BANCA D'ITALIA

EUROSISTEMA

Questioni di Economia e Finanza

(Occasional Papers)

Long-run trends in Italian productivity

by Claire Giordano, Gianni Toniolo and Francesco Zollino

November 2017

Number 406

BANCA D'ITALIA
EUROSISTEMA

Questioni di Economia e Finanza

(Occasional papers)

Long-run trends in Italian productivity

by Claire Giordano, Gianni Toniolo and Francesco Zollino

Number 406 – November 2017

The series Occasional Papers *presents studies and documents on issues pertaining to the institutional tasks of the Bank of Italy and the Eurosystem. The* Occasional Papers *appear alongside the* Working Papers *series which are specifically aimed at providing original contributions to economic research.*

The Occasional Papers *include studies conducted within the Bank of Italy, sometimes in cooperation with the Eurosystem or other institutions. The views expressed in the studies are those of the authors and do not involve the responsibility of the institutions to which they belong.*

The series is available online at www.bancaditalia.it .

ISSN 1972-6627 (print)
ISSN 1972-6643 (online)

Printed by the Printing and Publishing Division of the Bank of Italy

LONG-RUN TRENDS IN ITALIAN PRODUCTIVITY

by Claire Giordano[1], Gianni Toniolo[2] and Francesco Zollino[3]

Abstract

Based on updated datasets of value added and of labour and capital inputs, this paper provides a reassessment of the proximate causes of Italy's economic development since its political unification in 1861 to 2016. Italy's pre-WWII economy featured weak productivity growth, with the exception of the Giolitti era and the 1920s. Italy then embarked on an exceptional catching-up process relative to the technological leaders during the Golden Age. Compared with the pre-WWII years, when the Italian economy was held back by slow productivity growth in the large agricultural sector, the catching-up process during the Golden Age was propelled by the rapid shift of labour out of agriculture. As in many countries, this rapid growth in productivity could not be sustained after 1973, but the further slowdown since the 1990s has been more pronounced in Italy than elsewhere. The disappointing performance of the Italian economy since the early 1990s is largely explained by slow labour productivity growth in the now dominant services sector and by sluggish aggregate total factor productivity. Labour productivity developments actually turned negative during the protracted crisis following the global financial turmoil, due to the decline in capital accumulation and in total factor productivity. Since the start of the recovery in 2013, while total factor productivity has returned to a moderately positive trend, the capital stock has not fully overcome the legacy of the crisis.

JEL classifications: N10, N30, O47, O57
Keywords: Labour productivity, sectorial reallocation, growth accounting.

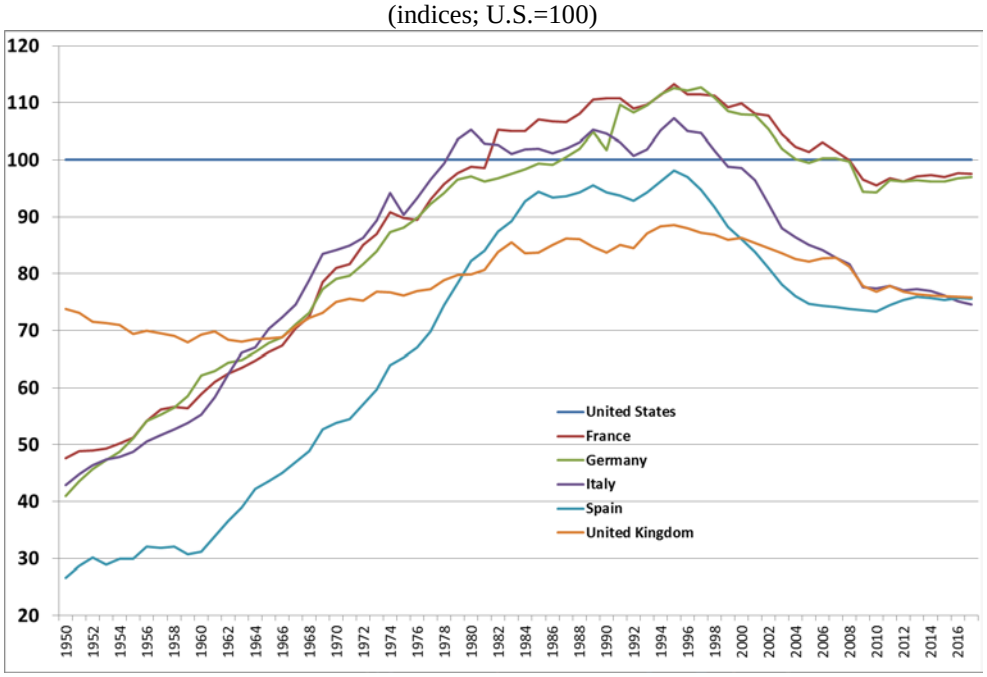
Contents

[1] Banca d'Italia, DG Economics, Statistics and Research, Balance of Payments Analysis Division.
[2] LUISS University and CEPR.
[3] Banca d'Italia, DG Economics, Statistics and Research, Economic Outlook Division.

1. Introduction and main findings[1]

The debate on the secular stagnation assumption, which seeks to explain the long negative trend in real interest rates at a global level, provides fresh motivation to investigate the trends and sources of productivity growth in a long-term perspective. In this paper we cast the secular stagnation assumption in historical perspective in the case of Italy. The Italian case is particularly interesting as the country's rapid productivity growth – mainly, but not only, in the three decades beginning in the 1950s – was followed, after the mid-1990s, by an equally fast decline (Fig. 1).

Figure 1. Output per hour worked in selected countries with respect to the U.S., 1950-2017
(indices; U.S.=100)



Source: Conference Board, Total Economy Database.

We focus on Italy's growth and sectorial productivity performance since 1861, first in isolation, and then in an international comparative perspective. Italy is compared to the old and new technological leaders, the United Kingdom and the United States and to a similar "late-unifier" such as Germany. The study makes use of the recent releases of Italian national accounts based on the ESA2010 standards in order to revise and update up to 2016 both Baffigi's (2015) estimates of Italian GDP broken down into ten sectors and Giordano and Zollino's (2015; 2016) estimates of labour and capital inputs. The two datasets allow performing a growth accounting exercise in a historical perspective in order to shed additional light on the source of the slow growth of the Italian economy in the last two decades, as well as to analyse the intensity and the direction of structural changes of the Italian productive system. In this respect, the paper provides a reassessment of Broadberry, Giordano and Zollino's (2012) findings, with the update of the underlying data allowing a more detailed appraisal of the drivers of Italy's recent recessionary phase in 2008-2013 and of its subsequent mild recovery.

Our main findings are summarised as follows. In the thirty years after political unification, the new country's growth was disappointingly low. Since the end of the XIX century the Italian

[1] We wish to thank our discussants Federico Barbiellini Amidei and Marcello Messori, as well as all participants of the Riccardo Faini Memorial Conference "Italy's lost productivity and how to get it back" and of the workshop "Secular Stagnation and Financial Cycles", held in Banca d'Italia in January and in March 2017, respectively. We are also very grateful to Stephen Broadberry for co-authoring the original research (Broadberry, Giordano and Zollino, 2011; 2013) of which this paper represents a follow-up. Any error remains the Authors' responsibility and the views expressed herein are those of the Authors and not of the Institutions represented.

economy broadly followed the pattern of the international long cycles: expansion in 1898-1913 and in the 1920s, followed by a severe recession in the 1930s. Overall, before WWII, Italy's development was held back by slow productivity growth in the large agricultural sector. Economic performance was then more impressive than in most other countries during the Golden Age (1951-1973), mainly due to the shift of labour out of agriculture into industry. Rapid growth was not sustained after the shocks of the Seventies, when Italy's growth, however, was still not disappointing in international perspective. On the other hand, the post-1993 slowdown has been more marked in Italy than elsewhere (Toniolo, 2013). During this period, Italy's growth rates have been strongly affected by the modest performance of the dominant sector, services, with growth actually turning negative in most recent years, and by the gradually fading boost of industry, in particular of manufacturing.

Italy thus made little headway in catching-up on the technological leaders before WWII, but then enjoyed a dramatic period of catching-up between 1951 and 1973. Since 1993 Italy has fallen behind the technological leaders. Labour productivity dynamics have been the main driver of GDP per capita growth for the whole period until 2008. In 2008-2013 the labour participation rate exerted a larger drag on growth than the negative productivity dynamics; the drop in the participation rate was even more severe than in the Great Depression of the 1930s. The modest economic recovery currently under way is driven by a pick-up in the labour participation rate.

Overall, TFP growth turns out to be the main driver of labour productivity in Italy, although to a different degree across sub-periods since the country's political unification. Until WWI sluggish TFP dragged labour productivity down, whereas insufficient capital formation became the main brake on growth in the interwar years. TFP gradually accelerated prior to the Great Depression; following a temporary contraction, it peaked at 4.1% per year during the Golden Age, when it outpaced intense capital deepening as the engine of labour productivity. TFP and capital accumulation gradually lost momentum thereafter, and their contributions to labour productivity actually turned negative in the recession triggered by the global financial crisis. As the economic recovery started in 2014, capital deepening continued exerting a drag on labour productivity, due to the previous huge contraction in investment, while a partially offsetting stimulus came from the mild improvement in TFP.

In an international comparison, labour productivity in Italy was very poor in the period 1861-1881, mostly due to low growth in agriculture, while it was high during the years 1881-1911 (although recording similar rates to Germany) and in 1951-1973. As for TFP, in the interwar years Italy fell back from the technological frontier. The post-WWII rapid catch-up was propelled by the pronounced acceleration of TFP, second only to Germany. Since 1973 labour productivity was strikingly slow in services, largely explaining the slowdown of the total Italian economy. After 1993 even industry lost some of its impetus. Noticeably, Italy's deterioration in TFP growth since the mid-Nineties has been unprecedented in historical and international comparison. The double recession that followed the onset of the global financial crisis exacerbated the deceleration that was already in place. However the years 2014-2016 were slightly brighter, owing to the pick-up in manufacturing and in selected service activities, such as trade, restaurants and accommodation; the recovery was however subdued in international comparison, confirming the ample productivity gap relative to the global technological leader, the U.S.

The paper proceeds as follows. Section 2 sketches the historical data sources employed herein. Section 3 investigates the long-run trends of Italy's GDP per capita and labour productivity growth, for the latter with a focus on sector developments and structural change. Section 4 delves into Italy's performance by performing a growth accounting exercise since the country's unification. Section 5 casts the long-run trends of Italian economy in an international comparison based both on labour productivity (changes and levels) and TFP growth. Section 6 concludes.

2. The historical dataset

As the starting point for our analysis, we have updated the large historical annual national account dataset, already adopted in Broadberry, Giordano and Zollino (2011; 2013), by using Istat (2017), in compliance with the most recent ESA2010 standards. We have revised both the output (originally sourced from Baffigi, 2015) and labour input dataset (published in Giordano and Zollino, 2015; 2016) such that it covers the extended period 1861-2016. Data cover the territory of Italy at current boundaries throughout the period. The dataset is disaggregated at a 10-sector level, employing the following classification: a) agriculture, including forestry and fishing, as well as farming; b) industry, covering mining, manufacturing, construction and utilities; c) services, including trade and tourism, transport and communications, credit and insurance, social and personal services and government services. Much of the story of Italian development over this nearly 160-year period can be told with the 3-sector disaggregation into agriculture, industry and services, although it will at times be helpful to look more closely at trends within industry and services.

