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ACCOUNTING FOR GROWTH: SPAIN, 1850–2019

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Abstract. The current productivity slowdown has stimulated research on the causes of growth. We investigate here the proximate determinants of long-term growth in Spain. Over the last 170 years, output per hour worked raised nearly 24-fold dominating gross domestic product (GDP) growth, while hours worked per person shrank by one-fourth and population trebled. Half of labour productivity growth resulted from capital deepening, one-third from total factor productivity (TFP) and labour quality contributed the rest. In phases of acceleration (the 1920s and 1954–1985), TFP was labour productivity's main driver complemented by capital deepening. Since Spain's accession to the European Union (1985), labour productivity has sharply decelerated as capital deepening slowed down and TFP stagnated. Up to the Global Financial Crisis (2008) GDP growth mainly resulted from an increase in hours worked per person and, to a less extent, from sluggish labour productivity coming mostly from weak capital deepening. Institutional constraints help explain the labour productivity slowdown.

Keywords. Capital deepening; Growth; Labour productivity; Labour quality; Spain; Total factor productivity

The current productivity slowdown in advanced economies has triggered a lively debate about its causes. A long phase of robust growth initiated in the aftermath of World War II, that brought about unprecedented progress in absolute and per capita Gross Domestic Product (GDP), has given way to a phase of deceleration in output per hour worked. Exploring the origins and drivers of such a vigorous productivity expansion may cast some light on the causes of today's poor performance. Economic history research provides an opportunity to expand the exploration beyond the narrow time boundaries of modern national accounts. Here, we will investigate growth in Spain from a long-term perspective, highlighting phases of fast growth and stagnation and exploring its proximate determinants.

The paper's aim is, on the one hand, to present consistent estimates of labour productivity and its drivers, including new series of capital stock and services, labour quality and total factor productivity (TFP), and to describe their long-run trends. On the other hand, to determine how much physical and human capital and efficiency gains have contributed to labour productivity enhancement over time and to what extent they are complementary.

Our main findings are that labour productivity (measured as output per hour worked) dominated GDP long-run growth, accounting for four-fifths of it, while the number of hours worked per person

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contracted and population contributed the rest. Half of the increase in labour productivity came from capital deepening (that is, capital services per hour worked) and one-third from efficiency gains in the use of physical and human capital (namely, TFP), while labour quality contributed the rest. The progress of labour productivity was not steady. During its phases of acceleration (the 1920s and, especially, 1954–1985), TFP was its driving force, complemented by capital deepening. Since Spain's accession to the European Union, labour productivity has sharply decelerated as capital deepening slowed down and TFP stagnated. Sustained GDP growth up to the Global Financial Crisis (1986–2007) largely resulted from an increase in hours worked per person and to a less extent from labour productivity, whose sluggish growth came mostly from weak capital deepening. Institutional constraints help explain the labour productivity slowdown.

The paper opens by examining GDP growth and looking at its proximate determinants: population, hours of work per person and output per hour worked. A breakdown of the hours worked per person is, then, carried out. Next, output per hour worked and its proximate sources, namely, intensity in the use of production factors and efficiency gains, are investigated. In order to do it, we construct long series of capital, land and labour inputs, as well as factor shares in GDP to proxy their output elasticities. A discussion of the main trends in labour productivity and its drivers follows. A research agenda is suggested in Section 5.

1. GDP Growth and Its Determinants

Between 1850 and 2019 GDP rose 55-fold. A breakdown of GDP can be carried out using an identity,

$$Y = LP \times LQ/N \times N \tag{1}$$

being Y, GDP; N, population; LQ, the number of hours worked and LP (= Y/LQ), GDP per hour worked. Note that GDP per head, Y/N, equals $LP \times LQ/N$.

Over the last 170 years, population multiplied 3.2 times, hours worked per person shrank by about one-fourth and output per hour worked raised nearly 24-fold. GDP per head gain was lower (17-fold) though, as we have to detract the decline in hours worked person from the gains in output per hour worked.

Logarithmic rates of variation allow us to compare the pace of growth of GDP and its components over periods of different length. Thus, being ln the natural logarithm,

$$\ln\left(Y^t/Y^{t-1}\right) = \ln\left(LP^t/LP^{t-1}\right) + \ln\left((LQ/N)^t/(LQ/N)^{t-1}\right) + \ln\left(N^t/N^{t-1}\right) \tag{2}$$

Long-term growth in GDP (2.4% per year) appears largely attributable to labour productivity gains, that grew at 1.9%, compared to population, at 0.7%, and hours worked per person, that shrank at −0.2%.

