- **Manufacturing** only sector with positive LP throughout the period (except the Great Depression)

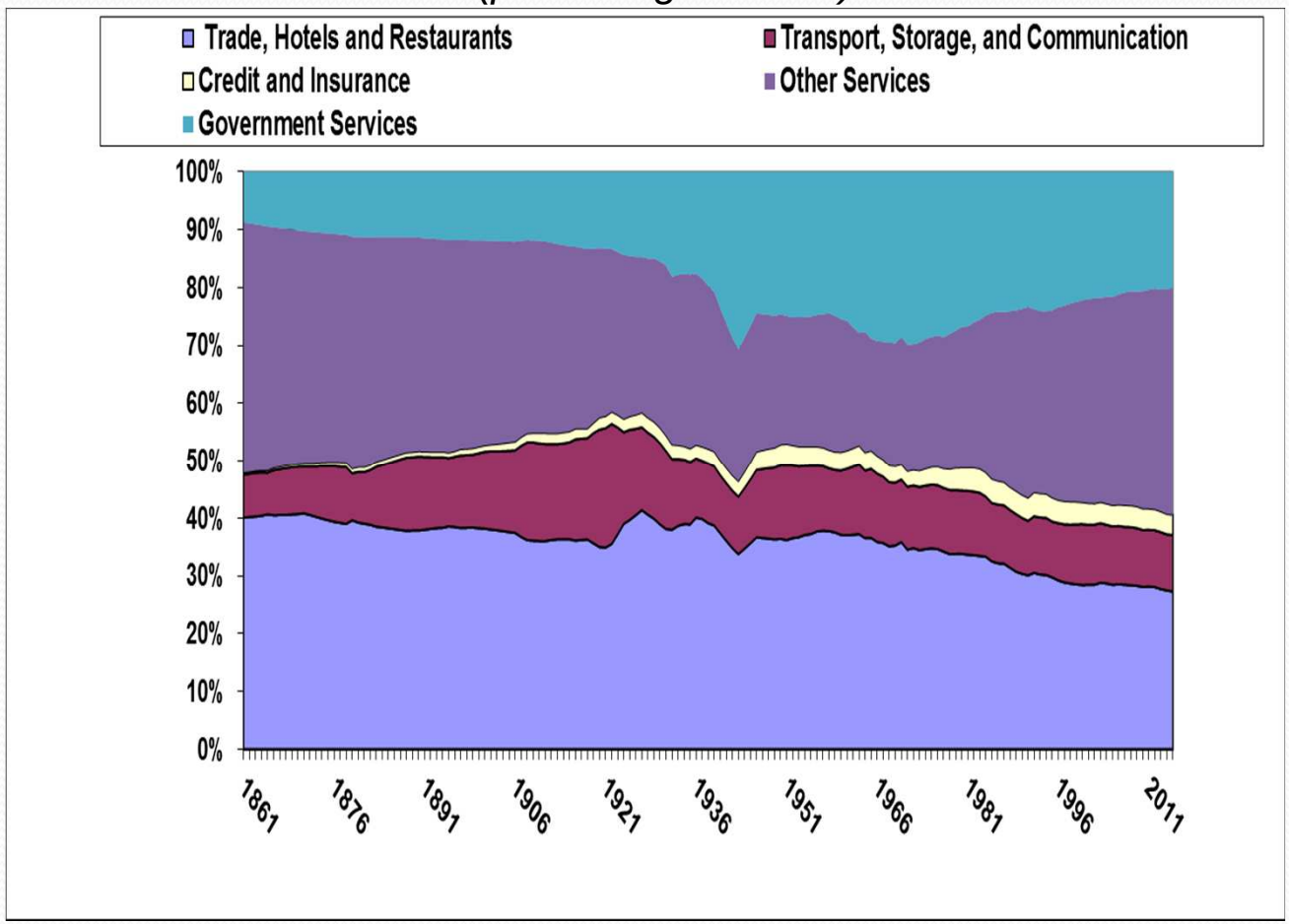
- **In Construction** sluggish LP growth on average, due to falls in Great Depression and since 1994

- Exceptional growth rates across the board in **Golden Age**

- **Since then** slowdown in manufacturing with a modest reversal in 2014-2015

Italy's services' employment composition

FTE labour shares within services, 1861-2015
(percentage shares)



Source: Authors' estimations.

- **Trade, hotels and restaurants and other services** are the largest sectors, accounting for two thirds of total services

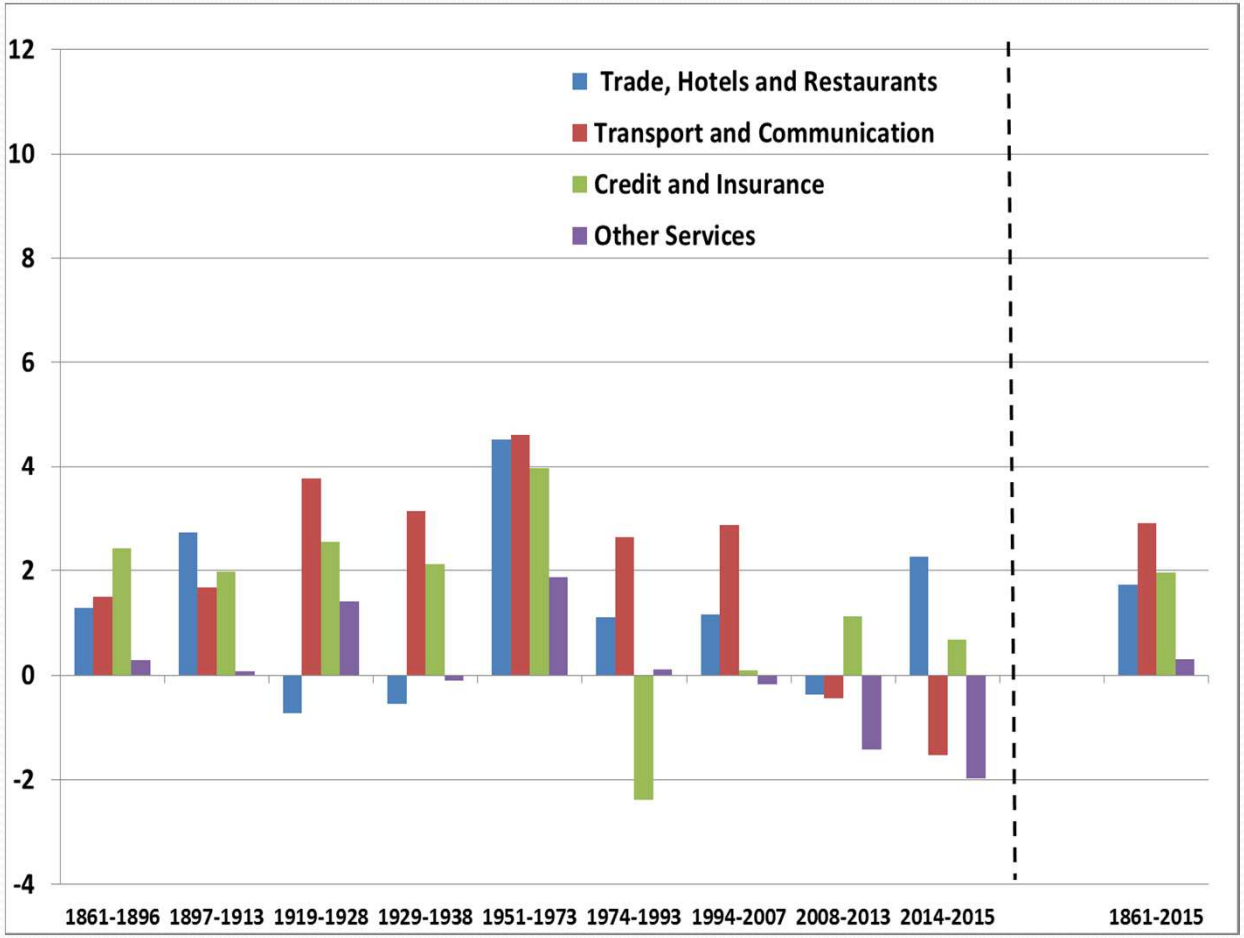
- **Transport and communication** roughly stable around 10-20%

- **Government services** increasing until peak, excluding war years, in 1972 (about 30%)

- **Credit and insurance** increasing over 155 years but still tiny (3.5% in 2015)

Services' labour productivity dynamics

FTE labour productivity growth rates within services
(annual average percentage changes)



Source: Authors' estimations.

- **Until WWI**, services registered positive growth rates across the board, as in the **Golden Age**, when growth rates were the highest ever in all branches

- **Transport & communication** was the strongest driver throughout, although its LP declined in 2008-15

- "**Other services**" exerted the largest drag on services' LP growth over the whole period

- **Trade, hotels and accommodation** attenuating the decline in total services' LP in 2014-15

2. Defining the contours of Italy's economic growth

c) Total factor productivity trends

The proximate sources of Italy's growth

Decomposition of GDP growth
(percentage changes and points)

Years	Changes in non housing GDP	Contribution of labour	Contribution of capital services	*of which asset substitution*	Changes in TFP
1861-1896	1.25	0.36	0.77	0.20	0.11
1897-1913	2.47	0.70	1.13	0.16	0.63
1919-1928	2.80	0.82	-0.18	-0.24	2.16
1929-1938	1.04	0.31	1.20	0.24	-0.48
1951-1973	6.90	0.86	1.96	0.05	4.07
1974-1993	2.74	0.49	1.19	0.07	1.06
1994-2007	1.91	0.45	0.79	0.08	0.67
2008-2013	-1.59	-0.92	0.00	-0.07	-0.67
2014-2015	0.12	0.39	-0.41	-0.12	0.14
1861-2015	2.36	0.46	0.89	0.08	1.02

Source: Authors' estimations.