As for the output estimates, they are obtained on a real value added basis. Labour inputs are instead computed both on a headcount (HC) and full-time equivalent (FTE) basis, and the methodological details underlying these reconstructions can be found in Giordano and Zollino (2015; 2016), to which we refer. As shown in Figure A1 in Annex A, due to the underlying historical sources (population vs. industrial censuses), until 1951 HC data may be considered as the upper bound, or the full potential, of Italy's labour input whereas the FTE series may be seen as a lower bound. The gap between the two sets of estimates can therefore be interpreted as a proxy of underemployment which characterised the first century after unification. This feature was clearly evident (in absolute terms) in agriculture, where women and children worked less than men, and day labourers worked less than people farming their own or rented land. In percentage terms it was also significant in industry. Indeed, in both agriculture and industry approximately one third of workers was "underemployed" between 1861 and 1951. In services the gap between the two labour measures was around half that registered in the other two sectors (16%). After 1951, our methodology changed: official, or quasi-official, data on HC and FTE employment were used and the two datasets rapidly converge, also owing to an actual reduction in underemployment. The current differences reflect the existence of part-time jobs, workers applying to the redundancy fund (*cassa integrazione*), multiple jobs, etc. Since the outbreak of the recent global financial crisis the gap between the two series has slightly widened, at least in industry and services. Growth trends are anyhow similar in the two series, so the narrative of labour productivity growth is not too dissimilar, regardless of the chosen series. When discussing trends in Italy, we shall use the FTE data, which is the theoretically preferred measure,[2] but when international comparisons are drawn, we will use the HC data, for data comparability reasons.

As for the physical capital stock, we have updated our previous estimates published in Giordano and Zollino (2015; 2016) over the full horizon since 1861, employing the same approach followed by Istat to compile official figures for gross and net capital stocks, available since 1980 (Lupi and Mantegazza, 1994). The main innovations we introduced concern accounting for war destruction of the building stock and a first reconstruction of intangibles in a historical perspective.[3] Accordingly, we compute net and gross capital stock, at current prices and at chained values, for five different assets: (i) machinery, infrastructure and equipment; (ii) means of transport; (iii) non-

[2] Ideally, one would like to employ measures of output per hour worked as in Figure 1. Historical time series, disaggregated by sector, are not available nor simple to reconstruct, so this endeavour has been postponed to a future research agenda.

[3] In compliance with the ESA2010 standards, ISTAT has been regularly publishing data on intangibles (investment and stock) covering years since 1995. In our historical reconstruction we followed two steps: a) estimating a long time series for gross fixed investment on intangibles by properly reclassifying data on asset spending released in the past national accounts for years since 1970 and, for earlier periods, by assuming a proportionality rule between intangibles and machinery and equipment spending; ii) estimating the stock following the same depreciation rule as in Istat (2016).

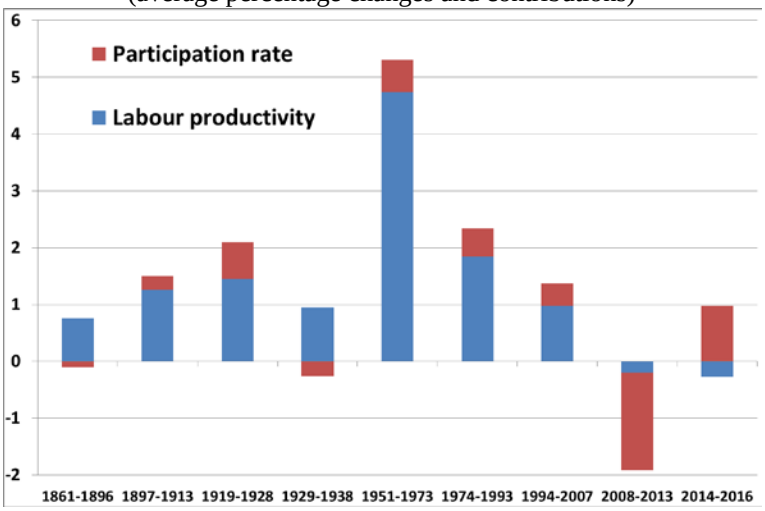
residential buildings; (iv) housing; v) intangibles. Based on our estimates, Italy experienced important changes in capital composition as economic development deepened (Figure A2 in Appendix A). Initially, asset substitution took place mostly from non-residential construction to machinery and equipment, and to a lesser extent, to means of transport. Since the first decade of the XX century a housing upsurge began, against a continuing drop of the share of non-residential construction and a roughly stable profile of the remaining assets. This pattern changed in the late 1960s, since machinery, equipment and means of transport resumed a positive trend, which was offset by a declining share of housing as the downward correction of non-residential structures came to a halt. Regarding intangibles, their share on total capital was negligible before a mild increase started prior to WWI, peaking at the end of the Golden Age; following a gradual deterioration, the share of intangibles has broadly stabilized since the early Nineties.

3. The contours of Italy's economic growth

3.1 GDP per capita developments

As of the 1890s, Italy's GDP per capita accelerated, averaging up to around 2% per year in the decade 1919-1928, boosted by an increasing FTE labour participation rate and by rising labour productivity growth (Fig. 2; Fig. A3 in Appendix A). The negative effects of the Great Depression were not as dramatic as in countries such as the United States, when considering the overall economy, and proved temporary in nature, as they were more than offset in the following recovery, stimulated by the oncoming Ethiopian war, and, even more so, in the years following the post-WWII reconstruction.[4] Indeed, in the years 1929-1938 GDP per capita grew by almost 1% per year, similarly to the immediate post-unification period, despite the significant drag stemming from the declining labour participation rate. During the Golden Age (1951-1973), stimulated by the post-WWII reconstruction, Italy's GDP per capita growth rate jumped to a spectacular 5.2% per year. As in other countries, Italy's economic performance gradually worsened in the subsequent period: the average growth rate in GDP per capita halved in the twenty years to the early Nineties' crisis. Differently to other countries, however, Italy's slowdown continued and intensified thereafter, by losing an additional percentage point until the eve of the Great Recession in 2007.

Figure 2. GDP per capita growth in Italy
(average percentage changes and contributions)



Source: Authors' estimates.
Notes: See main text in Section 2.

[4] We exclude the two World War years in the periodization presented in Figure 2 and heron, given the exceptional nature of the two war episodes and the unsatisfactory quality of the historical data for these years.

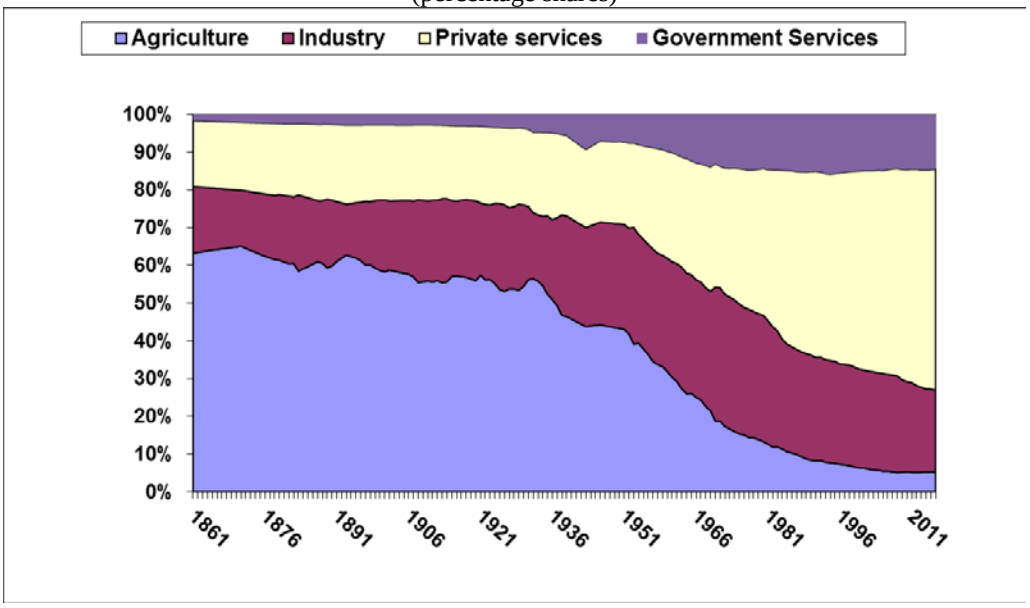
With the eruption of the most severe recession in the country's history, as documented also in Figure A4 in Appendix A, which compares the recent recession to the country's Great Depression, between 2008 and 2013 per capita GDP decreased on average by 1.9% per year. In this period the participation rate exerted a larger drag on GDP per capita growth than the negative productivity growth rate (the drop in participation was more severe than during the Great Depression). A rebound in labour participation supported the expansion of GDP per capita at an average rate of 0.7% since 2014, whereas the contribution of labour productivity growth remained negative, and even more so than in 2008-2013. In fact, according to our estimates, the latter was actually the most severe negative contribution stemming from labour productivity ever registered since the country's political unification.

3.2. The structure of employment in Italy

Before examining Italy's labour productivity patterns in more detail, Figure 3 charts the changing sectoral composition of the Italian labour force on an FTE basis. In 1861 nearly two-thirds of the labour force worked in agriculture, with the remaining workers more or less equally distributed between industry and services. The exodus from agriculture was quite limited until the 1930s. As late as the beginning of the 1950s, over 40% of the labour force remained in agriculture. Between 1951 and 1973 agriculture's share declined sharply, with both industry and private services increasing their shares. The rise in employment in Government services halted in the 1960s and its share remained broadly stable at around 15%. After 1973 industry's share began to decline, as private services became the clearly dominant sector. By 2007 overall services accounted for more than two-thirds of employment with less than a third working in industry and only a small fraction in agriculture, a complete reversal of the picture in 1861. The increase in the employment share of the private tertiary sector was not interrupted during the recent double recession. Indeed, in 2016 private services accounted for an impressive 59% of the total work-force. In conclusion, Italy followed a standard development pattern *à la* Kuznets-Clark (Clark, 1951; Kuznets, 1974), defined by employment contraction in agriculture, a steady expansion in private services, especially after WWII, and a mild hump-shaped pattern observed in industry.

Figure 3. FTE employment shares by macro-sector

(percentage shares)



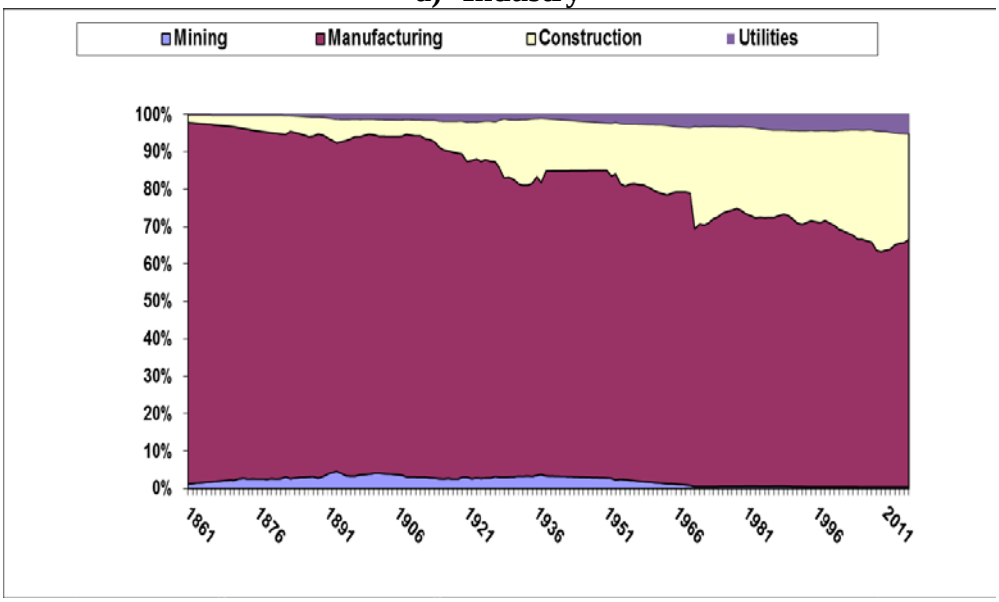
Source: Authors' estimates.
Notes: See main text in Section 2.