Different long swings can be distinguished in which growth deviates from its long-run trend as a result of technological change, economic policies, and access to international markets (Figure 1).[1] Growth rates, measured as average annual logarithmic rates of variation, are provided in Table 1.

Moderate growth took place between mid-19th century and the Golden Age, with GDP growing at a yearly average rate of 1.5%, to which output per hour worked was the largest contributor (0.9%), followed by population (0.6%), while hours worked per person contracted mildly. Then, Spain's Golden Age (1954–1975), witnessed a fourfold GDP growth acceleration, almost exclusively attributable to labour productivity (5.8% of 6.2% GDP growth), as population expansion was largely offset by the reduction in hours worked per person (1% against −0.7%).

The 1970s oil shocks took place at the time of the transition from General Franco's dictatorship (1939–1975) to democracy that culminated with Spain's accession to the European Union (1985). Output per hour worked continued thriving as the economic crisis and stabilization and liberalization reforms led to the closure of inefficient industries sheltered from competition. Labour productivity growth more than

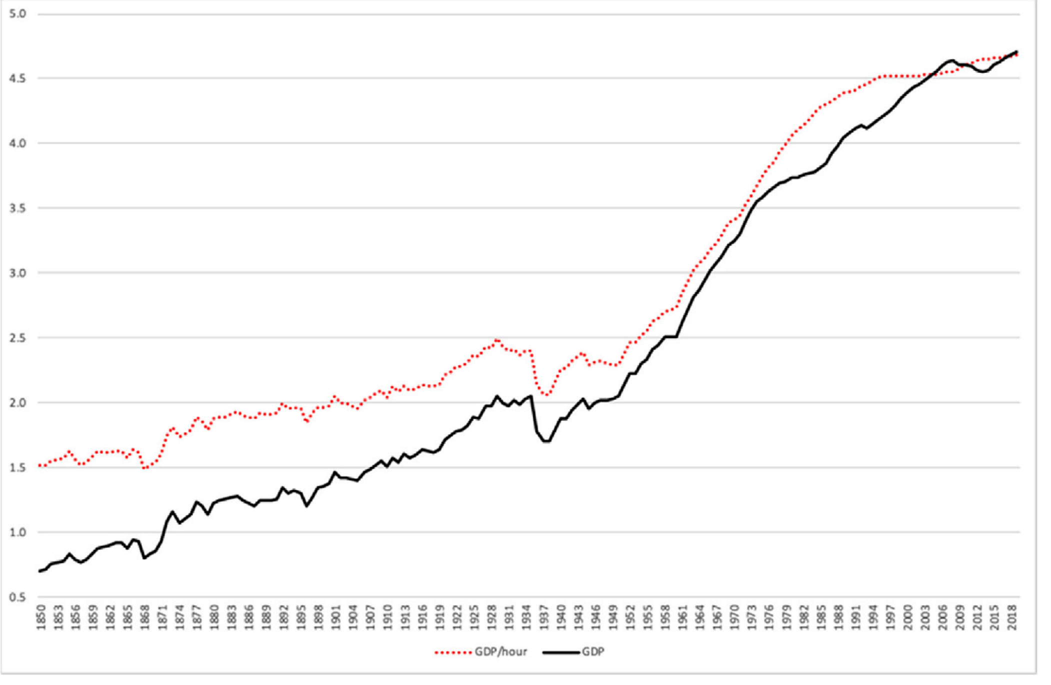

Figure 1. Real GDP, Absolute and Per Hour Worked (2010 = 100) (logs). [Colour figure can be viewed at wileyonlinelibrary.com]

offset the sharp decline in hours worked per person (−3.8%), allowing mild growth in absolute and per capita GDP (2.3% and 1.5%, respectively).

Fast GDP growth (3.7% yearly) presided from Spain's EU accession (1985) to the eve of the Great Recession (2007). Nearly half of it resulted from an increase in hours worked per head, since unemployment fell and new jobs were created, while labour productivity only contributed one-third.

During the Global Financial Crisis (2008–2013) GDP shrank with similar intensity to that experienced in the Great Depression (1929–1933) (−1.4% vs. −1.5% per annum), second only to the sharp contraction during the Civil War (1936–1939). The pace of employment destruction was comparable to that of the 'transition to democracy' decade (1976–1985) with hours worked falling at −3.5% yearly (against −3.8%), but labour productivity lacked the strong response of the 'transition' years (1.6% vs. 5.3% growth rate) and was unable to prevent a contraction in absolute and per capita GDP. The post-Great Recession recovery (2014–2019), in which GDP and per capita GDP grew practically at the same pace (as immigrants inflow, the driver of population growth, was cut short), resulted mainly for the increase in hours worked per person (2.0% of 2.6% GDP growth rate) leaving the contribution of output per hour worked in a paltry 0.5%.