- **TFP gradually accelerated** until years before the Great Depression

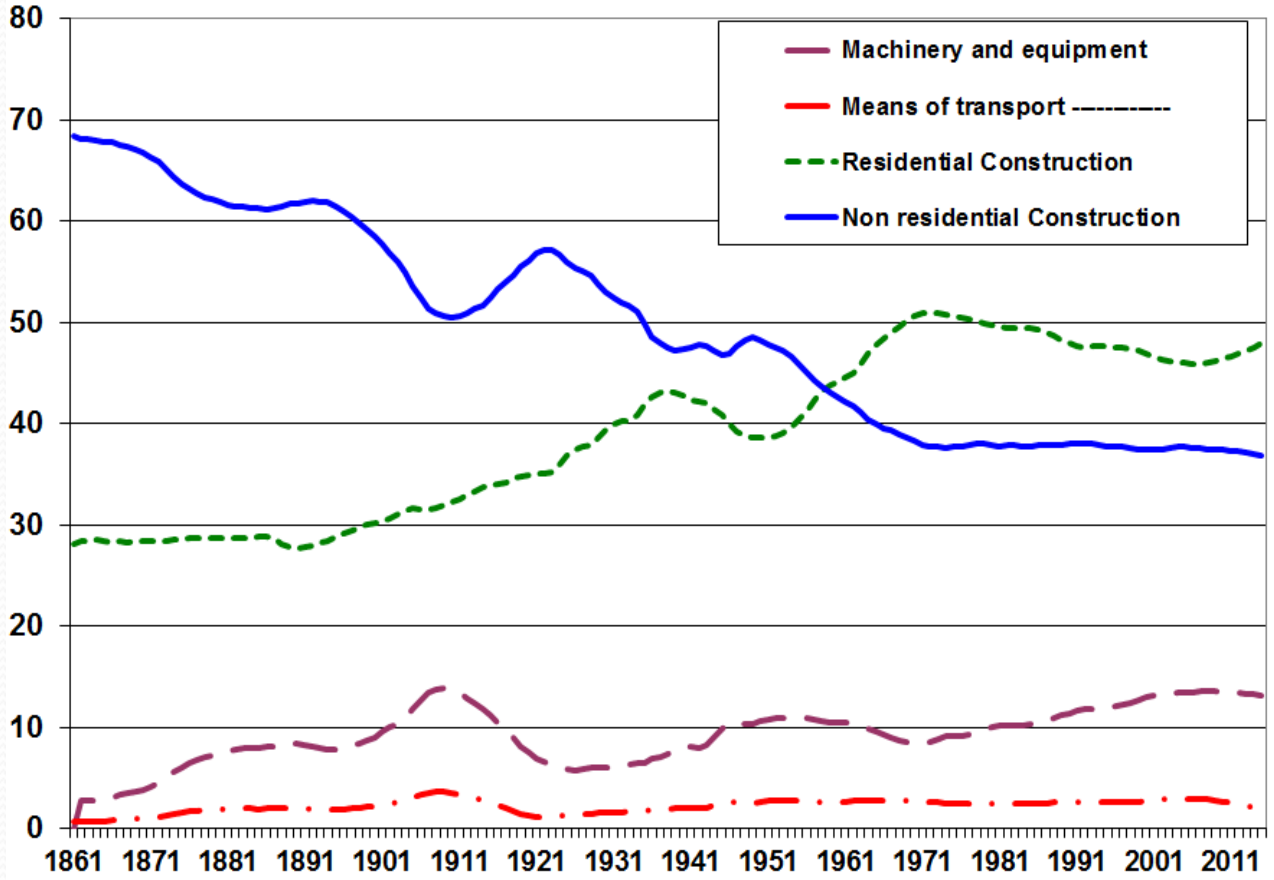
- **First spurts** were primarily associated with **capital accumulation**, that was over-paced by labour contribution in 1919-28

- **TFP growth peaks in Golden Age**, hitting 4.1% per year

- The **disappointing TFP performance prior to the global crisis** is the main determinant of the slowdown in GDP, together with capital accumulation among the lowest ever registered (with the exception of 1919-1928)

- **During the crisis** the fall in GDP traced back to **negative labour input as well as TFP reduction**. In the last two year the two drivers somewhat recovered against a falling capital accumulation.

The changing composition in net capital stock



- In the early stage, asset substitution mostly from non-residential structures to machinery and equipment

- Since early XX century a housing upsurge against a recovery followed by a steady drop in other construction.

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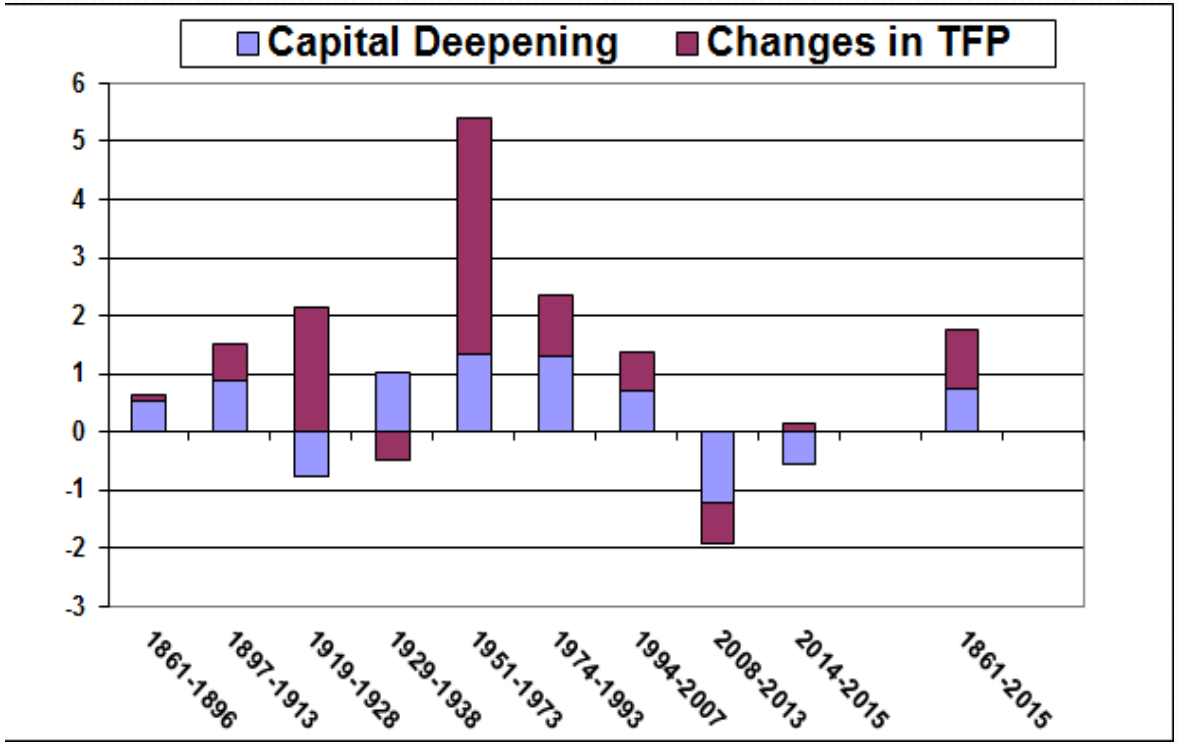
Different pattern since late 1960s: positive trend in machinery and equipment offset by a decline in housing share (apart from years since mid 2000s) while the contraction of non-residential structures virtually stopped

LP dynamics: A further decomposition

A decomposition of labour productivity growth
(percentage changes)



Source: Authors' estimations.

- Slow labour productivity result of sluggish TFP growth **until WWI** and limited capital intensity **in interwar years**

- Strongest TFP growth but also greatest capital deepening **during the Golden Age**

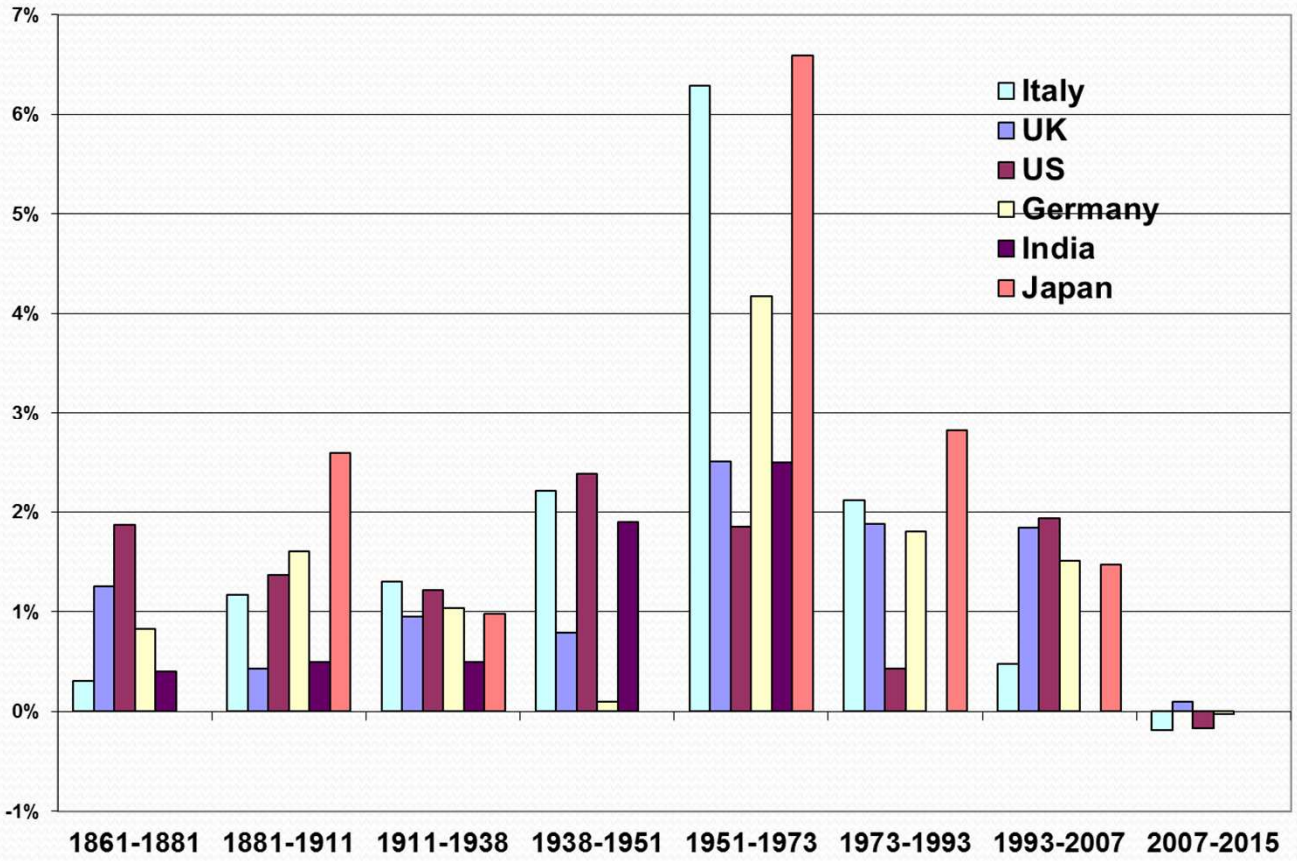
- Deterioration in both components **thereafter**, until turning negative **during the crisis,** and **in the current recovery for** the sole **capital deepening.**