By breaking down the data further, one can observe that industrial labour was nearly all employed in manufacturing, while mining and the utilities have systematically been small sectors,

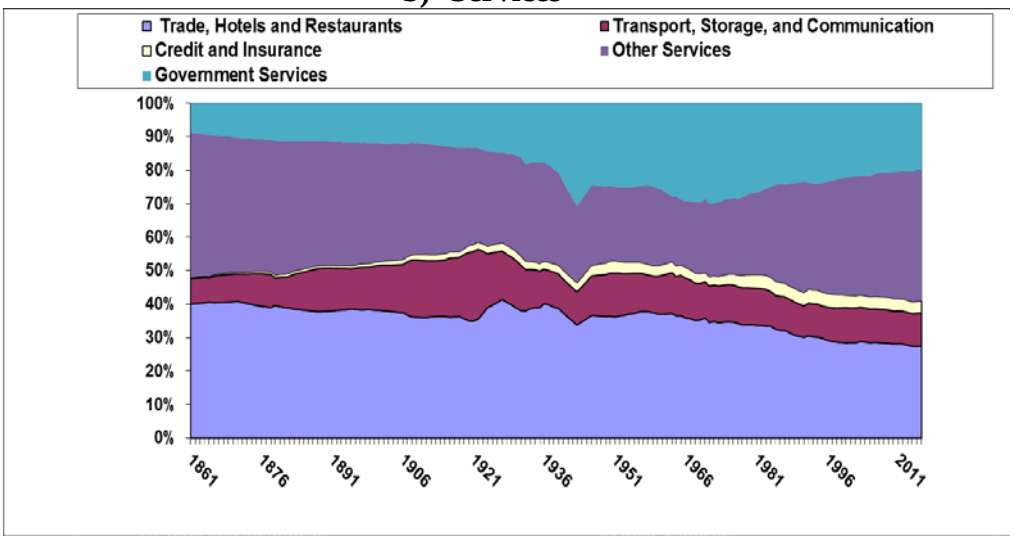
accounting for 4% at their peak at the end of the XIX century and then again in the 1930s (Fig. 4; panel a). Over time, construction has instead increased its share of industrial labour, to its current share of 28%. Within services, employment has been more evenly spread across its component sectors (Fig. 4; panel b). Trade and personal services were the largest sectors from the outset, accounting for 60-80% of all service sector employment over the whole period. Transport and communications were also quite stable within a range of 10-20%. Labour engaged in the credit and insurance sector grew from a negligible share in 1861 to its peak of over 4% in the 1980s and 1990s, reverting to around 3.5% in 2016.

Figure 4. FTE employment shares within macro-sectors
(percentage shares)

a) Industry



b) Services



Source: Authors' estimates.
Notes: See main text in Section 2.

3.3 Labour productivity growth

Continuing to focus on FTE workers and zooming in on output of the total economy, net of government and imputed housing services in order to more correctly assess developments of the productive economy, Table 1 depicts labour productivity growth in Italy by macro-sectors (agriculture, industry and private services) in the country's different phases of development. Macro-sectors developed along different patterns, thus stressing the importance of a sectorial analysis. In particular, as will soon become clear, our data confirm for the case of Italy that "the treatment of the services sector as a homogeneous and stagnant sector, in contrast to dynamic manufacturing, is no longer warranted" (Timmer et al., 2010, p.13).

Table 1. Full-time equivalent labour productivity growth rates

(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	3.1	0.5	1.6	2.1
1929-1938	1.8	-0.6	-0.2	0.7	0.7
1951-1973	4.7	5.9	4.5	6.0	5.3
1974-1993	5.0	3.1	0.6	2.1	2.4
1994-2007	2.9	1.2	0.6	1.1	1.4
2008-2013	1.5	0.2	-0.5	-0.3	-1.9
2014-2016	-1.0	0.8	-0.7	-0.3	0.7
1861-2016	2.1	1.8	1.0	1.6	1.8

Source: Authors' estimates.

Notes: Shaded areas refer to periods of aggregate labour productivity and GDP per capita growth which are equal or above the long-term average.

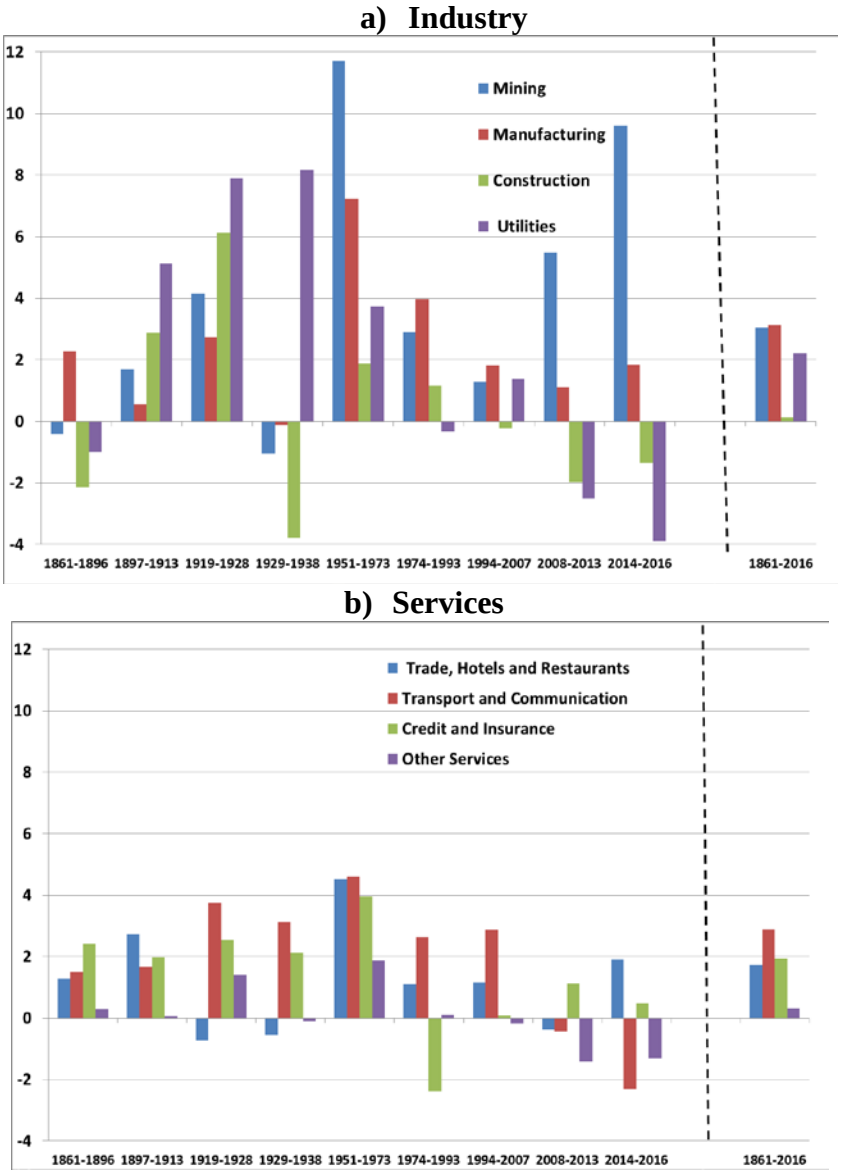
In the first three decades and a half after political unification, the annual aggregate labour productivity growth rate was modest (0.8%), being particularly meagre in agriculture and in services, while in industry it grew at a yearly average rate of 1.5%. Between 1897 and 1913, the increase in aggregate labour productivity was driven by growth in agriculture and, especially, in services, while in industry it slowed down to just under 1%. In the 1920s industry recorded substantial labour productivity growth rates (3.1%) which contributed to determine the high growth rates of the total economy, whereas during the Great Depression labour productivity moderately declined in industry and services, with only agriculture posting positive growth rates. The increase in labour productivity growth in the post-WWII period (1951-1973), was impressive, reaching a hitherto unprecedented overall average annual rate of 6.0%, with industry growing at an exceptional 5.9%.[5] This period, known in Western Europe as the Golden Age, stands out not only against Italy's economic record over the whole 155-year period, but also in an international context. Italy's exceptional performance was propelled by industry, but agriculture, where mechanization was rapidly introduced (Federico and Malanima, 2004), and services also registered productivity growth rates of over 4% per year during this period. In the twenty years following the energy crisis and the

[5] As we shall see in section 3.4, the 1951-1973 years constitute the period in which the shift of labour from the low-productivity agricultural sector to the higher-productivity industrial and services sectors contributed most, in absolute terms, to aggregate labour productivity growth. This fact thus explains why the private total economy labour productivity growth in 1951-1973 reported in Table 1 is higher than the (weighted) average of labour productivity growth in the three component sectors.

breakdown of the Bretton Woods system, productivity growth slowed down in industry and especially in private services, which recorded a modest annual average growth rate of 0.6%. This slow trend continued in the following period (1994-2007), and was further exacerbated during the recent double recession, when labour productivity actually declined in private services, leading to an aggregate negative productivity growth rate. Despite the overall recovery registered as of 2014, the decline in services' labour productivity has persisted and slightly exacerbated, and has also extended to agriculture. Labour productivity growth has instead accelerated in industry, although remaining under 1% average annual rates and well-below the sector's long-run average. The overall private economy's labour productivity continued to decline as a result, at a similar rate to that recorded after the onset of the recent global financial crisis.

Underlying these aggregate trends we find a more heterogeneous picture across sectors at a more disaggregated level of analysis. In this respect, manufacturing is the only branch with positive labour productivity growth throughout the 155 years considered here (with the exception of the Great Depression; Fig. 5, panel a).

Figure 5. Full-time equivalent labour productivity growth within macro-sectors
(average percentage changes)



Source: Authors' estimates.

During the Great Depression indeed, all sectors recorded a fall in labour productivity, with the exception of utilities.[6] On average over the entire 1861-2016 period, construction displayed a poor productivity performance, mostly due to the declines observed during the Great Depression and, more systematically, since 1994. Another broad-based feature characterizing all industrial sectors is the exceptionally high growth rates recorded in the Golden Age; since then there has been a slowdown in manufacturing with a slight reversal recorded in the most recent years (2014-2016). Utilities, in addition to construction, were then the main drivers of the recent labour productivity slowdown in industry.

As for services (Fig. 5, panel b), until WWI they registered positive labour productivity growth across all main sectors, similarly to the Golden Age, when growth rates were also the highest ever recorded in all tertiary branches. During the Great Depression, instead, only transport and communication, on the one hand, and credit and insurance, on the other hand, posted positive growth rates. These were indeed the years in which horse-drawn carts were being replaced by trucks and lorries (Battilani, Bertagnoni and Vignini, 2004) and, thanks to swift and "secret" bailouts, the country's banking system was saved from collapse (Toniolo, 1980). Transport and communication, a sector which traditionally accompanies the production and consumption of industrial goods, actually proved to be the strongest driver of aggregate services' labour productivity growth throughout the overall period under study, although in this branch labour productivity has declined significantly since the onset of the global financial crisis. Conversely, "other services" have contributed significantly to the slowdown of total services' productivity growth since 1974, on account of their size as well as of the stability and then decline since 1994 in their productivity growth rate. More recently, in the years 2014-2016 trade, hotels and restaurants mitigated the decline in total services' labour productivity by growing at an average yearly rate of nearly 2%.

3.4 The impact of structural change

Aggregate labour productivity can vary because of changes of labour productivity *within* individual sectors, but also because of structural change *between* sectors, as suggested by the "dual-economy" approach, initially formalized by Lewis (1954) and expanded upon by Ranis and Fei (1961), which draws a sharp distinction between the traditional sector (agriculture) and the modern sector (in our case, industry and services) of the economy. Aggregate growth depends therefore also on the rates at which labour migrates from the traditional, low productivity sector to the modern, high-productivity branches. The relative importance of within-sector labour productivity growth and of structural change can be quantified using shift-share analysis. This decomposition clarifies how analyses of productivity performance within individual sectors can be misleading when large productivity differentials across sectors exist.