A pattern can be observed since 1975: output per hour worked and hours worked per person exhibit opposite tendencies. Phases of (absolute and per capita) GDP growth acceleration and recovery (1986–2007 and 2014–2019) went hand-in-hand with rising hours worked per person through employment creation, while labour productivity growth slowed down. Conversely, phases of sluggish or negative (absolute and per capita) GDP growth and employment destruction (1976–1985 and 2008–2013) coincided with those of labour productivity acceleration. Thus, it can be concluded that since the

Table 1. GDP Growth and Its Composition, 1850–2019.

	(Annual average logarithmic rates %)			
	GDP	Population	Hours worked per head	GDP per hour worked
1850–2019	2.4	0.7	−0.2	1.9
1850–1872	1.7	0.5	0.2	1.1
1873–1892	1.3	0.4	0.3	1.2
1893–1913	1.2	0.7	−0.1	0.6
1914–1919	0.5	0.8	−0.4	0.1
1920–1929	4.1	0.9	−0.3	3.5
1930–1935	0.0	1.5	0.0	−1.6
1936–1939	−6.6	0.4	−1.0	−5.9
1940–1945	2.8	0.2	0.4	2.1
1946–1953	3.4	1.0	0.3	2.1
1954–1958	5.7	0.8	−0.1	4.9
1959–1975	6.3	1.1	−0.9	6.1
1976–1985	2.3	0.7	−3.8	5.3
1986–2007	3.7	0.7	1.8	1.2
2008–2013	−1.4	0.5	−3.5	1.6
2014–2019	2.6	0.2	2.0	0.5

Source: Prados de la Escosura (2017), updated data accessible at https://frdelpino.es/investigacion/category/01_ciencias-sociales/01_economia-espanola/04_economia-espanola-perspectiva-historica/?lang=en.

mid-1970s the Spanish economy has been unable to combine employment creation and labour productivity growth. This is consistent with the fact that expanding sectors that created more jobs (construction and services) had lower labour productivity relative to industry and experienced slower output per hour growth (Prados de la Escosura, 2017), which implies that they were less successful in attracting investment and technological innovation.

This paradox leads us to explore what underlies the behaviour of hours worked per person and output per hour worked.

We can break down the evolution of the number of hours worked per person (*LQ*/*N*) as follows:

$$(LQ/N) = (LQ/LF)\,(LF/WN)\,(WN/N) \tag{3}$$

being (*LQ*/*LF*) the hours per full-time equivalent worker; (*LF*/*WN*), the ratio of full-time equivalent workers to the working age population (those age 15–64), that is, the participation rate and (*WN*/*N*), the share of the working age population in total population.

Thus, in rates of variation,

$$\ln\left((LQ/N)^t/(LQ/N)^{t-1}\right) = \ln((LQ/LF)^t/\left((LQ/LF)^{t-1}\right) + \ln\left((LF/WN)^t/(LF/WN)^{t-1}\right) + \ln\left((WN/N)^t/(WN/N)^{t-1}\right) \tag{4}$$

The change in hours per full-time equivalent worker (*LQ*/*LF*), which fell from 2800 hr by mid-19th century to less than 1900 hr in the early 21st century, represents the main driver of hours worked per person in the long run (Table 2). Its contribution is especially noticeable during phases of industrialization and urbanization in the early 20th century – in which the 8 hr per day standard was gradually adopted – and the Golden Age (1954–1975). It also contributed during phases of labour market adjustment and

Table 2. Growth of Hours Worked per Head and Its Composition, 1850–2019.

	(Annual average logarithmic rates %)			
	Hours worked per head	Hours/full-time worker	Full-time worker/WN	WN/Population
1850–2019	−0.2	−0.2	0.0	0.0
1850–1872	0.2	0.0	0.1	0.1
1873–1892	−0.3	0.0	−0.1	−0.1
1893–1913	−0.1	−0.1	0.1	0.0
1914–1919	−0.4	−0.3	−0.3	0.1
1920–1929	−0.3	−0.4	0.0	0.1
1930–1935	0.0	−0.4	0.2	0.2
1936–1939	-1.0	0.0	−1.3	0.2
1940–1945	0.4	0.0	0.0	0.4
1946–1953	0.3	−0.1	0.2	0.2
1954–1958	−0.1	−0.6	0.9	−0.3
1959–1975	−0.9	−0.6	0.0	−0.2
1976–1985	−3.8	−1.6	−2.6	0.4
1986–2007	1.8	−0.1	1.5	0.3
2008–2013	−3.5	0.4	−3.4	−0.5
2014–2019	2.0	−0.3	2.5	−0.3

Source: Prados de la Escosura (2017), updated data accessible at https://frdelpino.es/investigacion/category/01_ciencias-sociales/01_economia-espanola/04_economia-espanola-perspectiva-historica/?lang=en.
WN represents working age population (those age 15 to 64)

union activism such as the II Republic (1931–1936) and the 'transition to democracy' decade (1976–1985).