- Overall, **TFP growth main driver** of LP growth

3. Italy's long-run productivity performance in an international perspective

Labour productivity growth in selected countries

Headcount labour productivity growth rates
(annual average percentage changes)



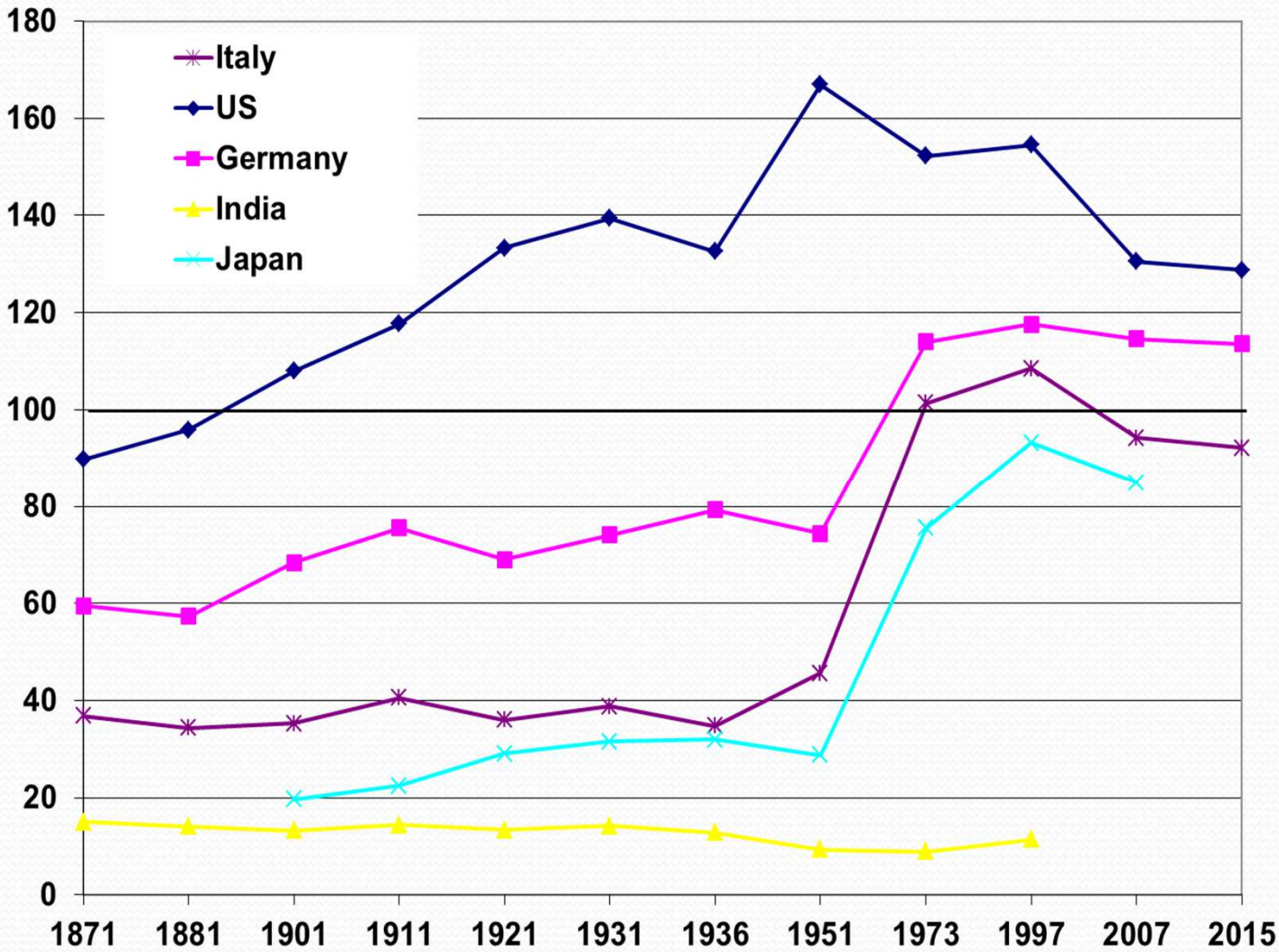
Source: Authors' estimations and calculations on OECD data and other data sources
Notes: The periodization is different with respect to the charts only on Italy due to availability of international data only for benchmark years.

- Italy's LP growth the lowest in **1861-1881**, mostly due to **agriculture**
- LP growth in Italian **industry** higher than in other countries only during two sub-periods (1881-1911 BUT similar to Germany and 1951-1973 BUT outstripped by Japan)
- Italy's LP growth in **services** since 1973 strikingly slower than in all other countries, hence explaining low aggregate rates
- LP during **recent recession** lowest in Italy than in other European countries

Sectoral LP growth rates by country

Comparative LP levels of selected countries

LP levels of selected countries relative to the UK
(UK=100)



- The **US** i productivity leader since late XIX century in the 3 main sectors
- **Germany** started off at a higher LP level, overtook the UK before Italy, and has maintained a lead over the UK, in particular due to stronger industrial performance
- **Japan**'s catch-up process quite similar to Italy's, although it never overtook the UK
- **India** clearly a less-developed country

Source: Authors' estimations and calculations on OECD data and other data sources.
Notes: Historical data for countries other than Italy and the UK are available only for benchmark years.

France and Spain

TFP growth in an international perspective

TFP dynamics
(average annual percentage changes)

A. Italy	GDP	TFP
1861-1896	1.3	0.3
1897-1913	2.3	0.6
1919-1928	2.7	1.7
1929-1938	1.5	-0.4
1951-1973	6.0	3.5
1974-1993	2.6	1.0
1994-2007	1.7	0.4
2008-2015	-1.0	-0.9

B. United Kingdom	GDP	TFP
1871-1891	1.8	0.6
1891-1911	1.7	0.3
1911-1950	1.3	0.6
1929-1937	*2.3*	*1.1*
1950-1973	2.7	1.2
1973-1990	1.1	0.3
1990-2007	2.6	0.7
2007-2014	1.0	-0.2

C. United States	GDP	TFP
1869-1889	4.3	0.0
1889-1909	4.2	0.8
1909-1950	3.0	1.3
1929-1937	*0.6*	*0.3*
1950-1973	3.6	1.4
1973-1990	1.5	0.0
1990-2007	3.1	0.9
2007-2014	1.1	0.4

D. Germany	GDP	TFP
1871-1891	2.4	0.7
1891-1911	2.1	0.8
1911-1950	-0.3	0.6
1929-1935	*0.1*	*0.7*
1950-1973	5.4	7.0
1973-1990	4.6	2.3
1990-2007	0.6	1.5
2007-2014	1.1	0.5

E. India	GDP	TFP
1890/91 to 1900/01	0.4	-0.7
1900/01 to 1946/47	0.9	0.0
1950/51 to 1970/71	3.8	1.2
1970/71 to 1999/00	4.8	1.5

F. Japan	GDP	TFP
1891 – 1911	2.9	1.1
1911 – 1950	2.4	0.4
1929 – 1935	2.3	-0.3
1950 – 1973	8.7	4.2
1973 – 1990	3.8	0.8
1990 – 2007	1.4	1.1

Source: Authors' estimations and calculations on OECD data and other data sources

- Between late XIX century and the early XX catching-up on UK, but TFP growth rates slightly lower than Germany and U.S.

- **In Golden Age** TFP strongest acceleration in Germany, followed by Italy, with an inverted rank among the two with respect to GDP growth

- In Italy **the deterioration in TFP growth since mid-Nineties** is unprecedented in the international comparison

4. Candidate explanations of the recent productivity slowdown in Italy

Candidate #1: low competition

Table 7. OLS estimates of structural parameters - Main industries

Dependent variable: nominal Solow residual

	Industry			Manifacturing			Regulated services			Other market services (*)		
	1970-2012	1970-1992	1993-2012	1970-2012	1970-1992	1993-2012	1970-2012	1970-1992	1993-2012	1970-2012	1970-1992	1993-2012
Estimated regressor coefficients												
X	0.32	0.22	0.40	0.22	0.28	0.15	0.72	0.81	0.39	0.40	0.48	0.34
	0.06	0.05	0.10	0.02	0.03	0.01	0.07	0.08	0.08	0.05	0.07	0.05
V	0.14	0.06	0.21	0.10	0.15	0.06	0.75	0.94	0.20	0.43	0.58	0.30
	0.07	0.04	0.10	0.01	0.03	0.02	0.10	0.09	0.09	0.07	0.11	0.10
Estimated structural parameters												
μ	1.47	1.29	1.66	1.28	1.39	1.18	3.60	5.26	1.64	1.67	1.92	1.52
Φ	0.16	0.07	0.27	0.11	0.17	0.06	3.00	15.67	0.25	0.75	1.38	0.42
Diagnostics												
R-sq.	0.67	0.49	0.52	0.69	0.72	0.73	0.77	0.82	0.81	0.66	0.74	0.54
F-stat.	14.09	10.40	23.51	23.43	15.99	100.00	11.70	41.59	26.59	49.69	63.11	13.50
Prob>F	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
No. Obs.	440	220	220	328	160	168	120	58	60	82	42	40

Source: Giordano and Zollino (2016)

- In Giordano and Zollino (2016) we compute **sectorial mark-ups** on NA data using a model which takes into account imperfect competition in labour, as well as in product, markets
- **μ** is the mark-up before rent extraction by workers, whose bargaining power is proxied by ϕ
- Mark-ups μ are found to be **higher in services** (in particular regulated services) than in manufacturing, even after the de-regulation in the early 1990s
- Daveri, Lecat and Parisi (2013) document the negative impact of barriers to entry on productivity dynamics, via the mark-up channel (**direct effect**); Barone and Cingano (2011) show that low competition in upstream service branches also negatively affects productivity in downstream branches (**indirect effect**), dragging aggregate productivity down

Candidate #2: slow ICT diffusion across sectors

Failure in effective use in ICT in services in the euro area relative to the U.S. (e.g. Inklaar, O'Mahony, Timmer 2003)

Table 11, Contributions to labour productivity growth of Non-ICT capital deepening by ICT producing, ICT using and Non-ICT industries, EU-4 and U.S.