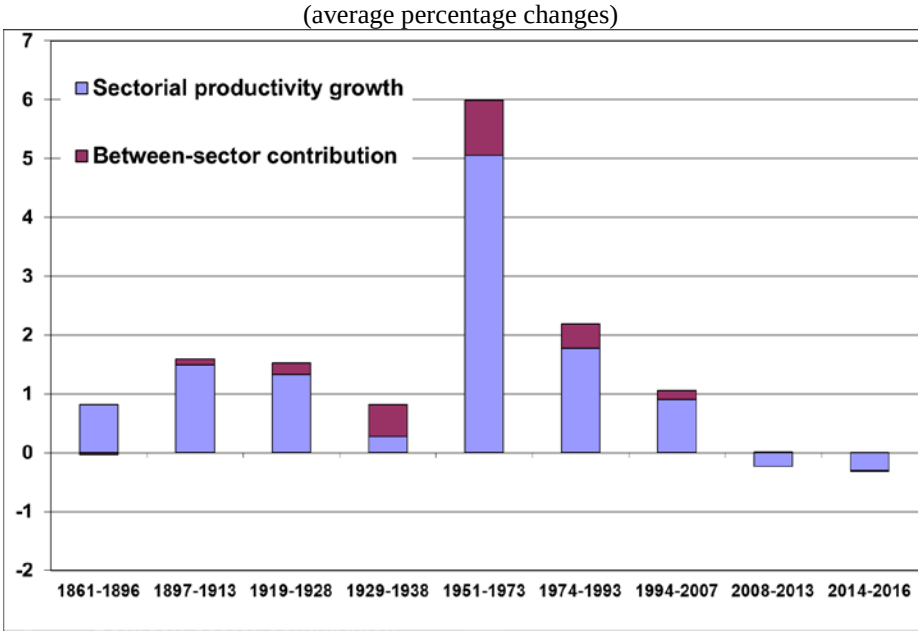
Following the standard approach, as modified by Broadberry (1998) to take into account the differential effects coming from labour reallocation on output in declining versus expanding sectors (see Appendix B for details of the methodology), we find that structural change, namely the across-sector labour shifts, accounted on average for one fifth of the aggregate labour productivity growth in the whole period since 1861, but with a changing intensity (in absolute levels) across sub-periods (Fig. 6). In particular, the contribution of labour reallocation, irrelevant in the first post-unification years, progressively increased from the end of the XIX century, peaking in absolute terms in 1951-1973, and remained sizeable, although decreasing in magnitude, in the following twenty years. Structural adjustment has become negligible since the onset of the global financial crisis, when within-sector labour productivity growth has also been negative. The recent-time evidence is in

[6] See Giordano and Giugliano (2015) for an in-depth investigation of labour productivity growth within manufacturing during this period. This study, together with Giordano, Piga and Trovato (2014) and Giordano and Zollino (2017), suggests that aggregate growth in Italy in the 1930s was hampered by restrictive domestic competition policies that the fascist regime introduced as a reaction to the 1929 recession and which significantly reduced competition and raised mark-ups in many sectors.

striking contrast with the record of the Great Depression, when labour reallocation exerted a large positive impulse to aggregate labour productivity growth.

Figure 6. Labour productivity growth decomposition

(average percentage changes)



Source: Authors' estimates.
Notes: See Appendix B for details on the methodology.

4. Accounting for Italian economic growth

In this section we report the results of a growth accounting exercise. The purpose is, on the one side, to provide further historical insights into the process of economic development in Italy and, on the other, to track the evolution of total factor productivity (TFP), thus shedding additional light on the main components of labour productivity. Methodological details of the framework employed are provided in Appendix C.

For the purpose of growth accounting, we consider only the total economy – again net of the public sector and housing from both the output and input sides – due to the fact that historical investment and capital stock at the sector level are currently unavailable. We follow Jorgenson (2001) to take account of the changing quality of productive services provided by capital assets. Rather than simply summing up the net stocks of different assets, the Divisia index of capital inputs assigns relatively larger weights to changes in the more productive (or short-lasting) assets than to the less productive (or long-lasting) assets. For this purpose we estimated historical time series for user costs for each of the considered capital assets, by summing up the financial cost (as proxied by interest rates on long-term government bonds) and capital gains (as proxied by a three-year moving average of the asset deflator), net of the depreciation rate (average ratio of economic consumption to the gross capital stock). Although Jorgenson (2001) suggests a similar quality adjustment for the labour input, data limitations on wage and employment composition by skill or education level do not permit its implementation in our analysis, in which we therefore adopt the FTE measure employed so far. We do, however, construct historical series of wages by four main macro-sectors (agriculture, industry, private services, Government services), of which we again drop the latter sector to focus only on the private, productive economy. In order to estimate the labour share we follow Gollin (2002), thereby assuming that compensation of the self-employed is equal to that of employees.[7] Under the standard assumptions of constant returns to scale and perfect competition, the capital share is computed as the complement to one of the labour share. Finally, although it is

[7] Employees' compensation includes wages, salaries and the employers' contribution to social security.

agreed that distortions from imperfect competition, externalities, omitted input and non-constant returns to scale confound the interpretation of TFP as a pure technology measure, "it remains a useful indicator of the underlying technological factors" (Stiroh, 2002).[8]

Over the whole period 1861-2016, TFP growth accounted for nearly half of GDP growth, with capital services accounting for the greater part of the remainder (Table 2). However, the importance of TFP growth varied considerably over time. TFP growth was very moderate during the first thirty years after the country's political unification, then steadily increased and, following the temporary drop during the Great Depression, it reached a peak of 4.1% per year by the Golden Age. Since then TFP started gradually deteriorating, declining to around 0.6% during the double recession started in 2007, followed by a partial recovery since the business cycle turned positive in 2014.[9] The contributions of inputs from primary factors were less volatile, particularly in the case of labour and if we exclude the years since the financial crisis, when labour hindered output growth more intensively than the declining TFP. In the case of capital, in the first spurts of growth it provided a primary contribution, which was over-paced by labour in 1919-1928 as capital accumulation turned temporarily negative. In the remaining years capital once again became the main source of growth (second to TFP in the Golden Age), but its contribution evaporated during the recent global financial crisis, then turned negative in the years 2014-2016 - mostly reflecting the lagged effects of the huge contraction in gross capital formation during the crisis years-, and the output recovery was supported by the positive contribution of labour input and, to a larger extent, by TFP.

Table 2. The proximate sources of economic growth in Italy

(average percentage changes and percentage points for contributions)

Years	Changes in non housing GDP	Contribution of labour	Contribution of capital services	*of which asset substitution*	Changes in TFP
1861-1896	1.25	0.37	0.75	0.19	0.13
1897-1913	2.47	0.71	1.11	0.15	0.65
1919-1928	2.80	0.82	-0.18	-0.24	2.15
1929-1938	1.04	0.31	1.16	0.23	-0.44
1951-1973	6.90	0.87	1.90	0.04	4.13
1974-1993	2.74	0.50	1.15	0.26	1.09
1994-2007	1.86	0.46	0.75	0.14	0.65
2008-2013	-1.59	-0.95	0.00	-0.07	-0.63
2014-2016	0.61	0.64	-0.36	-0.16	0.33
1861-2016	2.35	0.46	0.84	0.10	1.05

Source: Authors' estimates.

Focusing on labour productivity determinants, over the period 1861-2016 as a whole TFP growth accounted for two-thirds of labour productivity growth (Fig. 7). However, the positive contribution of capital deepening was greater before WWI, during the Great Depression and, to a

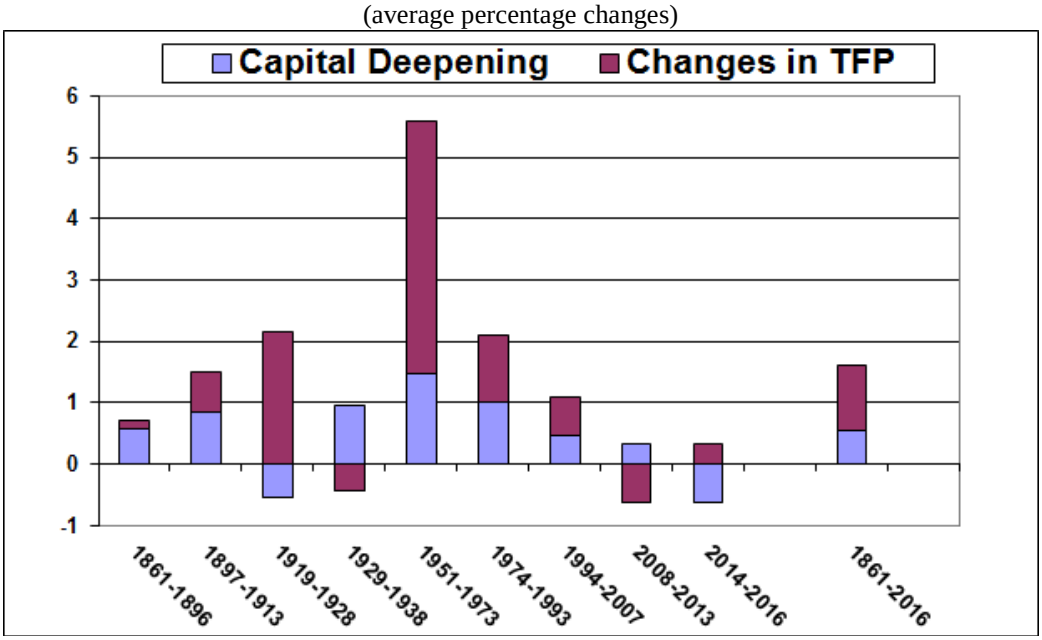
[8] See Giordano and Zollino (2017) for an attempt at measuring historical mark-ups by loosening some standard growth accounting assumptions.

[9] For years since 1995, results occasionally differ from evidence reported in Mistretta and Zollino (2017) because: a) we here rule out a large part of services activities (e.g. public administration, health, insurance); b) as mentioned in the text, we do not here perform any correction for skill substitution in the labour force; c) we perform historical growth accounting at a less disaggregated level in terms both of productive sectors and types of capital assets.

more limited extent, in the twenty years since the end of the Golden Age. Finally, during the recent global financial crisis the rising capital intensity of production – mostly due to the decline in employment - partially offset the drag on labour productivity growth stemming from negative TFP growth. The two drivers exerted an opposite impact in the years 2014-2016, when labour productivity continued to decline against significant employment expansion.

Figure 7. The main components of labour productivity growth

(average percentage changes)



Source: Authors' estimates.

5. Italy's productivity performance in an international perspective

In this section, we compare the historical performance of the Italian economy against a sample of advanced economies that includes the U.K., the U.S. and Germany. Although these countries were selected according to long-run data availability, they are all interesting benchmarks to compare Italy's development process with. Indeed, the U.K. was the first industrial country and Europe's per capita income leader until the last third of the XX century. It has been widely used as the *numeraire* country in historical international comparisons of productivity. As the productivity leader during the XX century, the U.S. is included to represent the global technological frontier. Germany attained its political unification at about the same time as Italy (1871) at which time it was still a relatively backward economy. However, in contrast to Italy, Germany quickly emerged as a major industrial power to challenge Britain's industrial dominance and today remains Europe's largest industrial producer and exporter.[10] The data sources for these countries are documented in Appendix D.

Since it is widely recognised that economic backwardness provides scope for relatively fast catch-up growth (Gerschenkron, 1962; Abramovitz, 1986; Baumol, 1986), we start by considering both levels and growth rates of labour productivity to then move on to compare historical trends in TFP. For international comparability reasons, in this section we measure labour productivity in Italy based on the number of persons employed and on total value added (including Government services and housing). Moreover, we occasionally change the periodization relative to that adopted in previous sections, to accommodate the data availability for the U.S. and Germany.

[10] We refer to Broadberry, Giordano and Zollino (2013) for a comparison of Italy also with Japan and with an emerging economy, India.