The participation rate (*LF*/*WN*) also made a substantial contribution to the hours worked per person. During the Civil War (1936–1939) it accounted for its entire decline, while in the 1950s mitigated its fall. Since 1975, the participation rate became its main driver. Thus, *LF*/*WN* accounts for two-thirds of the contraction in hours worked per head during the 'transition' decade (1976–1985) and for practically all its reduction during the Great Recession (2008–2013). In both cases, its decline was due to a dramatic surge in unemployment. In the 'transition' decade, its fall largely resulted from the impact of the oil shocks and the exposure to international competition on industrial sectors traditionally sheltered from competition, plus the return of migrants from western Europe. Conversely, from Spain's EU accession (1985) up to the Global Financial Crisis (2008), the increase in (*LF*/*WN*) was the main contributor to the increase in the number of hours worked per person, helped by rising female participation and, especially, the inflow of immigrants that represented about 5 million people between 1996 and 2008 (Izquierdo *et al.*, 2015, p. 25). Again, the rise in the participation rate, as unemployment gradually declined and immigration resumed, has been a main actor in the aftermath of the Great Recession.

Finally, the share of those in working age over total population (*WN*/*N*) increased during the 1930s and 1940s and, again, between 1976 and 2007, as the dependency rate (the children and elderly over working age population) fell, and represented a demographic bonus, preventing further decline in the number of hours worked per person during the 1930s and 1976–1985, and becoming its main driver in the 1940s.

What does explain the evolution of output per hour worked? A growth accounting framework allows us to breakdown labour productivity between the contribution of factor intensity (physical and human capital and land per hour worked) and multi-factor, TFP that includes 'changes in efficiency in the use of those inputs and changes in technology' (Bosworth and Collins, 2003, p. 114).

Labour productivity (*LP*) can be decomposed as:

$$LP^t = A\left(KS^t/LQ^t\right)^{\alpha}\left(X^t/LQ^t\right)^{\beta}\left(LI^t/LQ^t\right)^{\gamma} \tag{5}$$

being *LP* labour productivity; *KS*, a volume index of capital services (VICS); *X*, land input; *LI,* labour input *and LQ*, the quantity of labour (hours worked); A, TFP; and α, β and γ output elasticities to each factor of production.

Thus, to disentangle the proximate determinants of labour productivity we require volume series of capital, land and labour inputs.

2. Factors of Production

2.1 *Labour Input*

The labour input is the flow of services the labour force provides to production. To compute it, we start from an estimate of the labour quantity expressed as hours worked.[2] The data for the main sectors (agriculture, forestry and fishing, industry construction and services) come from Prados de la Escosura (2017, updated to 2019). For the period 1850–1994, the number of hours worked is derived by allocating workers and days worked per occupied in each of the main four sectors to their subsectors and, then, multiplying the number of days worked by the average hours worked per day in each subsector on the basis of Prados de la Escosura and Rosés (2010) estimates. From 1995 onwards, the national accounts (CNE10 and CNE15) supply the hours worked by subsector.

Next, we need to allow for quality of the labour force and here we face a choice between an income-based approached, pioneered by Jorgenson (1990), and an education-based approach inspired by Mincer (1958) (see the discussion in Oxley *et al.*, 2008).

In the income-based approach, a labour input index results of weighting the hours worked by each category of workers within each branch of economic activity by their share in total nominal labour earnings. The rationale is that relative wages capture the relative productivity of workers with different attributes and, thus, any returns per worker above those received by the unskilled worker represent returns to worker's skills (human capital). However, this approach assumes a fully competitive economy and not complying with this assumption may result in upwards biased estimates.[3]

Returns to each type of worker have been taken from Prados de la Escosura and Rosés (2010) up to 1984.[4] From then onwards, national accounts provide average returns per employee at a disaggregated sector level although, unfortunately, no detailed information is provided by age, sex and qualification within each industry.[5] This lack of differentiation within the labour force may bias the labour input index.[6]

Returns per occupied have been used to weight total labour (employees and self-employed) by branch. No distinction is made between employees and self-employed in the labour force estimates for the pre-national accounts period, 1850–1953. However, national accounts distinguish between compensation of employees and gross operating surplus and mixed incomes.[7] Part of the mixed incomes corresponds to self-employed compensation. Thus, for the post-1954 years, we have estimated self-employed labour returns following the principle of opportunity cost and assuming that the self-employed labour cost equals that of the average employee in their specific industry.[8]

Thus, total labour compensation is obtained as

$$w^t L^t = (w^t E^t/E^t)L^t \tag{6}$$

being $w^t L^t$ the total labour compensation in period t; $w^t L^t$, the compensation of employees; E^t, the number of employees and L^t, total employment (employees plus self-employed) in period t.