	1979-1995			1995-2000			Change 1995-2000 over 1979-1995		
	EU-4	U.S.	U.S.-EU	EU-4	U.S.	U.S.-EU	EU-4	U.S.	U.S.-EU
Total economy	0.70	0.35	-0.35	0.25	0.43	0.18	-0.45	0.08	0.53
ICT producing industries	0.08	0.05	-0.02	0.03	0.06	0.04	-0.05	0.01	0.06
Electrical and electronic equipment & instruments	0.04	0.04	0.00	0.01	0.04	0.03	-0.03	0.01	0.04
Communications	0.04	0.02	-0.02	0.02	0.02	0.00	-0.02	0.00	0.02
ICT using industries	0.18	0.12	-0.05	-0.03	0.10	0.13	-0.20	-0.02	0.18
ICT using manufacturing	0.05	0.01	-0.04	0.02	0.01	-0.01	-0.03	0.00	0.03
Wholesale trade	0.02	0.04	0.02	0.01	0.03	0.02	-0.02	-0.01	0.01
Retail trade	0.02	0.04	0.02	0.01	0.04	0.03	-0.01	0.00	0.01
Financial intermediation	0.03	0.08	0.05	0.00	0.08	0.08	-0.03	0.01	0.03
Business services	0.05	-0.04	-0.10	-0.07	-0.06	0.01	-0.12	-0.02	0.10
Non-ICT industries	0.44	0.17	-0.27	0.25	0.26	0.02	-0.20	0.09	0.29
Agriculture, forestry and fishing	0.03	0.00	-0.04	0.03	0.02	0.00	-0.01	0.03	0.03
Mining and quarrying	0.13	0.10	-0.03	0.04	0.02	-0.01	-0.09	-0.07	0.02
Non-ICT manufacturing	0.14	0.06	-0.08	0.06	0.08	0.02	-0.08	0.02	0.10
Transport & storage	0.01	-0.02	-0.03	0.00	0.01	0.01	-0.01	0.03	0.04
Social and personal services	0.02	0.01	-0.02	-0.01	0.02	0.03	-0.04	0.01	0.05
Non-market services	0.04	0.03	-0.01	0.03	0.04	0.01	0.00	0.01	0.02
Other non-ICT	0.07	0.01	-0.06	0.10	0.07	-0.03	0.03	0.06	0.03

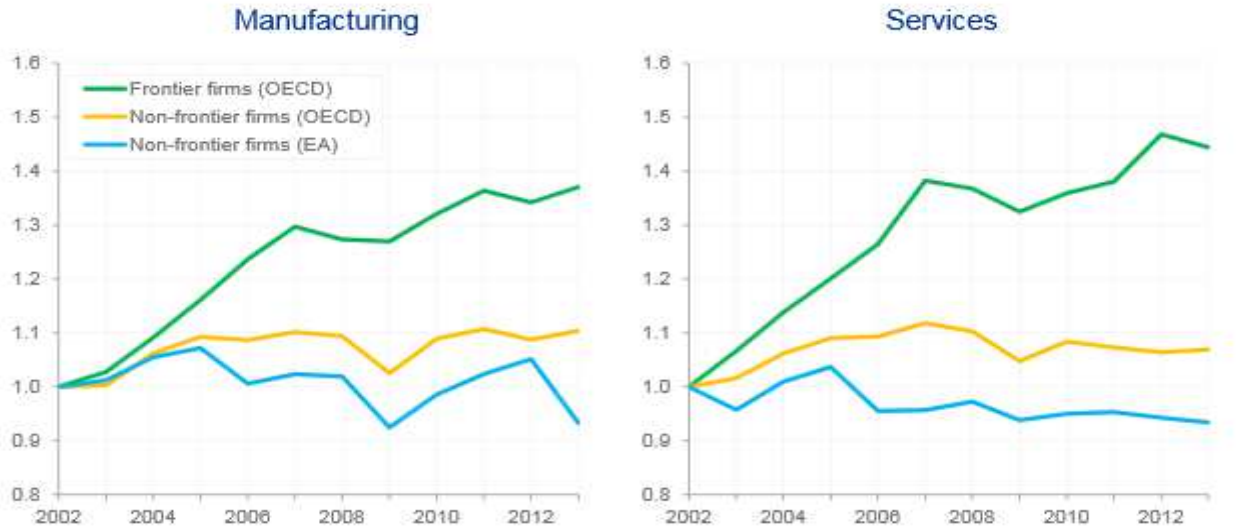
Notes: An industry's contribution is calculated as industry non-ICT capital deepening weighted by the industry's share of non-ICT capital compensation in aggregate value added. ICT using manufacturing includes paper, printing & publishing, machinery and furniture and miscellaneous manufacturing
Non-ICT manufacturing includes food, textiles, wood, petroleum, chemicals, rubber & plastics, non-metallic mineral, metal products and transport equipment
Other non-ICT incudes utilities, construction and hotels & restaurants
Source: see Appendix A

Candidate #3: slower technological diffusion within sectors

The productivity growth gap between global frontier firms and laggard firms within sectors has increased over time especially in the euro area (relative to the OECD) and **in particular in services** (Andrews, Criscuolo and Gal 2015; Draghi's Lectio Magistralis November 30, 2016)

Labour productivity growth of global frontier firms and non-frontier firms

Index 2002 = 1

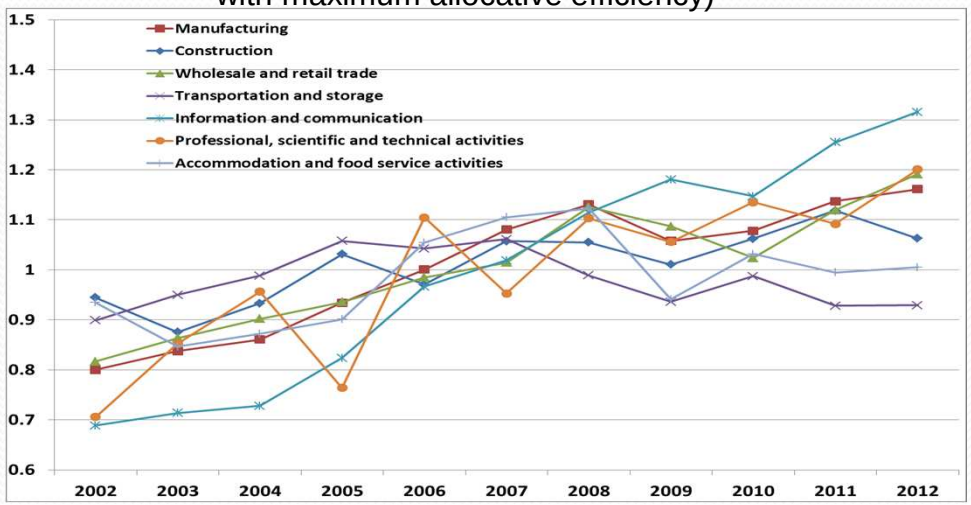


Sources: OECD (2014) and CompNet sample based on firms with 20 employees or more. Notes: OECD global frontier firms are defined as the 100 most productive firms within an industry (defined at the 2 digit level according to NACE rev.2) and year. OECD non-frontier firms refer to the (weighted) average productivity growth of non-frontier firms in each of the 2-digit manufacturing industries, considering all OECD countries. Euro area countries covered are: Austria, Belgium, Finland, France, Germany, Italy, Portugal and Spain.

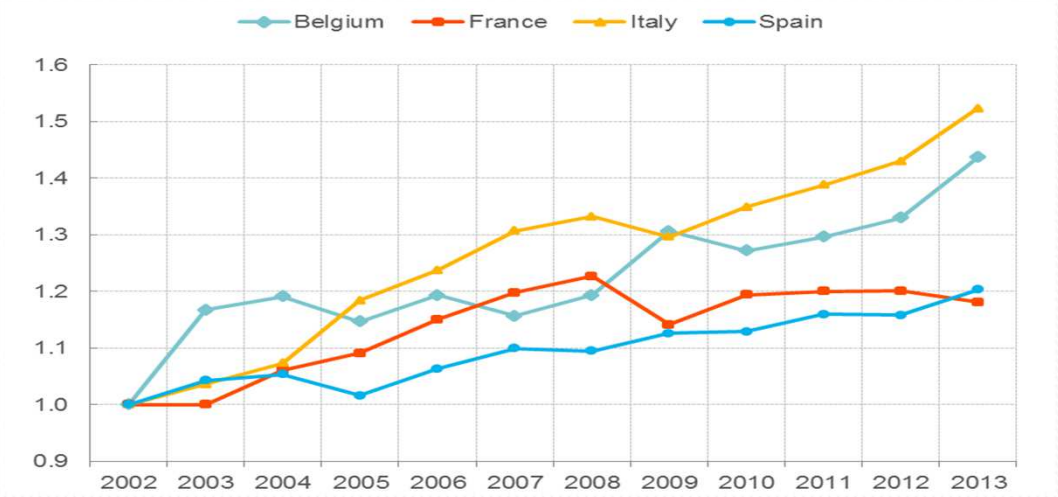
3

Candidate #4: within-sector capital misallocation

Within-sector capital misallocation in Italy…
(dispersion in marginal revenue product of capital; benchmark = 0 in sector with maximum allocative efficiency)



…and in an international comparison (weighted sectoral averages)



Source: Gamberoni, Giordano and Lopez-Garcia (2016) on CompNet data

- **Allocative efficiency (AE)** gains within a sector are achieved when production inputs (K,L) flow from the least to the most efficient firms within the sector; within-sector AE can account for **half of sectorial productivity growth**, as much as the contribution stemming from firms' individual productivity growth

- There is evidence of **high, and increasing, K misallocation in Italy**, in particular in trade & accommodation; information & communication; professional services, also in international comparison (Gamberoni, Giordano and Lopez-Garcia 2016; Calligaris et al. 2016)

5. Conclusions

- **Before WWII**, Italy made little headway in catching up on the UK: LP growth in **agriculture** disappointing, as it offset industry's stimulus, due to its large role in economy; **structural change** limited; slow labour productivity growth also result of **sluggish TFP growth** until WWI.

- **In the interwar years**, Italy **fell back even more** from technological frontier. In common with other European countries, Italy was **hampered in adopting US high-throughput technology in industry**, due to the abundance of cheap labour and the fragmentation of markets. **Inadequate capital formation** in these years

- **After WWII** rapid catch-up process, propelled by **industry** (manufacturing mainly), which allowed Italy to overtake UK in the 1970s; strong productivity growth **in all sectors**; crucial release of labour from agriculture. **Strongest TFP growth** but also greatest capital deepening until mid Nineties.