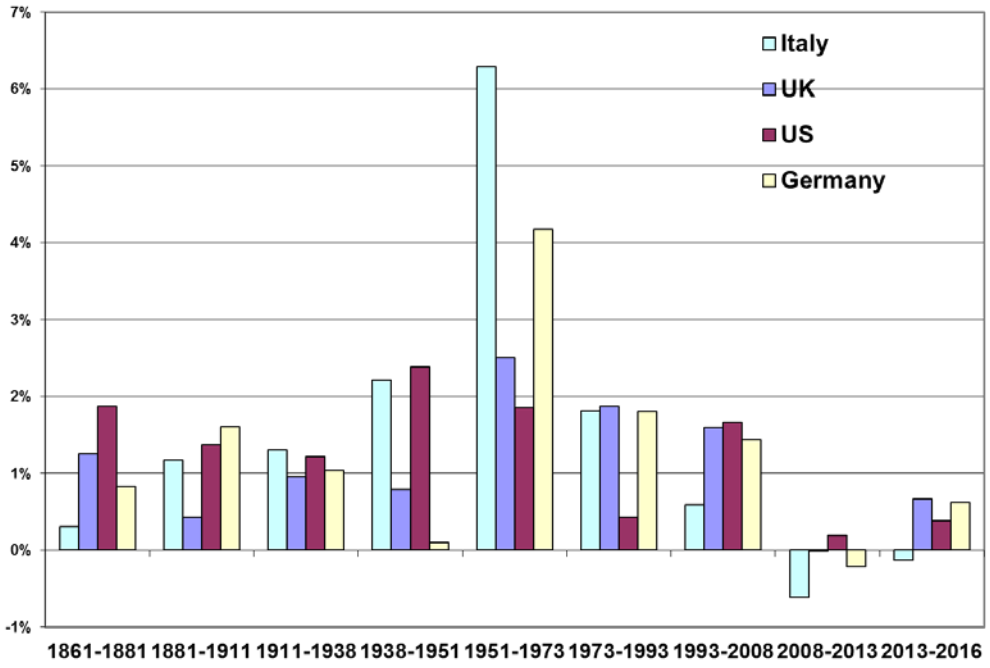
5.1 Labour productivity growth rates and levels

In the first twenty years following political unification Italy's labour productivity performance was substantially exceeded by that of the U.K. and the U.S. - somewhat less by Germany - mostly due to the country's disappointing productivity growth in agriculture (Figure 8; Table 3). Over the long horizon until the mid-Seventies Italy performed a gradual catching-up to the international standards, mostly due to the substantial increase of productivity in industry, noticeably higher than in other countries over the period 1881-1991 (yet similar to Germany) and especially during the Golden Age when Italy's performance was outstanding. In the period 1973-1993 Italy's labour productivity dynamics were comparable to those in the U.K. and in Germany, whereas the U.S.' productivity slowdown stood out, driven by sluggish growth in industry and in services. Since 1993 Italy has was the worst performer, mainly dragged down by services, by then the largest macro-sector of the economy. Italy is currently the only country of the four under consideration showing declining labour productivity in services.

However, before interpreting the recently declining performance as a failure of the Italian economy, mostly due to services, it is worth considering comparative labour productivity levels: it is widely accepted that economic backwardness opens up opportunities for rapid catch-up growth and, on the opposite, starting from high levels of productivity makes it harder to achieve large improvements.

Figure 8. Headcount labour productivity growth in selected advanced economies, 1861-2016

(average percentage changes in sub-periods)



Source: Authors' estimates.

Notes: See Appendix D for the original data sources.

Table 3. Headcount labour productivity growth in selected advanced economies by macro-sector, 1861-2016

(average percentage changes)

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	6.1%	2.7%	0.6%	1.8%
1993-2008	3.1%	1.0%	0.5%	0.6%
2008-2013	1.2%	-0.6%	-1.0%	-0.6%
2013-2016	-0.7%	1.6%	-0.6%	-0.1%
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%
1993-2008	2.5%	1.8%	1.6%	1.6%
2008-2013	0.1%	-0.2%	0.1%	0.0%
2013-2016	1.6%	0.6%	0.7%	0.7%
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%
1990-2008	2.7%	2.1%	1.7%	1.7%
2008-2013	-0.9%	0.9%	0.1%	0.2%
2013-2015	-5.3%	1.2%	1.0%	0.4%
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%
1990-2008	2.4%	2.2%	0.8%	1.4%
2008-2013	-6.7%	0.3%	-0.4%	-0.2%
2013-2016	-4.0%	2.1%	0.1%	0.6%

Source: Authors' estimates.
Notes: See Appendix D for the original data sources.

For the purpose of the comparison of productivity levels, we take the U.K. as the *numeraire* country, setting the U.K. labour productivity level at a value of 100 in all years and sectors. To pin

down the comparative labour productivity level, we use a cross-sectional benchmark for 1997, derived from the EU KLEMS database (Timmer, Ypma, van Ark, 2007). The benchmark is estimated from data on nominal value-added in national currency, deflated by relative sector-specific price ratios adjusted for PPP, per person engaged in each country. This deflation procedure is necessary because the exchange rate cannot be assumed to accurately reflect differences in prices between different countries, especially at the level of individual goods and services, or particular sectors.[11] In the case of cross-country comparisons, value measures must be corrected for differences in relative prices between countries. Furthermore, sector-specific PPPs are to be used, because large cross-sector differences in PPPs can be shown to exist (Inklaar and Timmer, 2008, pp. 16–17). Indeed EU KLEMS provides sectorial PPPs. The time series of labour productivity are then projected, backward and forward, from the 1997 benchmark thus built. A number of studies (Prados de la Escosura, 2000; Ward and Devereux, 2003; 2004) have questioned the use of time series projections from a single benchmark over long periods of time, the methodology used here, which potentially raises index number problems. The problem may be mitigated by using additional benchmark estimates—for earlier and later years—to check for consistency with the comparative labour productivity levels suggested by the time series projections (Broadberry, 2003). These additional checks were discussed in depth in Broadberry, Giordano and Zollino (2013), to which we refer, and shed light on the satisfactory accuracy of our time series projections here for all macro-sectors.

Focusing on labour productivity in the economy as a whole, Italy failed to catch-up on the U.K. between 1871 and WWII, embarked on a steep catching-up trajectory after the war and overtook the UK by the late Sixties (Fig. 9). Since the mid-Nineties, however, the U.K. has overtaken Italy once again.[12] Italy's industry became by far more productive than the U.K.'s as of the second half of the XX century, with the recent double recession inverting this result. However, the recent recovery in the Italian economy in 2014-2016 has led to Italian industry outperforming the U.K.'s once again. Conversely, labour productivity in Italy's services has been systematically falling back relative to the U.K. since the early 2000s.

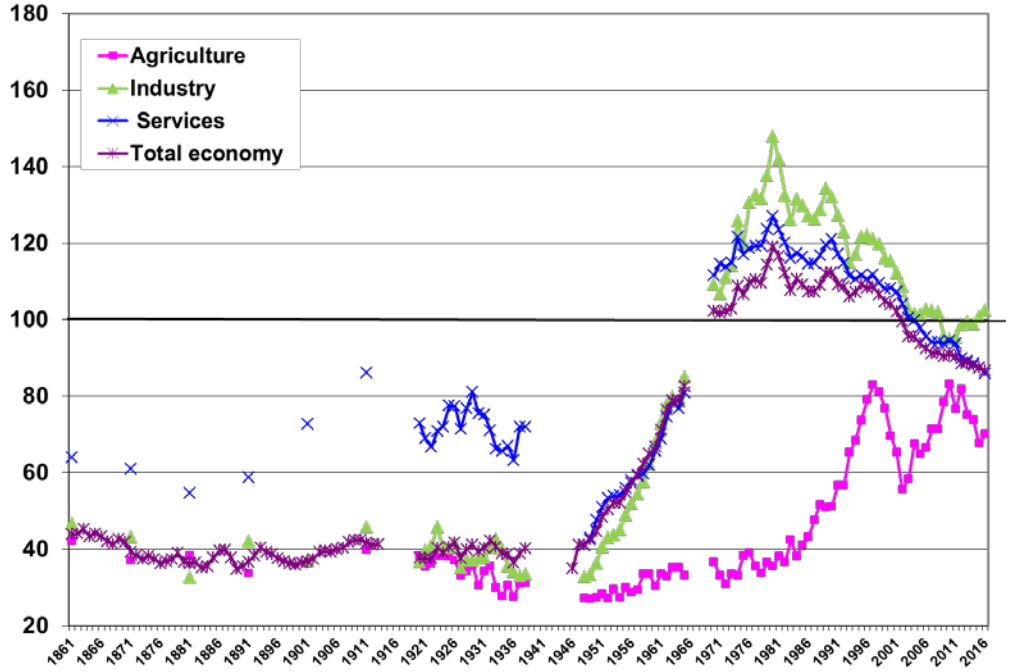
Labour productivity in the U.K. started lagging behind that of the U.S. already at the turn of the XIX century, with the U.S. becoming the new global technological leader (Fig. 10, left-hand side chart). The U.S.'s lead is still substantial, despite gradually reducing since the Fifties. The U.S. versus U.K. comparison helps to put Italy's achievements into perspective, raising severe warnings on Italy's ability to keep up with the frontier pushed by the leading countries. As for Germany, it started off at a higher labour productivity level (compared with the U.K.) than Italy but managed to overtake the UK earlier and to maintain its lead almost unchanged since the early Seventies. Finally, to broaden the international comparison we borrow a chart from Bergeaud, Cette and Lecat (2015) to compare Italy's labour productivity levels (relative to the U.S. in this case) with that of other euro-area countries (Fig. 10, right-hand side chart). According to these scholars' estimates, France and the Netherlands' labour productivity levels are higher than those recorded in the U.S., further distancing themselves from Italy's performance, and in recent years even Spain has overtaken Italy in labour productivity terms.

[11] In principle, price discrepancies converge to zero in sectors open to international trade, yet different degrees of monopoly power, lags in response to exchange rate movements, barriers to trade, and so forth may fuel persistent differences. Furthermore, exchange rates have been known to be subject to substantial short-term fluctuations and international capital movements, thus becoming misleading converters to a common currency, even for tradeable goods and services. See Taylor and Taylor (2004) for a review of the debate on PPP and Fidora, Giordano and Schmitz (2017) and citations therein for a specific focus on euro-area countries.

[12] At a sectorial level, in the early stages of Italy's development agriculture and industry shared similar levels of productivity in Italy relative to the U.K., whereas services started off at a higher level. Indeed, it has been found in the literature that both the employment share and the nominal value added share for the service sector are bounded away from zero even at very low levels of development (Herrendorf, Rogerson and Valentinyi, 2013), yet this holds even more so for Italy than for the U.K.

Figure 9. Labour productivity levels in Italy relative to the U.K. by macro-sector, 1861-2016

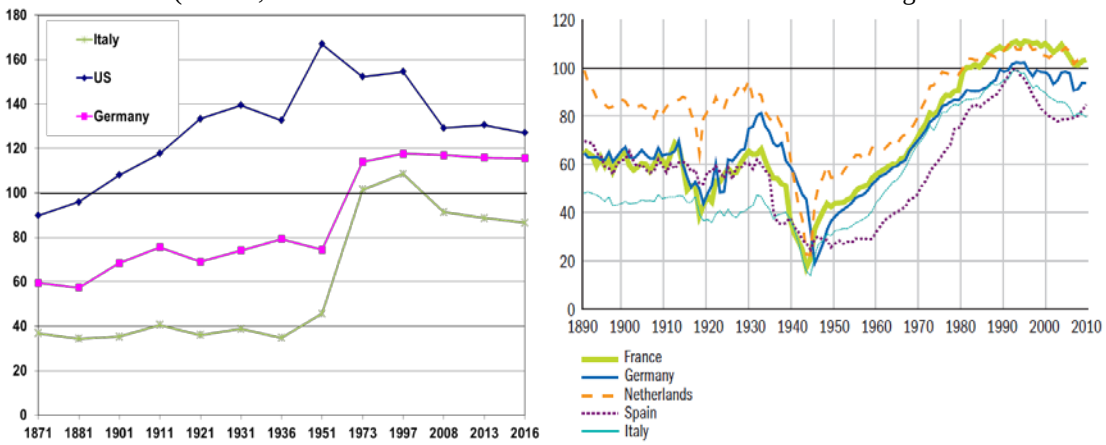
(indices; U.K.=100)



Source: Authors' estimates.