A Törnqvist index of labour input (*LI*) is, then, computed,

$$\ln\left(LI^t/LI^{t-1}\right) = \sum \bar{v}^{i,t} \ln\left(LQ^{i,t}/LQ^{i,t-1}\right) \tag{7}$$

where $LQ^{i,t}$ is the quantity of labour (hours worked) in branch i and $\bar{v}^{i,t} = 1/2\ (v^{i,t-1} + v^{i,t})$ the 2-year average share of each branch in total labour compensation ($w^t L^t$), being $\bar{v}^{i,t} = w^{it} L^{it}/w^t L^t$. Then, the labour input index is obtained as the exponential.

An index of labour quality (*H*) that measures the labour input's composition effect can be derived as the ratio between the labour input and labour quantity indices.[9]

$$H^t = LI^t/LQ^t \tag{8}$$

Our education-based labour input combines the quantity of labour (hours worked) with an estimate of the quality of labour on the basis of school attainment. Data on average years of schooling for working age population (15–64 years) derive from Prados de la Escosura and Rosés (2010) up to 2000, who draw on Núñez (2005) education attainment estimates, completed for 2000–2010 with Barro and Lee (2013, updated) 5-year benchmark estimates, linearly interpolated and UNESCO data, from 2010 onwards.

Following Bosworth and Collins (2003) and Lee and Lee (2016), we derived labour quality by combining years of schooling with the rate of return of education.[10] Rates of return tend to be higher in early phases of development, but decline as economies develop. However, since private rates of return overestimate social rates of returns, it seems reasonable to adopt low values for the rate of return over time, and a 7% per year of education has been adopted.[11]

$$\text{Thus, } EDU = (1 + r)^s \tag{9}$$

being *r* the rate of return and *s* the average years of schooling.

Then, the education-based labour input index is derived as the product of the labour quantity and labour quality indices.

An important caveat is that the education approach only considers levels of quantitative achievement (number of years of schooling) without any adjustment for the quality of education received. It ignores experience, on-the-job training and informal education as well as differences in the rate of return between different types of education. It also neglects the fact that education can be pursued as consumption, not as investment for production. Furthermore, in early stages of economic development labour skills are largely dependent on experience and on-the job training while formal education contribute more to labour quality in later phases.[12]

A comparison of the alternative labour input indices derived through them shows they follow similar although the education-based series exhibit faster growth over time (Figure 2). However, if we focus on labour quality substantial differences emerge in their evolution (Figure 3). Education-based labour quality accelerated in the late 19th century to flatten until the mid-1920s when another spurt took place and, after the fall in the aftermath of the Civil War (1936–1939), steady growth has taken place, and only slowed down during the Great Recession. Conversely, income-based labour quality improved moderately until 1920 when accelerated until the eve of the Civil War. The post-1950 recovery, that only matched the pre-war level in 1960, gave way to an improvement until 1990, although decelerated in the 1980s, and has flattened during the last three decades. In a nutshell, the main difference between the two approaches' outcomes is that, in the education-based labour input, labour quality makes a substantial contribution since the mid-20th century while, according to the income-based labour input, the contribution of labour quality has been significant only during the 1920s and early 1930s and between 1950 and the mid-1980s (Table 3).

A challenge is posed by these opposite trends between the income- and education-based labour quality estimates. Which one captures the evolution of human capital better? Both the income- and the education-based approaches suffer from serious shortcomings. The fully competitive economy assumption in the