  YET Japan registered higher LP growth in Golden Age; Germany higher TFP growth

5. Conclusions (continued)

- **After 1973,** slowdown in **services'** growth brought down overall growth rates, even more so **after 1993**, when also industry lost its impetus. The **recent double recession** exacerbated the pre-existing unfavourable developments, although **2014-2015** were slightly brighter years, thanks to the pick-up in manufacturing and the return to positive LP growth of trade, restaurants and accommodation. A substantial productivity gap with the US however remains

- Has Italy come full circle? In first 20 post-unification years **large agriculture** held back aggregate growth rates; now **services** (in particular "other services") are playing similar damaging role with industry struggling to maintain historically high productivity growth rates.

- In the recent slowdown, rather than potential for catching-up being exhausted, our sectoral analysis suggests **structural factors at work** which show up in weak LP growth in services and low TFP growth in economy as a whole…
- Various possible candidate and interlinked explanations….

Thank you for your attention.

RESERVE SLIDES

The historical dataset (1861-2015)

Italy:

- **Output** – sectoral value added (Baffigi 2015), updated with Istat (2016)

- We exclude the *public and real estate sectors* to compute our productivity estimates for Italy; these sectors are re-included only for international comparisons

- **Labour** – our new estimates of both headcount (HC) and full-time equivalent (FTE) workers in 10 sectors

- We prefer the *FTE measure*, but resort to HC for international comparisons

- **Physical capital stock** - our new estimates for 4 asset types

- We compute the *rental price of single assets* to control for the trend in the quality of productive services. The resulting Divisia index of capital input implicitly assigns relatively larger weights to changes in the more productive (or short-lasting) assets. We exclude *housing investment* from our productivity calculations, for the reasons above

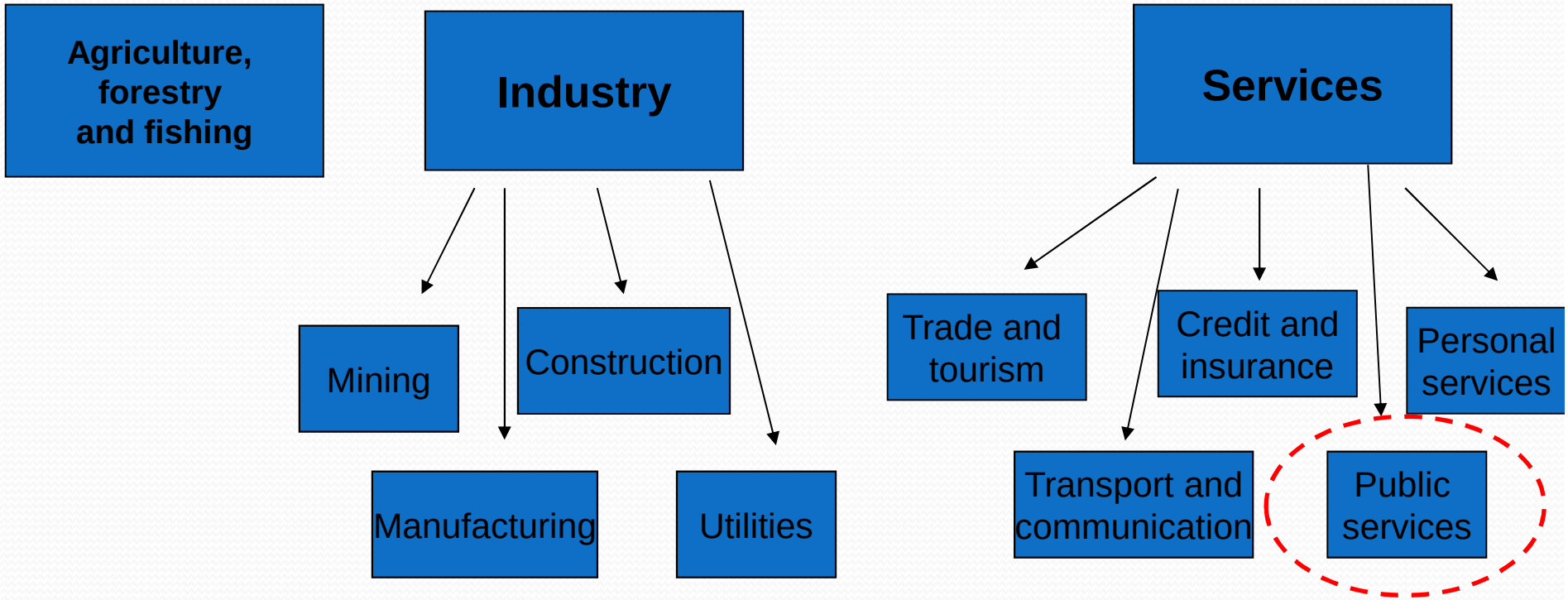
- **Wages -** our new estimates for 4 macro-sectors

- We need them to compute wage shares α (sectoral unit wage*sectoral employment); profit shares are then computed as (1- α)

Other countries:

- Historical national accounts of various sources, updated with official recent national account data

The 10-sector disaggregation of our labour data



- Preference for FTE series in our productivity analysis

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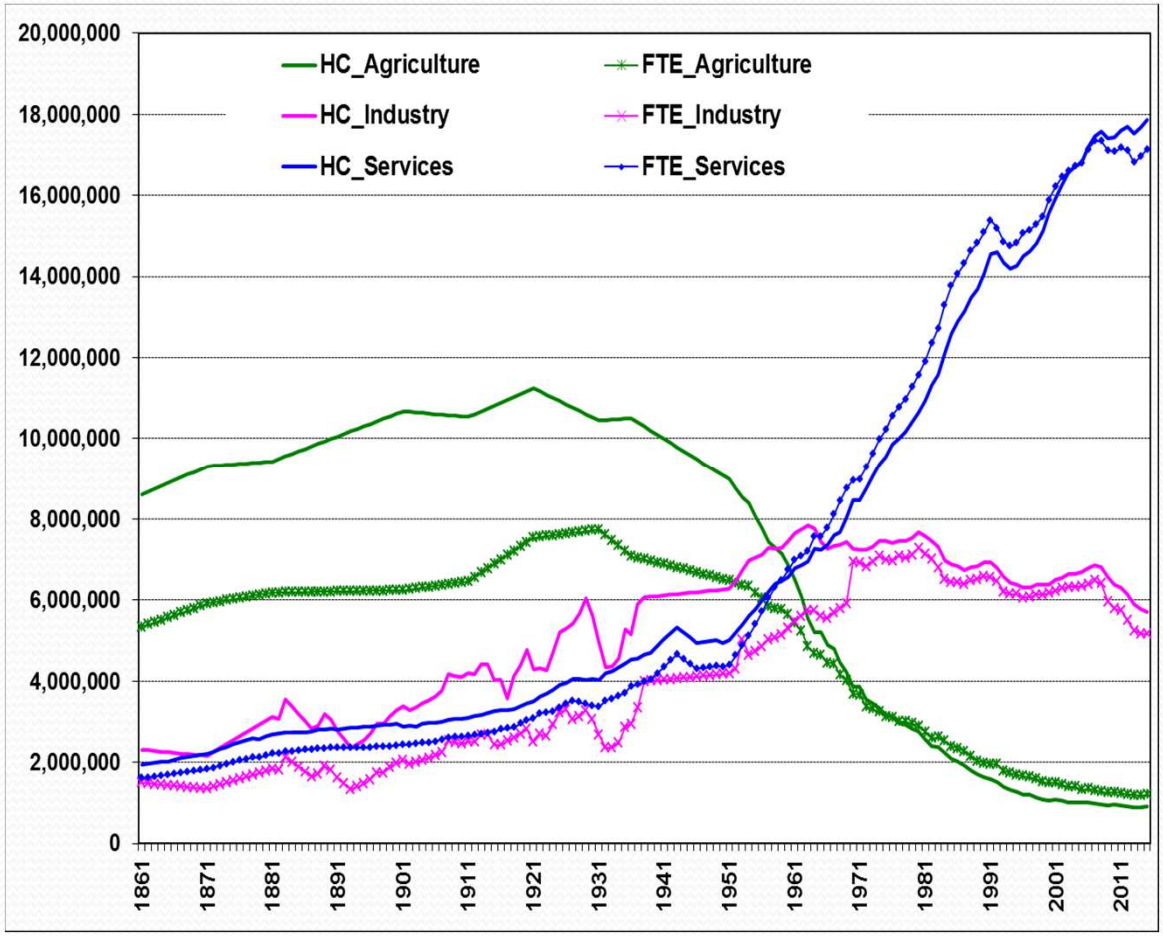
Italy's labour input