Figure 10. Total-economy labour productivity levels of selected countries relative to the U.K. and to the U.S. in the long run

(indices; U.K.=100 in the left-hand side chart and U.S.=100 in the right-hand side chart)



Source: Authors' estimates for the left-hand side chart and Bergeaud, Cette and Lecat (2015) for the right-hand side chart.

5.2 TFP growth in international perspective

In this section we compare Italy's TFP growth performance with that of the other countries in our selected sample, for which comparable data are available. Due to the lack of systematic data covering the whole period for all countries, we assume factor shares to be fixed at 0.65 for labour and 0.35 for capital, which is quite standard in the literature (Carreras and Josephson, 2010; Crafts and Toniolo, 2010). The labour input data are again on a headcount basis for all countries, for reasons of data availability. These assumptions do not dramatically change the Italian picture compared with results shown in Section 4 under variable factor shares and FTE labour input.

Table 4. Total factor productivity trends

(average percentage changes)

A. Italy	GDP	TFP		B. United Kingdom	GDP	TFP
1861-1896	1.3	0.3		**1871-1891**	1.8	0.6
1896-1913	2.3	0.6		**1891-1911**	1.7	0.3
1919-1928	2.7	1.7		**1912-1950**	1.3	0.6
1929-1938	1.5	-0.4		***1929-1937***	*2.3*	*1.1*
1950-1973	6.0	3.5		**1950-1973**	2.7	1.2
1973-1993	2.6	1.2		**1973-1990**	1.1	0.3
1994-2007	1.7	0.7		**1990-2007**	2.6	0.9
2007-2013	-1.6	-0.6		**2007-2013**	0.3	-0.5
2013-2016	0.6	0.3		**2013-2016**	2.4	1.6

C. United States	GDP	TFP		D. Germany	GDP	TFP
1869-1889	4.3	0.0		**1871-1891**	2.4	0.7
1889-1909	4.2	0.8		**1891-1911**	2.1	0.8
1909-1950	3.0	1.3		**1911-1950**	-0.3	0.6
1929-1937	*0.6*	*0.3*		***1929-1935***	*0.1*	*0.7*
1950-1973	3.6	1.4		**1950-1973**	5.4	7.0
1973-1990	1.5	0.0		**1973-1990**	4.6	2.3
1990-2007	3.1	0.9		**1990-2007**	0.6	1.2
2007-2013	0.8	2.2		**2007-2013**	0.7	1.7
2013-2016	0.6	0.4		**2013-2016**	0.3	0.6

Source: Authors' estimates.

Italy's TFP growth is confirmed to be always positive apart from during the Great Depression and in the double recession following the recent global financial and the sovereign debt crises (Table 4). Although Italy's TFP growth performance was unimpressive before WWI, it was broadly in line with rates achieved in other countries. In the following decade Italy's TFP growth improved relative to that of other countries, with the lead strongly resuming in the Golden Age compared with the U.S. and the U.K., while Germany performed at a striking 7.0% per year between 1950 and 1973. Italy's TFP growth rate has become particularly low by international standards since the early Nineties, at a time when TFP growth has picked up in the U.S. and the U.K., and remained substantially positive in Germany (although at a reduced pace). The recessionary years 2008-2013 exacerbated the pre-existing deceleration in Italy, although more favourable signals have been registered since.

6. Conclusions

Based on a new historical dataset covering the period 1861-2016, we provide a reassessment of Italy's economic development since its political unification. During the period prior to 1938, Italy's GDP and labor productivity made little headway in catching-up on the technological leaders, yet catch-up turned out to be exceptional during the Golden Age. As in many European countries, this rapid process could not be sustained after 1973, due to the reduced scope to redeploy labour out of agriculture and the narrowing of the technology gap, also resulting from the productivity growth slowdown in the technological frontier, the U.S. However, the further slowdown after 1993, and the disappointing TFP performance, has been more pronounced in Italy than elsewhere, suggesting that country-specific structural factors were at play.

A sectorial analysis helps understanding these aggregate productivity trends. Before WWII, the Italian economy was held back by slow productivity growth in the large agricultural sector, the least productive at the time. This allocative inefficiency, however, later turned into an engine of growth, when a rapid shift of labour out of agriculture accelerated growth in the 1920s and contributed to the swift catching-up process observed during the Golden Age, which was mainly propelled by industry. However, although structural transformation can indeed fuel rapid growth, if it is not backed up by strong within-sector productivity drivers, such as education and competition

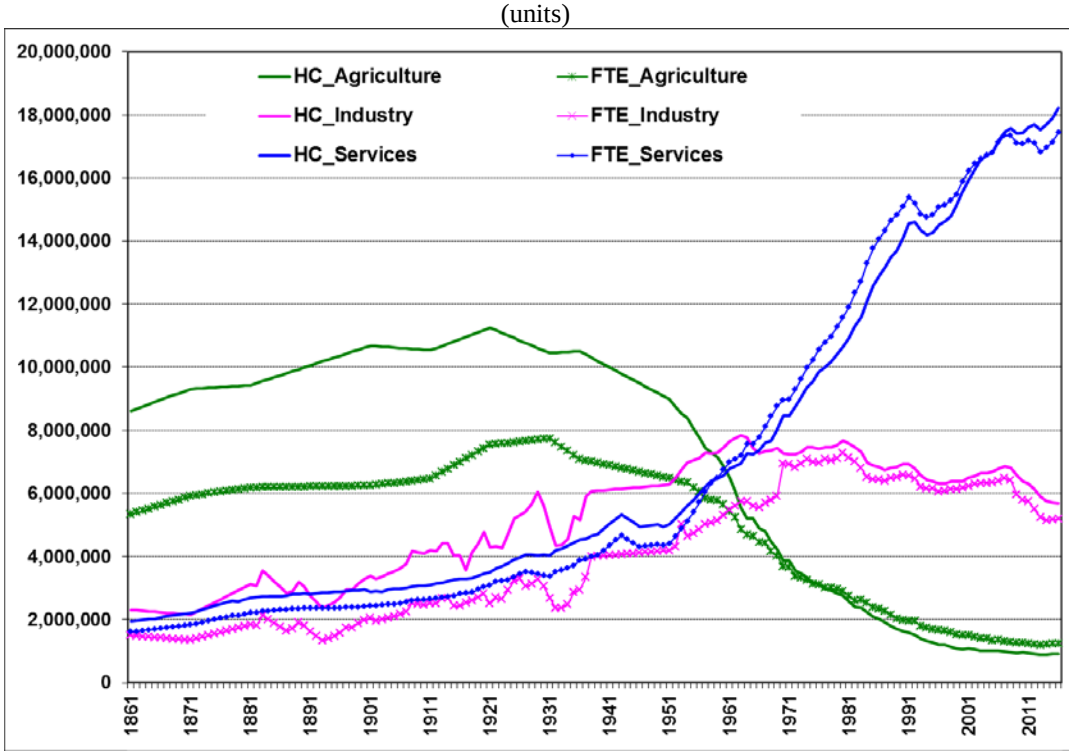
just to cite two possible factors stressed by Aghion and Howitt (2016), its positive impulse on aggregate growth peters out and remains episodic. This was indeed the case for Italy. The disappointing performance of the Italian economy since 1993 is explained largely by weak productivity growth in the now dominant services sector, both in historical and international comparison.

The investigation of the deep determinants of the recent deterioration of Italy's productivity performance, both over time and in the international comparison, goes beyond the scope of this descriptive paper, also because it would require a more detailed analysis at sector and even firm level. Based on recent evidence, we leave for future research a historical assessment of the following candidate, and interrelated, factors which may have negatively affected Italy's recent productivity trends: a) the dearth of public and private investment; b) the slow adoption of ICT as capital equipment, especially in some service activities; c) weak competition, especially in some highly regulated sectors; c) the slow diffusion of technology from high-productivity firms to the laggard enterprises; e) input misallocation across firms within sectors.

Annex A. Additional charts and tables

Figure A1. Headcount and full-time equivalent workers in Italy's three main economic sectors, 1861-2016

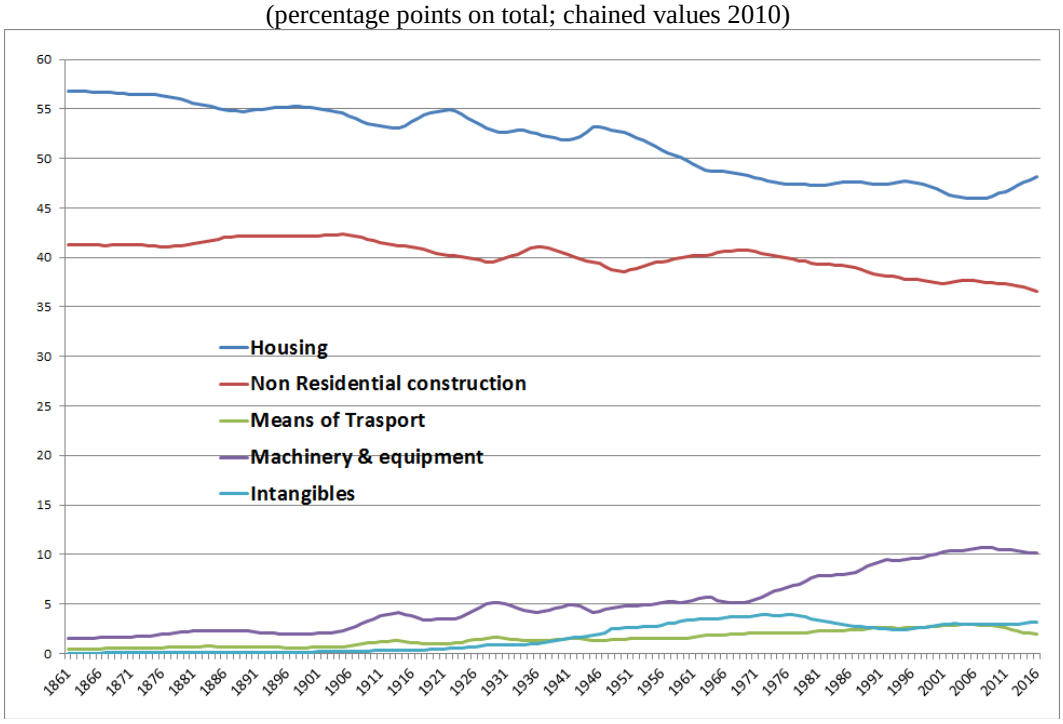
(units)



Source: Authors' estimates.
Notes: See main text in Section 2. HC=headcount; FTE=full-time equivalent.

Figure A2. Capital stock in Italy by asset type, 1861-2016

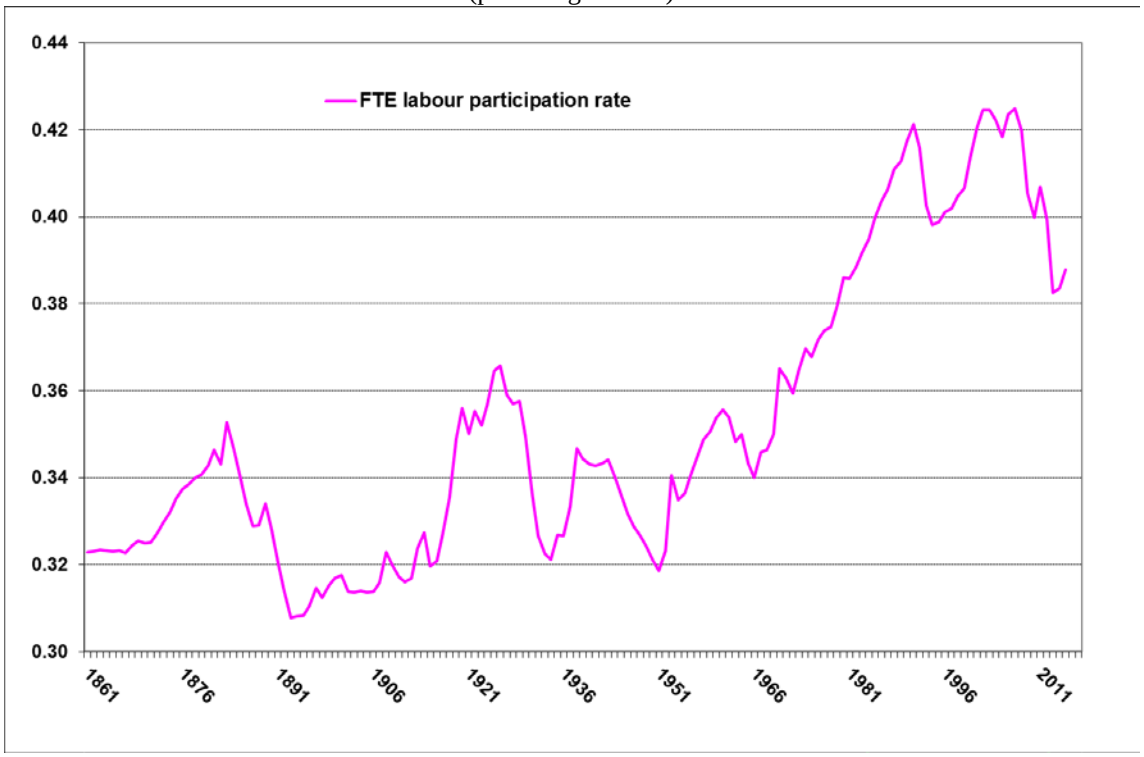
(percentage points on total; chained values 2010)



Source: Authors' estimates.
Notes: See main text in Section 2.