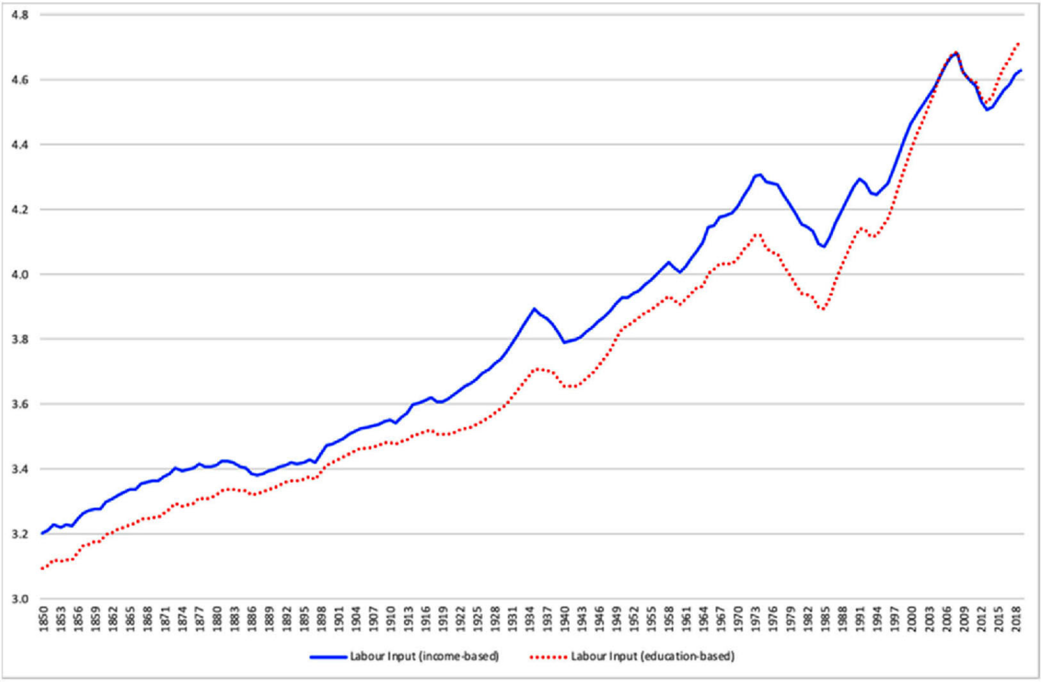

Figure 2. Labour Input: Income and Education Approach Estimates (2010 = 100) (logs). [Colour figure can be viewed at wileyonlinelibrary.com]

income-based approach, if relaxed, would imply that labour quality is upwards biased in the resulting estimates as part of it would simply represent the market power effect of higher income members in the labour force. In turn, ignoring experience, informal education and on-the-job training, would bias upwards the growth of education-based estimates of labour quality as compulsory and universal formal education (not just primary and secondary) has increased the number of years of schooling since mid-20th century. Moreover, it could be argued that education is a high-income elastic good whose consumption demand must have increased substantially over the last 30 years as per capita income doubled since Spain's accession to the EU (1985), without having necessarily a significant impact on the quality of labour.[13] Therefore, although the actual evolution of labour quality might lie somewhere in between the two alternative estimates, it is our conjecture that the income-based approach, though possibly downward biased, provides a less distorted picture.[14]

2.2 *Capital Input*

Capital input, or capital services, represents the flow of capital services into production (OECD, 2009) and, as a first step to compute a VICS, we need to estimate the capital stock.

In the construction of net capital stock estimates, the Permanent inventory Method (PIM) is used for each asset, cumulating flows of investment, corrected for retirement and depreciation. In order to implement the PIM, we require (a) investment volumes and deflators; (b) average service lives; (c) depreciation rates and (d) an initial benchmark level of capital stock.[15]

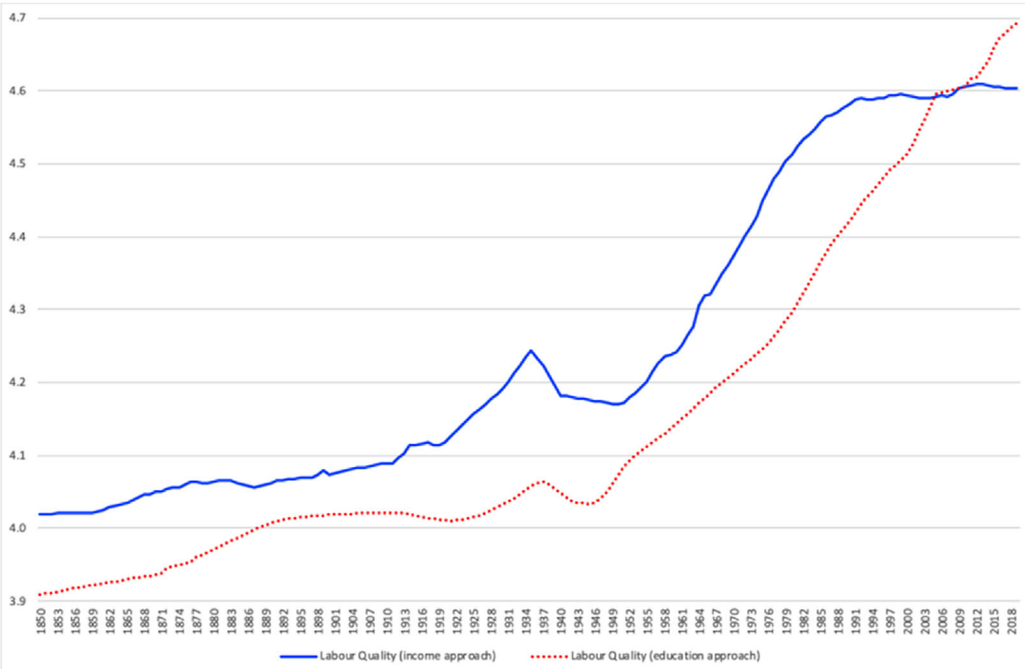

Figure 3. Labour Quality: Income and Education Approach Estimates (2010 = 100) (logs). [Colour figure can be viewed at wileyonlinelibrary.com]