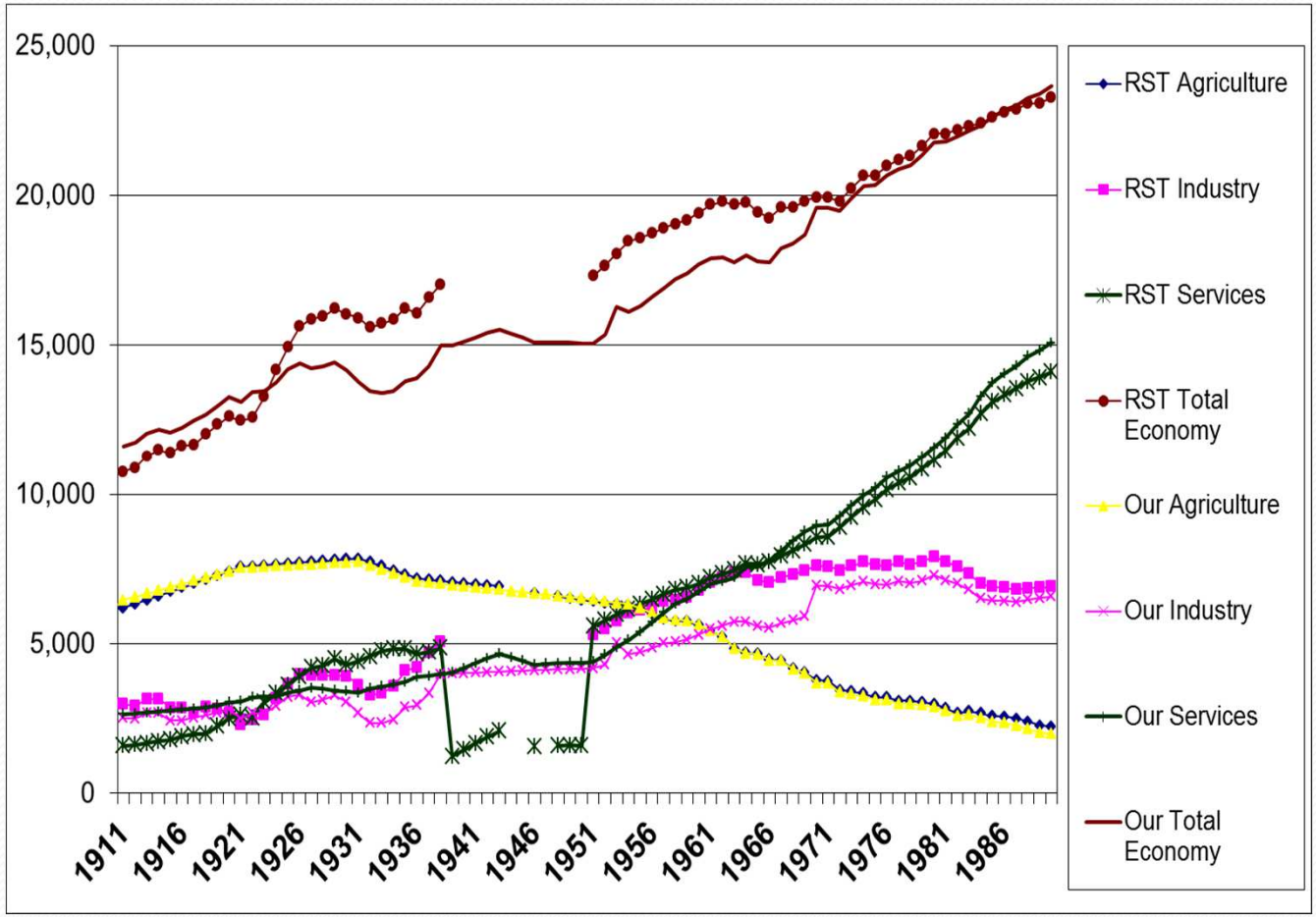
Source: Authors' estimations.

- In both agriculture and industry approximately one third of workers was underemployed between 1861 and 1951

- The (partial) closure of the gap between HC and FTE after 1951 reflects both statistical and economic factors

Comparison with Rossi, Sorgato and Toniolo (1993)

A comparison of our labour estimates with Rossi, Sorgato and Toniolo's data



Source: Authors' estimations and Rossi, Sorgato and Toniolo (1993).

- Little innovation in figures for **agriculture**
- Significant discrepancy in **industry** due to:

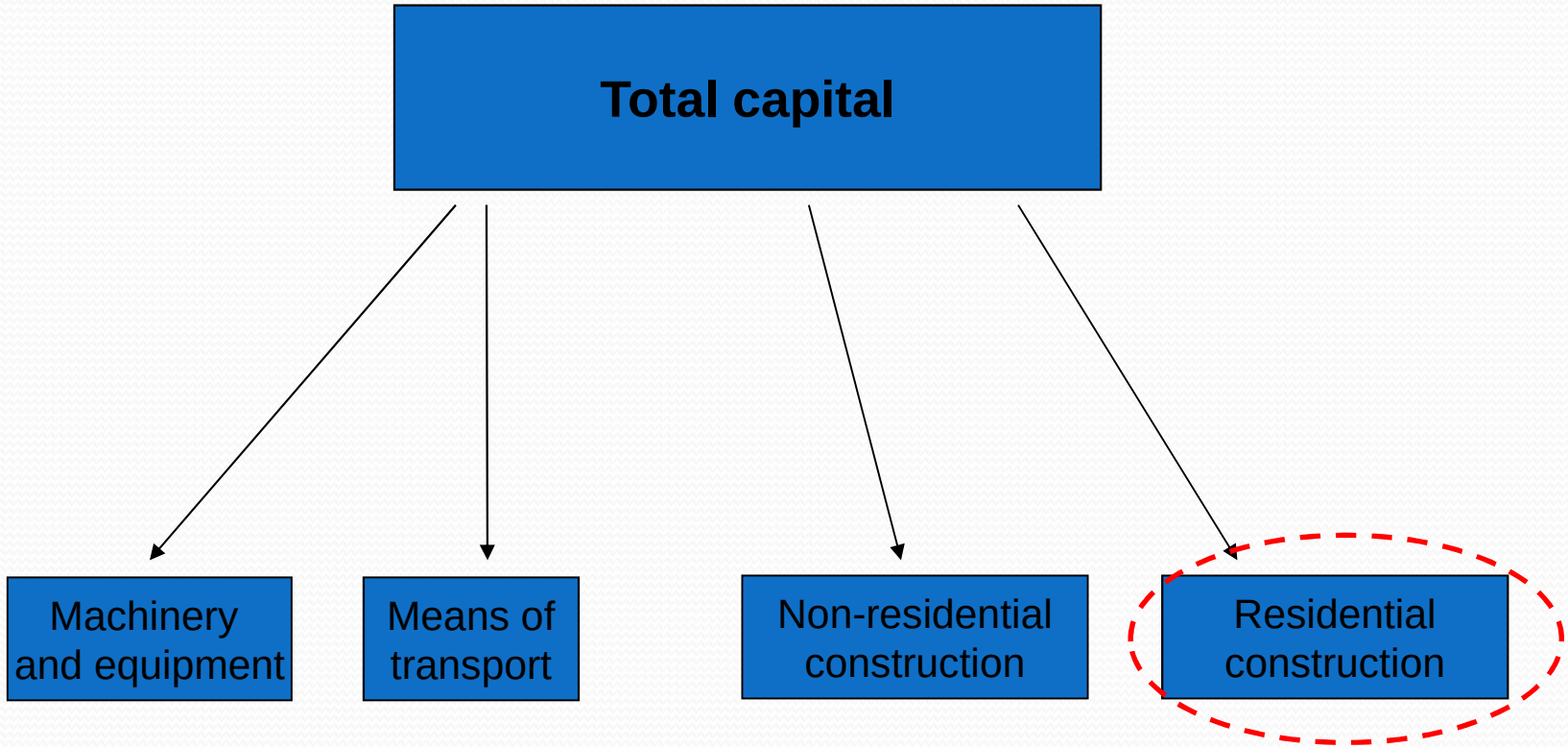
A) different <u>benchmarks</u> employed for 1911, 1927 and 1938 (Federico 2003 vs. Chiaventi 1987);

B) more <u>indicators</u> employed for inter-census years

⇒ More protracted and persistent slump during the 1930s Great Recession

- More complete and smoother series for **services**

The asset disaggregation of our capital data



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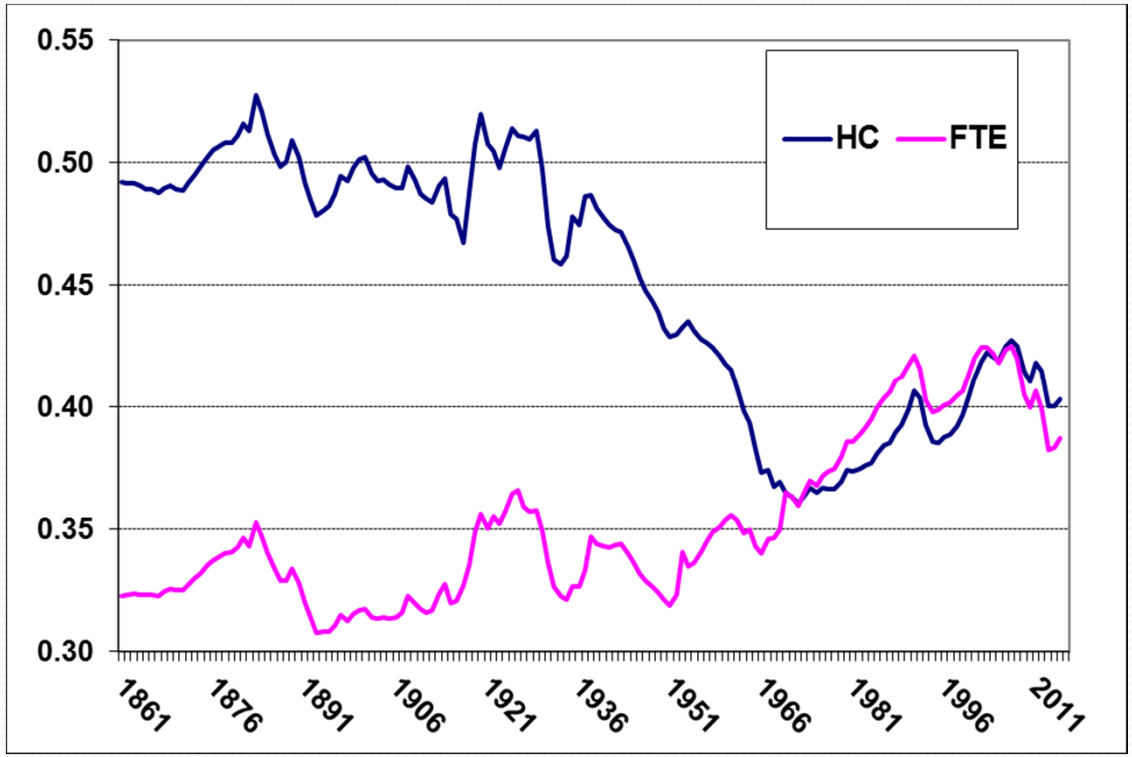
Changes in Italy's participation rate

Labour input-population ratios
(percentage shares)



Source: Authors' estimations and Istat data.