Figure A3. The full-time equivalent labour participation rate in Italy, 1861-2016

(percentage shares)

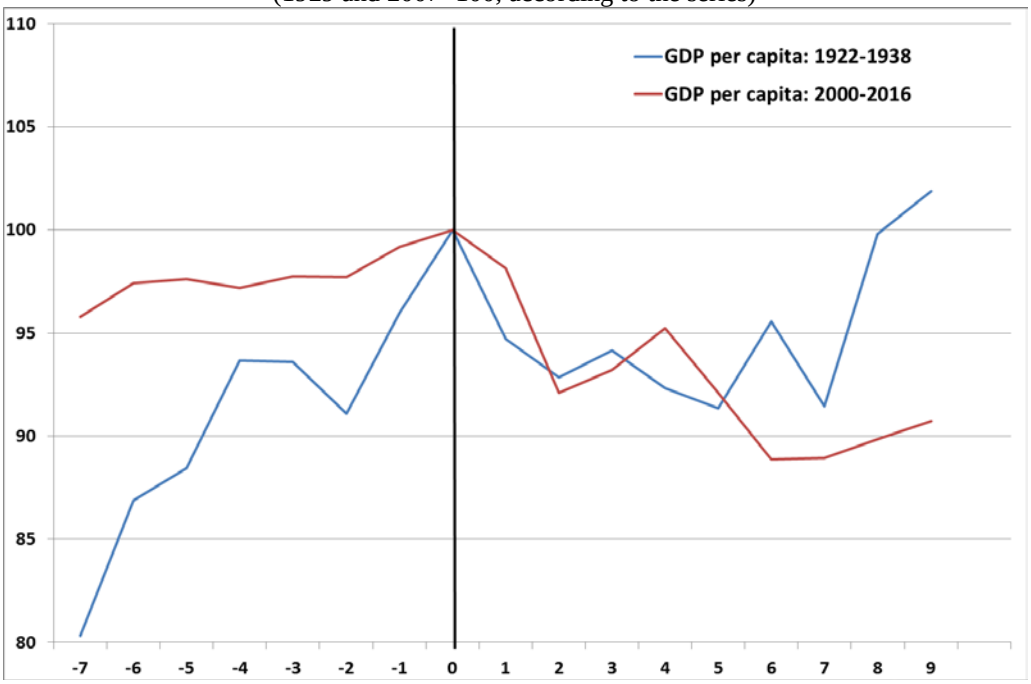


Source: Authors' estimates.

Notes: See main text in Section 2.

Figure A4. GDP per capita in Italy during the Great Depression and during the recent recessionary phase

(1929 and 2007=100, according to the series)



Source: Authors' estimates.

Notes: See main text in Section 2. The numbers on the horizontal axis signal the number of years prior and subsequent to 1929 and 2007, respectively.

Appendix B. The framework for the shift-share analysis

The basic approach for controlling the effects of labour reallocation on aggregate performance productivity is derived from Nordhaus (1972), where the growth of aggregate labour productivity is broken down to disentangle the structural component.

The level of labour productivity (X_0) is given by aggregate value added (VA_0) divided by aggregate employment (L_0), which can also be written as the weighted sum of the labour productivity in each sector *i* (A= agriculture; I = industry; T= tertiary sector) with employment shares as weights.

$$\text{(B1)} \quad X_0 = VA_0/L_0 = \sum_{i\in(\{A,I,T\}} X_i S_i$$

where S_i is the share of employment in sector i and X_i is the productivity level in sector i. By taking time derivatives (denoted by hats above variables), we obtain:

$$\text{(B2)} \quad \hat{X}_0 = \sum_{i\in(\{A,I,T\}} \hat{X}_i \cdot S_i + \sum_{i\in(\{A,I,T\}} \hat{S}_i \cdot X_i$$

Dividing through by X_0 and multiplying and dividing the first term by X_i:

$$\text{(B3)} \quad \hat{X}_0 / X_0 = \sum_{i\in(\{A,I,T\}} \hat{X}_i / X_i \cdot S_i \cdot (X_i / X_o) + \sum_{i\in(\{A,I,T\}} \hat{S}_i \cdot (X_i / X_o)$$

We can rewrite equation (3) in value added terms. After a few simple computations, one obtains:

$$\text{(B4)} \quad \hat{X}_0 / X_0 = \sum_{i\in(\{A,I,T\}} \hat{X}_i / X_i \cdot (VA_i / VA_o) + \sum_{i\in(\{A,I,T\}} VA_i / VA_o \cdot (\hat{L}_i / L_i - \hat{L}_o / L_o)$$

where VA_i is the value added in sector i and L_i is employment in sector i. Following Stiroh (2002), the value-added shares may be computed as average two-period sectoral value added shares.[13]

The first term on the right hand side of equation (4) is what Nordhaus (1972) calls the "pure" productivity effect, also known as the "direct" productivity effect or the "within effect". It is a weighted average of the productivity growth rates in component sectors, where the weights are period-average nominal value-added shares of each sector. As productivity in one sector grows, aggregate productivity rises in proportion to that sector's size. The within effect may thus be interpreted as the productivity effect if there were no changes in value added composition across sectors. The second term is the "reallocation effect", which captures the effect of changing shares of employment on aggregate productivity. When changes in employment shares are positively correlated with productivity levels, this term will be positive and structural change will increase aggregate productivity growth. This is sometimes known as the "Denison effect" (Nordhaus, 2001)

[13] Note that the right hand side of the equation may not be exactly equal to the labour productivity growth rate on the left-hand side due to the omission of second-order terms and to rounding effects. Following Fagerberg (2000), Schulze (2007), Timmer and de Vries (2009) and Giordano and Giugliano (2013), the residual of Eq. (B4) can be interpreted as an "interaction" or "dynamic shift effect", which measures the interaction between changes in productivity in individual industries and changes in the allocation of labour across industries. This effect will be positive if the fast-growing sectors also increase their share of total employment. This implies that the overall impact of structural change on aggregate productivity growth is given by the sum of the static and the dynamic shift effects. In our case, the dynamic effect is always close to zero, so the second term in equation (B4) is, in our view, a sufficient indicator of the impact of structural change in our data. In this approach, we are in line with McMillan and Rodrik (2011) and McMillan, Rodrik and Sepulveda (2017).

after Edward Denison, who was the first to point out how the shift from a low-productivity-level to a high-productivity-level sector raises productivity even if the growth rates in the two sectors are the same (Denison, 1967).

Broadberry (1998) argued that a major problem with this orthodox shift-share analysis is that it assumes that productivity growth rates in each sector would be unaffected by the absence of structural change. If Kindleberger's (1967) assumption that surplus labour was being drawn from agriculture and reallocated to nonfarm activities with little or no loss of agricultural output is accepted, then restoring labour to agriculture would not have positively affected output, but simply lowered labour productivity growth rates. On the other hand, the shift of labour away from nonfarm activities would not only have lowered the labour input, but also output, leaving labour productivity growth rates unaltered. Therefore, had agriculture continued to employ an unchanged share of workers, due to an absence of structural change, labour productivity growth rates in agriculture would have been lower. Hence, Broadberry (1998) modifies the direct productivity term in the following manner:

$$(5)\quad \hat{X}_0 / X_0 = \sum_{i\in(\{A,I,T\}} \alpha_i \cdot (\hat{VA}_i / VA_o) + \sum_{i\in(\{A,I,T\}} VA_i / VA_o \cdot (\hat{L}_i / L_i - \hat{L}_o / L_o)$$

where:

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

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

In this way, in a declining sector, 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 the particular sector, whereas in expanding sectors the actual productivity growth rate is used.[14] The modified shift-share calculation can be seen as a generalization of Denison (1967) and it is also adopted by Crafts and Toniolo (2010).

[14] These calculations are to be regarded as upper-bound estimates of the effects of structural change (Broadberry, 1998).

Appendix C. Standard growth decomposition

Growth accounting can be used to analyse the proximate sources of growth. The neoclassical approach described in Solow (1957) is based on a standard Hicks-neutral production function:

(C1) $Y = A\,F(K,L)$

where Y is output, K is capital, L is labour and A is the level of technology. Totally differentiating the production function (where hats denote time derivatives), and assuming that factors of production are paid their marginal products, yields the growth accounting identity:

(C2) $$\hat{Y}/Y = \theta\left(\hat{K}/K\right) + (1-\theta)\left(\hat{L}/L\right) + \hat{A}/A$$

where the weights θ and (1-θ) are the income shares of capital and labour, respectively, under the assumptions of perfect competition and constant returns to scale. Total factor productivity (TFP) growth is computed as a residual, that is as the difference between output growth and the weighted average of growth rates of the two production factors:

(C3) $$\hat{A}/A = \hat{Y}/Y - \left\{\theta\left(\hat{K}/K\right) + (1-\theta)\left(\hat{L}/L\right)\right\}$$

Equation (C2) can be rewritten in terms of the growth of labour productivity as follows:

(C4) $$\hat{y}/y = \theta\left(\hat{k}/k\right) + \hat{A}/A$$

where $\hat{y}/y = \hat{Y}/Y - \hat{L}/L$ and $\hat{k}/k = \hat{K}/K - \hat{L}/L$. This enables us to break labour productivity growth down into the contributions from capital deepening and TFP growth. The latter is often associated with technological innovation, but in fact includes all changes other than capital deepening which improve productivity

Appendix D. Data sources for countries other than Italy

The dataset employed for the countries other than Italy in this paper is taken from Broadberry, Giordano and Zollino (2013), updated for recent years with official data sources.

1. UNITED KINGDOM

The UK time series are taken largely from the historical national accounts of Feinstein (1972), updated with output estimates from the *UK National Accounts* and employment data from the EU KLEMS database. Capital stock estimates are from: Feinstein (1988) for 1871-1920, Feinstein (1972) 1920-1965; U.K. Central Statistical Office (various issues) for 1965-1990; EU KLEMS database for 1990-2007. Similarly to Feinstein (1972), the territory covered refers to the United Kingdom of Great Britain and the whole of Ireland before 1920, but Great Britain and Northern Ireland after 1920. Recent data are obtained from OECD.

2. UNITED STATES

Data on output by industry are taken from: Kendrick (1961) for 1869-1948; U.S. Department of Commerce (1983) for 1948-1979; U.S. Department of Commerce (various issues b) for 1979-1990. Figures on employment by industry are taken from: Kendrick (1961) for 1869-1948; U.S. Department of Commerce (1983) for 1948-1979; U.S. Department of Commerce (various issues a) for 1979-1990; OECD, Labour Force Statistics (various issues). These sources were used in Broadberry (1998). Capital stock estimates are taken from: Gallman (1987) for 1869-1899; Kendrick (1961) for 1899-1929, U.S. Department of Commerce (1987) for 1929-1985; U.S. Department of Commerce (various issues b) for 1985-1990. These sources were used by Broadberry (1998). All data were then updated by using OECD data.