(a) Four different asset types have been distinguished: dwellings, other construction, machinery and equipment and transport equipment.[16] Gross fixed capital formation (GFCF) volume series are derived by deflating current values, and expressed in 2010 Euro. GFCF value and deflator series come from Prados de la Escosura (2017, updated to 2019). It is worth noting that the GFCF deflator series have been smoothed using a Hodrick–Prescott filter in order to avoid negative values in the unit user costs. The same smoothing procedure has been applied to a general price index that, in our case, is the GDP deflator.

(b) As regards average services lives, that is, the length of time that assets are retained in the capital stock, a single set for each asset over the entire time span has been chosen, as services lives are kept constant for most countries.[17] Thus, we assigned average service lives of 60 and 40 years to dwellings and other construction, respectively, and 15 years to both transport and machinery equipment.[18]

(c) As for depreciation rates, a declining balance has been preferred, that is, a geometric rate, $\delta = R/T$, being T the asset's average service life and R the chosen parameter. Geometric depreciation rates differ across assets but are constant over time. Following the U.S. Bureau of Economic Analysis practice (Fraumeni, 1997) we opted for Hulten and Wykoff (1981) directly computed depreciation rates and implicit R values, 1.65 for transport equipment and machinery and 0.91 for structures. The resulting depreciation rates are, thus, 1.52% (dwellings), 2.28% (other construction), 11.0% (machinery and equipment) and 11.0% (transport equipment), respectively.

(d) In the absence of an initial stock of capital, a functional relationship between real GFCF for each of the four types of assets and GDP over 1850–1920 was estimated and, assuming that such a

Table 3. Labour Input Growth, 1850–2019.

	(Annual average logarithmic rates %)	Income-based		Education-based	
	Labour Quantity	Labour Quality	Labour Input	Labour Quality	Labour Input
1850–2019	0.5	0.3	0.8	0.5	1.0
1850–1872	0.7	0.2	0.8	0.2	0.8
1873–1892	0.1	0.1	0.1	0.3	0.4
1893–1913	0.6	0.2	0.8	0.0	0.6
1914–1919	0.4	0.2	0.6	−0.1	0.3
1920–1929	0.6	0.7	1.3	0.2	0.8
1930–1935	1.6	1.0	2.6	0.5	2.1
1936–1939	−0.7	−1.2	−1.9	−0.1	−0.8
1940–1945	0.7	−0.3	0.3	−0.4	0.3
1946–1953	1.3	0.1	1.4	0.8	2.1
1954–1958	0.7	1.0	1.7	0.6	1.3
1959–1975	0.2	1.3	1.5	0.7	0.9
1976–1985	−3.1	1.1	−2.0	1.2	−1.9
1986–2007	2.5	0.2	2.7	1.1	3.6
2008–2013	−3.0	0.3	−2.7	0.5	−2.5
2014–2019	2.1	−0.1	2.1	1.0	3.2

Source: See the text.

relationship is stable over time, volume GFCF series for each asset type between 1780 and 1850 were derived with the regression coefficients obtained and the available GDP series. Then, the PIM was employed to compute the net capital stock for each asset using the average lives and depreciation rates described in (b) and (c). This way, we obtained the initial level for each capital asset type in 1850.

Next, the Net Capital Stock for 1850–2019 was obtained using PIM. If we define the net stock at the beginning ($^{\mathrm{B}}$) of the first year, 1850, as $\mathrm{W}^{1850,\mathrm{B}}$, net stocks for each asset at the of end-year ($^{\mathrm{E}}$) in all consecutive years are,

$$W^{t\mathrm{E}} = W^{t\mathrm{B}} + I^t - \delta \left(I^t/2 + W^{t\mathrm{B}} \right) \tag{10}$$

being I^t, real yearly GFCF and δ, the rate of depreciation. All stocks are valued at average prices of 2010 and the Net Capital Stock in 2010 Euro is obtained by adding them up.[19]

Finally, productive stock, K^t, was derived by adding investment in the latest period to the net capital (wealth) stock[20],

$$K^t = I^t/2 + W^{t\mathrm{B}} \tag{11}$$

The next step is to compute a VICS as a weighted average of productive stock indices by type of asset in which each asset's share in the total current value of capital services are the weights.