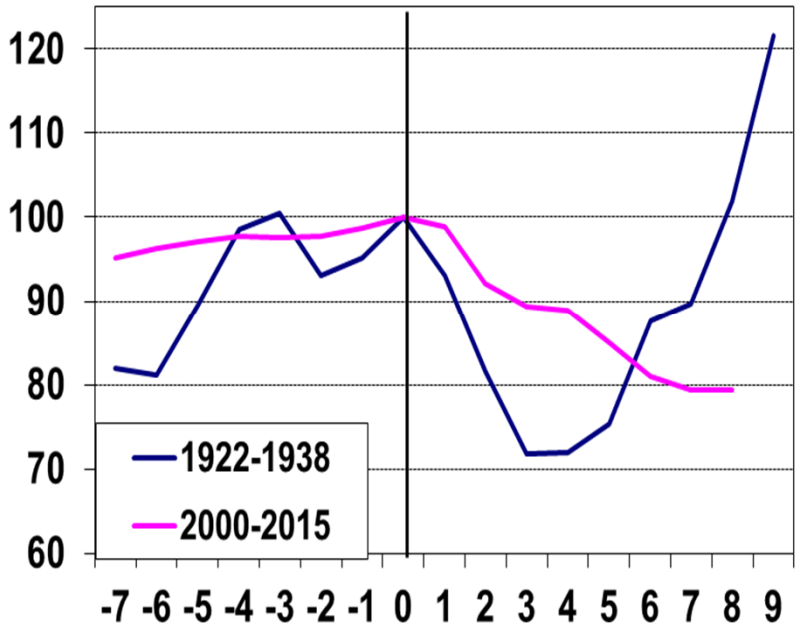
- Vast difference in rates according to labour input employed, due to underemployment in agriculture and industry until Golden Age
- Increase since the 1970s until the outbreak of the recent global financial crisis

back

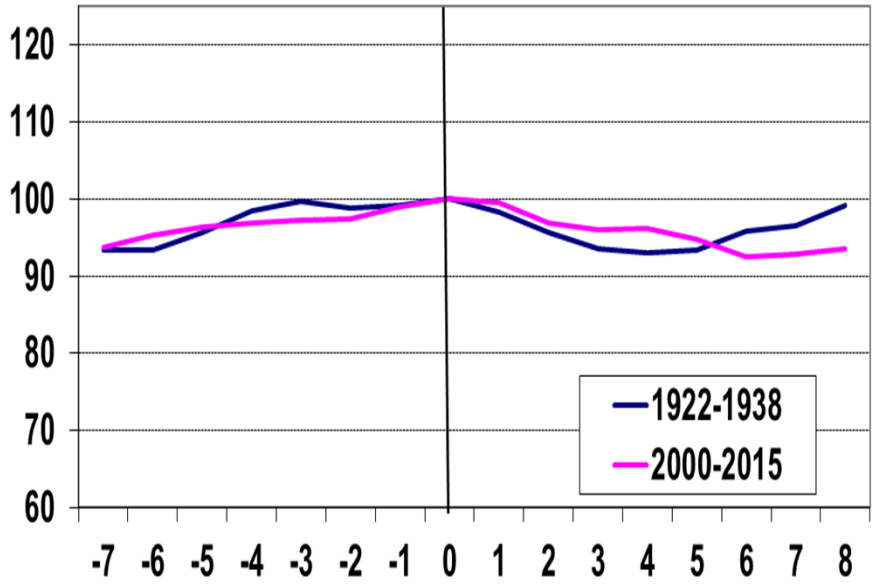
A comparison between the Great Depression and the Great Recession

FTE dynamics during the GD and the GR
(1929 and 2007=100)

Industry



Total economy



Source: Authors' estimations; update of Baffigi, Giordano, Toniolo and Zevi (2012)

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The shift-share decomposition

AGGREGATE PRODUCTIVITY = DIRECT PRODUCTIVITY EFFECT + BETWEEN-SECTOR EFFECT

$$\hat{X}_0 / X_0 = \sum_{i \in \{A,I,T\}} \alpha_i \cdot (\hat{VA}_i / VA_o) + \sum_{i \in \{A,I,T\}} VA_i / VA_o \cdot (\hat{L}_i / L_i - \hat{L}_o / L_o)$$

where:

$$\alpha_i = \hat{X}_i / X_i - (\hat{L}_o / L_o - \hat{L}_i / Li) \text{ if } \hat{S}_i < 0$$

$$\alpha_i = \hat{X}_i / X_i \text{ if } \hat{S}_i \geq 0$$

where *0* is the total economy, *i* is one of 3 sectors (*A*=agriculture; *I*=industry; *T*=tertiary sector), X is the level of labour productivity, L is FTE employment, S_i is the share of employment in sector *i* and time derivatives are denoted by hats above variables.

STANDARD DIRECT PRODUCTIVITY EFFECT = weighted average of sectoral labour productivity
MODIFIED DIRECT PRODUCTIVITY EFFECT (Broadberry 1998): in declining sectors, the actual productivity growth rate is reduced by the difference between the growth rate of the aggregate labour force and the growth rate of the labour force in that particular sector
BETWEEN-SECTOR EFFECT= weighted average of differences in sectoral vs. aggregate labour growth rates

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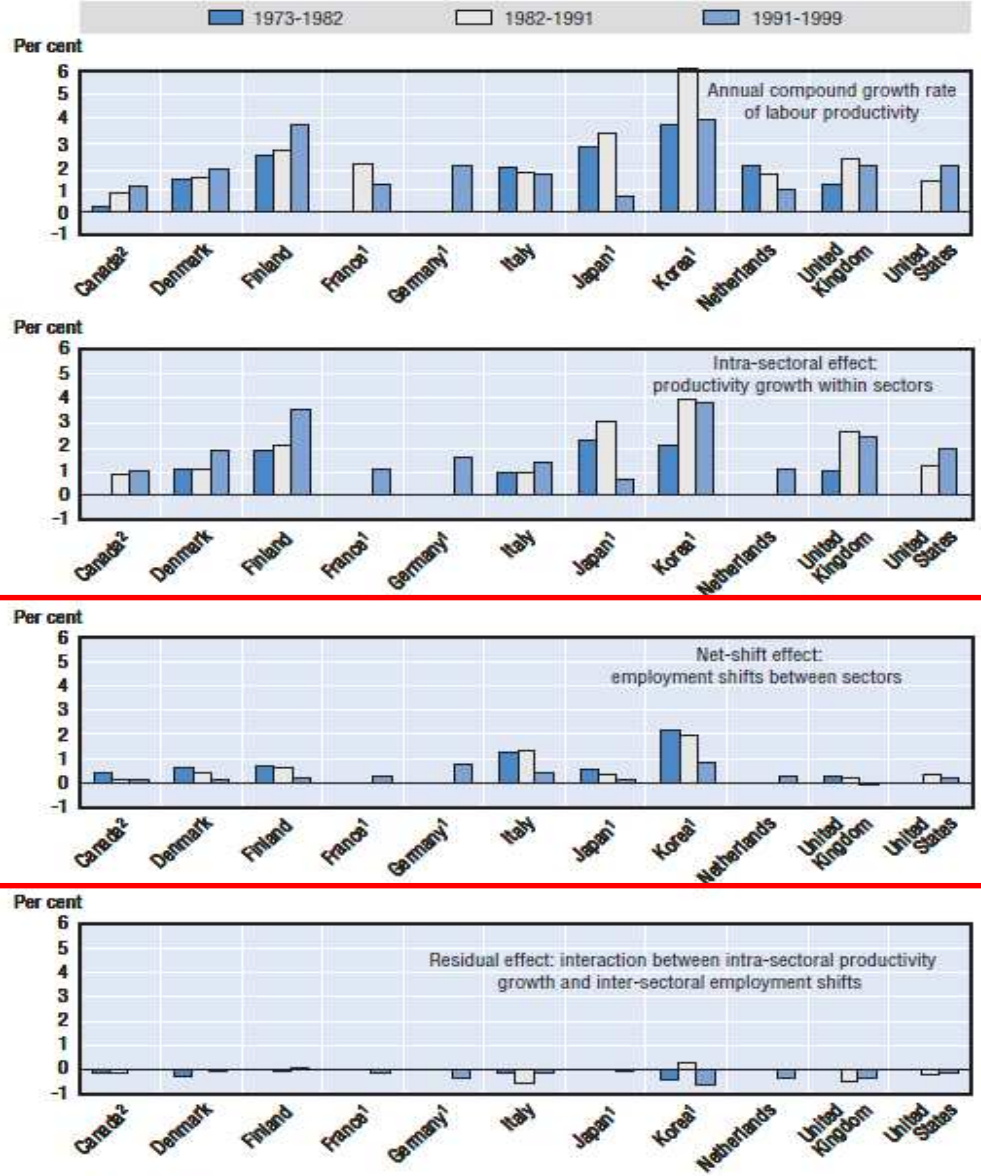
Figure 3.1. **Decomposition of aggregate labour productivity growth into intra-sectoral productivity growth and inter-sectoral employment shifts**

Non-farm business sector



1. 1991-1998 instead of 1991-1999.
2. 1991-1996 instead of 1991-1999.

Source: OECD.

- The declining role over time of the between-sector effect in recent years, common to all countries, may also be seen within the non-farm business sector (OECD, 2003)

back

Under the usual assumption that rental price does not vary across vintages of a capital asset *i* it is measured as:

$$u_{i,t} = q_{i,t-1} r_t + q_{i,t} \delta_{i,t} - \left(q_{i,t+1} - q_{i,t} \right)$$

where q_{it} is the market price of the productive asset i, r_t is a measure of the opportunity cost that we proxy by the nominal long term interest rate on public bonds, δi_t is the same depreciation rate adopted in estimating the capital stock and the terms in brackets stand for the expected revaluation of the asset, that we compute as a three-term moving average of the market price.

The changes in capital input are computed as a Divisia index:

$$\dot{k}_t = \sum_{i=1}^{n} v_{i,t} \dot{s}_{i,t} \qquad \text{with} \qquad v_{i,t} = \frac{1}{2}\left(u_{i,t-1} S_{t-1} \Big/ \sum u_{i,t-1} S_{t-1} + u_{i,t} S_t \Big/ \sum u_{i,t} S_t \right)$$

where s_i is the log of the chained values of the net stock of asset type *i* (Si) and v_{it} is the respective share on total returns to capital.

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Comparative LP levels: robustness check

We cross-checked our time-series projections with direct estimates of GDP per capita in 1905 *(Broadberry and Klein, 2008)* and in 2007 *(OECD, 2011*) and of FTE labour productivity in agriculture: they are sufficiently close.

Years	Direct benchmarks	Time series projections
1905	43.7	38.5
1910	43	42.4
2007	83.8	89.6

Sources: For the direct benchmarks, Broadberry and Klein (2012) for 1905; O'Brien and Toniolo (1991) for 1910; OECD (2011c) for 2007; our estimates for the time-series projections.
Note: The first and third are direct estimates of GDP per head; the second is a direct estimate of male FTE labor productivity in agriculture.