3. GERMANY

Data on output by industry are taken from: Hoffmann (1965) for 1871-1959 and Statistisches Bundesamt (1991) for 1959-1985. Figures on employment by industry are taken from: Hoffmann (1965) for 1871-1959; Statistisches Bundesamt (1991), Statistisches Bundesamt (1988) and Organisation for Economic Co-operation and Development (various issues) for 1959-1985. Capital stock estimates are taken from: Hoffmann (1965) for 1871-1950, Kirner (1968) for 1950-1960; Statistisches Bundesamt (1991) for 1960-1990. These data were used in Broadberry (1998). All data were then updated by using the EU KLEMS database for 1990-2007. As in Hoffman (1965), data refer to the following territories: 1871-1917 the territories of the German Reich, including Alsace-Lorraine; 1918-1944 the territories of the German Reich excluding Austria and the Sudetenland, but from 1934 including the Saar; 1945-1959 the territories of the German Federal Republic excluding West Berlin and the Saar; 1960-1990 the Federal Republic including West Berlin and the Saar. Note that the 1990 data exclude the new Laender from the former German Democratic Republic. For 1990-2007 Germany at current boundaries is considered. Recent data are sourced from OECD.

References

Abramovitz, M. (1986), "Catching Up, Forging Ahead and Falling Behind", *Journal of Economic History*, 46, pp. 385-406.

Aghion, P. and Howitt, P. (2006), "Appropriate Growth Policy, Schumpeter Lecture", *Journal of the European Economic Association.*

Baffigi, A. (2015), *Il PIL per la storia d'Italia. Istruzioni per l'uso*, Collana storica della Banca d'Italia, Marsilio: Venezia.

Battilani, P. Bertagnoni, G. and Vignini, S. (2004), *Un'impresa di cooperatori, artigiani, camionisti. La Cta e il trasporto merci in Italia*, Bologna: Il Mulino.

Baumol, W.J. (1986), "Productivity Growth, Convergence and Welfare: What the Long Run Data Show", *American Economic Review*, 76, pp. 1072-1159.

Bergeaud, A., Cette, G. and Lécat, R. (2015), "Productivity trends from 1890 to 2012 in advanced countries", *Rue de la Banque* 7.

Broadberry, S.N. (1997), *The Productivity Race: British Manufacturing in International Perspective, 1850-1990*, Cambridge: Cambridge University Press.

Broadberry, S.N. (1998), "How did the United States and Germany Overtake Britain? A Sectoral Analysis of Comparative Productivity Levels, 1870-1990", *Journal of Economic History*, 58, pp. 375-407.

Broadberry, S.N. (2003), "Relative Per Capita Income Levels in the United Kingdom and the United States since 1870: Reconciling Time-Series Projections and Direct-Benchmark Estimates", *Journal of Economic History*, 63, pp. 852-863.

Broadberry, S.N. (2006), *Market Services and the Productivity Race, 1850-2000: British Performance in International Perspective*, Cambridge: Cambridge University Press.

Broadberry, S.N. (2013), "Accounting for the Great Divergence", London School of Economics.

Broadberry, S., Giordano, C. and Zollino, F. (2011), "A Sectorial Analysis of Italy's Development, 1861-2011", *Banca d'Italia Economic History Working Papers* 20.

Broadberry, S., Giordano, C. and Zollino, F. (2013), "Productivity", in Toniolo, G. (ed.), *Oxford Handbook of the Italian Economy since Unification*, New York: Oxford University Press.

Carreras, A. and Josephson, C. (2010), "Growing at the Production Frontier: European Aggregate Growth, 1870-1914", in Broadberry, S. and O'Rourke, K.H. (eds.), *The Cambridge Economic History of Modern Europe. Volume 2: 1870 to the Present*, Cambridge: Cambridge University Press.

Clark, C. (1951), *The Conditions of Economic Progress*, (second edition), London: Macmillan.

Crafts, N. and Toniolo, G. (2010), "Aggregate Growth, 1950-2005", in Broadberry, S. and O'Rourke, K.H. (eds.), *The Cambridge Economic History of Modern Europe. Volume 2: 1870 to the Present*, Cambridge: Cambridge University Press.

Denison, E. (1968), "Economic Growth", in Caves, R. E and Associates, *Britain's Economic Prospects*, Washington DC: The Brookings Institution.

EU KLEMS Database, March 2008, http://www.euklems.net/data.

Fagerberg, F. (2000), "Technological progress, structural change and productivity growth: a comparative study", *Structural Change and Economic Dynamics* 11, pp. 393-411.

Federico, G. and Malanima, P. (2004), "Progress, decline, growth: Product and Productivity in Italian agriculture, 1000-2000", Economic History Review 57(3), pp. 437-464.

Feinstein, C.H. (1972), *National Income, Expenditure and Output of the United Kingdom, 1855-1965*, Cambridge: Cambridge University Press.

Feinstein, C.H. (1988), "Sources and Methods of Estimation for Domestic Reproducible Fixed Assets, Stocks and Works in Progress, Overseas Assets and Land", in Feinstein, C.H. and Pollard, S. (eds.), *Studies in Capital Formation in the United Kingdom, 1750-1920*, Oxford: Oxford University Press.

Fidora, M., Giordano, C. and Schmitz, M. (2017), "Real exchange rate misalignments in the euro area", *ECB Working Papers*, forthcoming.
Gallman, R.E. (1987), "Investment Flows and Capital Stocks: U.S. Experience in the Nineteenth Century", in Kilby, P. (ed.), Quantity and Quiddity: Essays in US. Economic History, Middletown, CT: Wesleyan University Press.
Gerschenkron, A. (1962), *Economic Backwardness in Historical Perspective*, Cambridge, MA: Harvard University Press.
Giordano, C. and Giugliano, F. (2015), "A Tale of Two Fascisms: Labour Productivity Growth and Competition Policy in Italy, 1911–1951", *Explorations in Economic History* 55, pp. 25–38.
Giordano, C., Piga, G. and Trovato, G. (2014), "Italy's industrial Great Depression: Fascist price and wage policies", *Macroeconomic Dynamics* 18(3), pp. 689-720.
Giordano, C. and Zollino, F. (2015), "A Historical Reconstruction of Capital and Labour in Italy, 1861-2013", *Rivista di storia economica* 2, pp. 155-224.
Giordano, C. and Zollino, F. (2016), "A Historical Reconstruction of Capital and Labour in Italy, 1861-2013", *Bank of Italy Economic History Working Papers* 37.
Giordano, C. and Zollino, F. (2017), "Macroeconomic estimates of Italy's mark-ups in the long-run, 1861-2012", *Bank of Italy Economic History Working Papers* 39.
Gollin, D. (2002), "Getting Income Shares Right", *Journal of Political Economy* 110(2), pp. 458-474.
Herrendorf, B., Rogerson, R. and Valentinyi, A. (2013), "Growth and structural transformation", *NBER Working Papers* 18996.
Hoffmann, W. G. (1965), *Das Wachstum der deutschen Wirtschaft seit der Mitte des 19. Jahrhunderts*, Berlin: Springer-Verlag.
Inklaar, R. and Timmer, M.P. (2008), "GGDC Productivity Level Database: International comparisons of Output, inputs and productivity at the industry level", *Groningen Growth and Development Centre Research Memorandum* GD-104.
Istat (2016), *Misure di Produttività*, October.
Istat (2017), *Conti economici nazionali*, April.
Jorgenson, D. W. (2001), "Information Technology and the U.S. Economy," *American Economic Review*, 91(1), pp. 1-32.
Kendrick, J. W. (1961), *Productivity Trends in the United States*, Princeton: National Bureau of Economic Research.
Kindleberger, C.P. (1967), *European Postwar Growth: The Role of Labor Supply*, Princeton: National Bureau of Economic Research.
Kirner, W. (1968), *Zeitreihen für das Anlagevermogen der Wirtschaftsbereiche in der Bundesrepublik Deutschland*, Berlin: Duncker& Humblot.
Kuznets, S. (1974), *Population, Capital and Economic Growth: Selected Essays*, London: Heinemann, pp.165-184.
Lewis, W.A. (1954), Economic development with unlimited supplies of labour, *Manchester School of Economic and Social Studies* 22(2), pp. 139-191.
McMillan, M. and Rodrik, D. (2011), "Globalization, structural change and productivity growth: A framework and case studies", *NBER Working Papers* 17143.
McMillan, M., Rodrik, D. and Sepulveda, C. (2017), "Structural change, fundamentals and growth: A framework and case studies", *NBER Working Papers* 23378.
Mistretta, A. and Zollino, F. (2017), "Recent trends of activity and TFP in Italy with a focus on embodied technical progress", *Banca d'Italia Working Papers*, forthcoming.
Nordhaus, W.D. (1972), "The Recent Productivity Slowdown", *Brookings Papers on Economic Activity*, n.3, pp. 493-545.
Nordhaus, W.D. (2001), "Alternative methods for measuring productivity growth, *NBER Working Papers* 8095.

OECD (various issues), *Labour Force Statistics*, Paris: OECD.
Ranis, G. and Fei, G.C. (1961), "A theory of economic development", American Economic Review 51(4), pp. 533-558.
Schulze, M.S. (2007), "Origins of catch-up failure: comparative productivity growth in the Habsburg Empire, 1870–1910", *European Review of Economic History* 11, pp. 189-218
Solow, R. (1957), "Technical change and the aggregate productivity function", *Review of Economics and Statistics* 39, pp. 312-320.
Statistisches Bundesamt (1988), *Lange Reihen zur Wirtschaftsentwicklung*, Wiesbaden.
Statistisches Bundesamt (1991), *Volkswirtschaftliche Gesamtrechnungen 1950 bis 1990*. Fachserie 18, Reihe S.15, Wiesbaden.
Stiroh, K.J. (2002), "Information Technology and the U.S. Productivity Revival: What do the Industry Data Say?", *American Economic Review*, 92(5), pp. 1559-1576.
Taylor, A. and Taylor, M. (20104), "The purchasing power parity debate", *Journal of Economic Perspectives* 18(4), pp. 135-158.
Timmer, M. and de Vries, G.J. (2009), "Structural change and growth accelerations in Asia and Latin America: A new sectoral dataset", *Cliometrica* 3(2), pp. 165-190.
Timmer, M.P., Inklar, R. and O'Mahony, M. (eds.) (2010), *Economic Growth in Europe: A Comparative Industry Perspective*, Cambridge: Cambridge University Press.
Timmer, M.P., Ypma, G. and van Ark, B. (2007), "PPPs for industry output: A new dataset for international comparisons", *University of Groningen Working Papers* GD-82.
Toniolo, G. (1980), *L'economia dell'Italia fascista*, Roma-Bari: Laterza.
Toniolo G. (2013) "An Overview of Italy's economic growth" in ID (ed.) *The Oxford Handbook of the Italian Economy since Unification*, Oxford-New York: Oxford University Press.
U.K. Central Statistical Office (various issues), *National Income, Expenditure and Output*, London.
U.K. National Statistics (various years), *UK National Accounts*, London: HMSO.
U.S. Department of Commerce (1983), *National Income and Product Accounts of the United States, 1929-1982*, Washington, DC.
U.S. Department of Commerce (1987), *Fixed Reproducible Tangible Wealth in the United States, 1925-85*, Washington, DC: GPO.
U.S. Department of Commerce (various issues a) *Statistical Abstract of the United States*, Washington, DC: GPO.
U.S. Department of Commerce (various issues b), *Survey of Current Business*, Washington, DC: GPO.
Ward, M. and Devereux, J. (2003), "Measuring British Decline: Direct versus Long-Span Income Measures", *Journal of Economic History*, 63, pp. 826-851.
Ward, M. and Devereux, J. (2004), "Relative UK/US Output Reconsidered: A Reply to Professor Broadberry", *Journal of Economic History*, 63, pp. 826-851.