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Labour productivity growth in selected countries by sector

Headcount labour productivity growth rates
(annual average percentage changes)

2. Average annual growth rates of ouput per worker (% per year) in Italy, the United Kingdom, the United States, Germany, India and Japan, 1870-2007

A. Italy

	Agriculture	Industry	Services	Total economy
1861-1881	0.5%	-0.1%	-0.3%	0.3%
1881-1911	0.8%	1.9%	1.2%	1.2%
1911-1938	1.3%	1.1%	0.0%	1.3%
1938-1951	1.9%	2.1%	1.7%	2.2%
1951-1973	5.8%	7.1%	3.7%	6.3%
1973-1993	6.4%	3.0%	0.5%	2.1%
1993-2007	3.3%	1.0%	-0.1%	0.5%
2007-2015	1.0%	-0.3%	-0.9%	-0.2%

B. United Kingdom

	Agriculture	Industry	Services	Total economy
1861-1881	1.0%	1.8%	0.5%	1.3%
1881-1911	0.1%	0.5%	0.3%	0.4%
1911-1938	1.7%	1.9%	0.1%	0.9%
1938-1951	2.7%	0.9%	0.5%	0.8%
1951-1973	5.0%	2.0%	1.2%	2.5%
1973-1993	2.9%	2.9%	1.0%	1.9%
1993-2007	2.4%	2.1%	1.9%	1.8%
2007-2015	1.6%	-0.4%	0.3%	0.1%

C. United States

	Agriculture	Industry	Services	Total
1869-1879	1.7%	1.0%	0.9%	1.9%
1879-1909	0.8%	1.6%	1.1%	1.4%
1909-1937	1.4%	1.8%	0.2%	1.2%
1937-1950	4.0%	2.4%	1.8%	2.4%
1950-1973	5.5%	3.1%	1.4%	1.9%
1973-1990	4.4%	0.8%	0.5%	0.4%
1990-2007	2.2%	2.5%	2.0%	1.9%
2007-2014	-1.2%	0.9%	-0.4%	-0.2%

D. Germany

	Agriculture	Industry	Services	Total
1871-1881	0.3%	1.5%	0.4%	0.8%
1881-1911	1.3%	1.7%	1.0%	1.6%
1911-1937	1.0%	0.9%	0.5%	1.0%
1937-1950	-0.4%	0.1%	0.0%	0.1%
1950-1973	6.3%	4.9%	3.1%	4.2%
1973-1990	6.0%	2.0%	1.5%	1.8%
1990-2007	1.5%	2.5%	1.0%	1.5%
2007-2015	-0.7%	0.4%	-0.2%	0.0%

E. India

	Agriculture	Industry	Services	Total economy
1872/73-1900/01	0.4%	1.1%	0.0%	0.4%
1900/01-1946/47	0.0%	1.4%	1.0%	0.5%
1950/51-1970/71	0.9%	3.4%	2.8%	1.9%
1970/71-1999/00	0.9%	2.7%	2.3%	2.5%

F. Japan

	Agriculture	Mining/Manufac	Construction	Facilitating Industry	Services	Total economy
1891-1920	2.3%	3.2%	0.3%	4.6%	0.3%	2.6%
1920-1950	-0.4%	1.4%	1.3%	-0.2%	1.0%	1.0%
1950-1973	4.9%	8.9%	4.3%	7.7%	3.1%	6.6%
1973-1990	2.3%	4.0%	1.5%	2.6%	1.9%	2.8%
1990-2007	2.5%	3.4%	-1.9%	1.4%	0.9%	1.5%

Source: Authors' estimations.

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Employment composition in selected countries

Headcount labour shares in benchmark years
(percentage shares)

1. Sectoral shares of employment in selected countries, 1870-2015

A. Italy

	Agriculture	Industry	Services
1871	68.1%	15.8%	16.2%
1911	59.1%	23.5%	17.4%
1921	59.1%	22.5%	18.4%
1931	53.8%	25.4%	20.8%
1936	52.0%	25.6%	22.5%
1951	44.3%	31.0%	24.8%
1973	17.4%	36.9%	45.7%
1993	6.3%	29.4%	64.3%
2007	4.2%	27.4%	68.4%
2015	3.7%	23.3%	73.0%

B. United Kingdom

	Agriculture	Industry	Services
1871	22.2%	42.4%	35.4%
1911	11.8%	44.1%	44.1%
1924	8.6%	46.5%	44.9%
1930	7.6%	43.7%	48.7%
1937	6.2%	44.5%	49.3%
1950	5.1%	46.5%	48.4%
1973	2.9%	41.8%	55.3%
1990	2.0%	28.5%	69.5%
2007	1.2%	18.0%	80.8%
2015	1.2%	16.0%	82.8%

C. United States

	Agriculture	Industry	Services
1870	50.0%	24.8%	25.2%
1910	32.0%	31.8%	36.2%
1920	26.2%	33.2%	40.6%
1930	20.9%	30.2%	48.9%
1940	17.9%	31.6%	50.5%
1950	11.0%	32.9%	56.1%
1973	3.7%	28.9%	67.4%
1990	2.5%	21.8%	75.7%
2007	1.5%	16.7%	81.8%
2015	1.6%	15.2%	83.7%

D. Germany

	Agriculture	Industry	Services
1871	49.5%	29.1%	21.4%
1913	34.5%	37.9%	27.6%
1925	31.5%	40.1%	28.4%
1930	30.5%	37.4%	32.1%
1935	29.9%	38.2%	31.9%
1950	24.3%	42.1%	33.6%
1973	7.2%	47.3%	45.5%
1990	3.4%	39.7%	56.9%
2007	2.1%	25.8%	72.1%
2015	1.9%	25.0%	73.1%

E. India

	Agriculture	Industry	Services
1875	73.4%	14.5%	12.1%
1910/1911	75.5%	10.3%	14.2%
1929/30	76.1%	9.1%	14.8%
1950/51	73.6%	10.2%	16.2%
1970/1971	73.8%	11.1%	15.1%
1999/0	64.2%	13.9%	21.9%

F. Japan

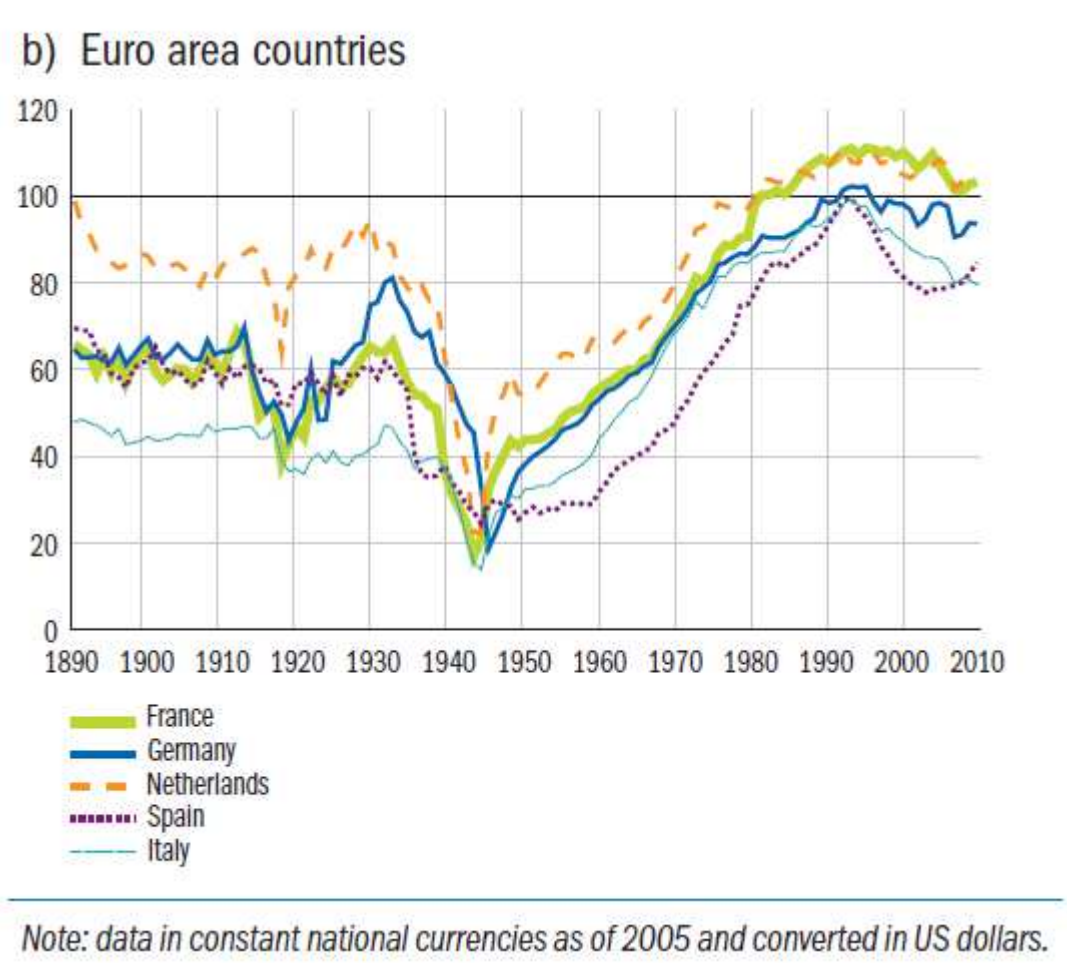
	Agriculture	Mining/Manufacturing	Construction	Facilitating Industry	Services
1891	75.8%	9.0%	1.4%	1.0%	12.8%
1920	55.4%	16.2%	2.8%	3.6%	22.0%
1950	48.3%	17.6%	4.3%	5.1%	24.7%
1973	16.0%	27.3%	9.3%	6.3%	41.1%
1990	9.2%	23.5%	9.2%	6.2%	51.9%
2007	5.1%	17.4%	8.4%	6.4%	62.7%

- **Kuznets-Clark pattern** followed by all countries except India BUT **timing of release of labour force from agriculture** different (UK in 1871, US and Germany after WWI, Italy and Japan after WWII).
- After 1950, the share of **industry** began to decline in the US and UK, In Germany, Japan and Italy, industry continued to expand its share of employment until 1973
- In **India** agriculture still the dominant sector, and expansion of services to the detriment of industry began in XIX century

Source: Authors' estimations and calculations on OECD data and other data sources

Relative labour productivity levels in the euro area relative to the U.S.

Labour productivity levels of selected euro-area countries
(US=100)



Note: data in constant national currencies as of 2005 and converted in US dollars.

Source: Bergeaud, Cette and Lecat (2016)

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