Thus, we needed the unit user cost of capital (or the price for capital services), ${F_0}^t$, for each asset, to multiply it by its productive capital stock, $K^{k,t}$, and, then, adding up the result for each asset to get the total value of capital services, U^t.

Capital services have been estimated using an *ex ante* exogenous rate of return.[21] In an *ex ante* approach, the rate of return for investment on a given asset should be similar to that of alternative investments with comparable risk. The OECD Manual (2009) advises to work with real rates of return and real changes in asset prices, and suggests a 4% real rate of return.[22]

The *ex ante* unit user cost, or capital service price, $F_0{}^t$, can be defined as

$$F_0{}^t = P_0{}^{k,t\mathrm{B}} \left(1 + \rho_{(t\mathrm{B})}\right) \left[r_a{}^* + \delta_0 \left(1 + i_{(t\mathrm{B})}{}^*\right) - i_{(t\mathrm{B})}{}^*\right] \tag{12}$$

$$\text{Then, the } \textit{ex ante} \text{ user cost of an asset as, } U^{k,t} = F_0{}^t K^{k,t} \tag{13}$$

$$\text{And the total user cost of capital as, } U^t = \Sigma_{k=1} U^{k,t} \tag{14}$$

being $P_0{}^{k,t\mathrm{B}}$, the purchase price of a new asset at the beginning ($^{\mathrm{B}}$) of year t; $\rho_{(t\mathrm{B})}$, the rate of change of the price index (GDP deflator) at the beginning ($^{\mathrm{B}}$) of year t; $r_a{}^*$, the real rate of return (the nominal rate corrected for inflation), 4%, in this case; $i_{(t\mathrm{B})}{}^*$ the real anticipated change in asset prices at beginning ($^{\mathrm{B}}$) of year t; δ_0 the rate of depreciation of a new asset; and $K^{k,t}$ the productive capital stock of asset k during period t.

Finally, the volume of aggregate capital services was computed with a Törnqvist index,

$$\ln\left(KS^{k,t}/KS^{k,t-1}\right) = \sum \bar{v}^{k,t} \ln\left(K^{k,t}/K^{k,t-1}\right) \tag{15}$$

where $K^{k,t}$ is the productive capital stock of asset k and $\bar{v}^{k,t} = 1/2\ (v^{k,t-1} + v^{k,t})$ the two-year average share of each asset in total user cost of capital, being $v^{k,t} = U^{k,t}/U$. Its exponential provided the VICS.

The evolution of the productive capital stock and the VICS reflects their different weighting, as the former represents the share of its assets in the current value of the total net capital stock and the latter the share of its assets in total returns to capital. VICS grows faster as more dynamic assets (machinery and transport equipment) are usually those with a shorter service life but higher returns. Figure 4 confirms their evolution diverged in the 1920s and early 1930s and, again, since the 1970s.

An index of 'capital quality', or compositional change of the capital input, is derived as the ratio between the VICS, *KS*, and the capital stock, *K*,

$$KQ^{k,t} = KS^{k,t}/K^{k,t} \tag{16}$$

A sustained increase is observed in the quality of capital, which implies a shift towards capital goods with higher unit user costs and, hence, higher marginal productivity (Figure 5). It was broken during the Civil War and its autarkic aftermath, but intensified during the first third of the 20th century and between the mid-1950s and the late 1970s. Since the early 1990s, although at a high level, the quality of capital has flattened.

Capital services have grown at fast but uneven pace over the long run. Different phases can be observed (Table 4). Moderate but steady growth during the first seven decades considered (2% per year) was followed by an acceleration in the 1920s, nearly doubling the rate of growth, and remained vigorous in the early 1930s. After the fall associated to the Civil War, gradual recovery presided over the 1940s. From the early 1950s to the eve of the Great Recession, the volume of capital services experienced fast growth: nearly 8% per year during the Golden Age (1954–1975) and 5% in the next three decades, but was cut short by the Global Financial Crisis (2008) giving way to a sharp deceleration.

Capital 'quality', made a non-negligible contribution to capital input growth in the central decades of the 19th century, between 1914 and 1935, and during the Golden Age. However, it hardly improved after 1976, and especially since Spain's accession to the European Union, a fact that may be associated to the investment allocation across economic activities (sectors and firms).

Capital deepening, namely, the volume of capital services per hour worked, increased steadily up to the Civil War, but for its acceleration in the 1920s (Figure 6). Strong growth prevailed from the early

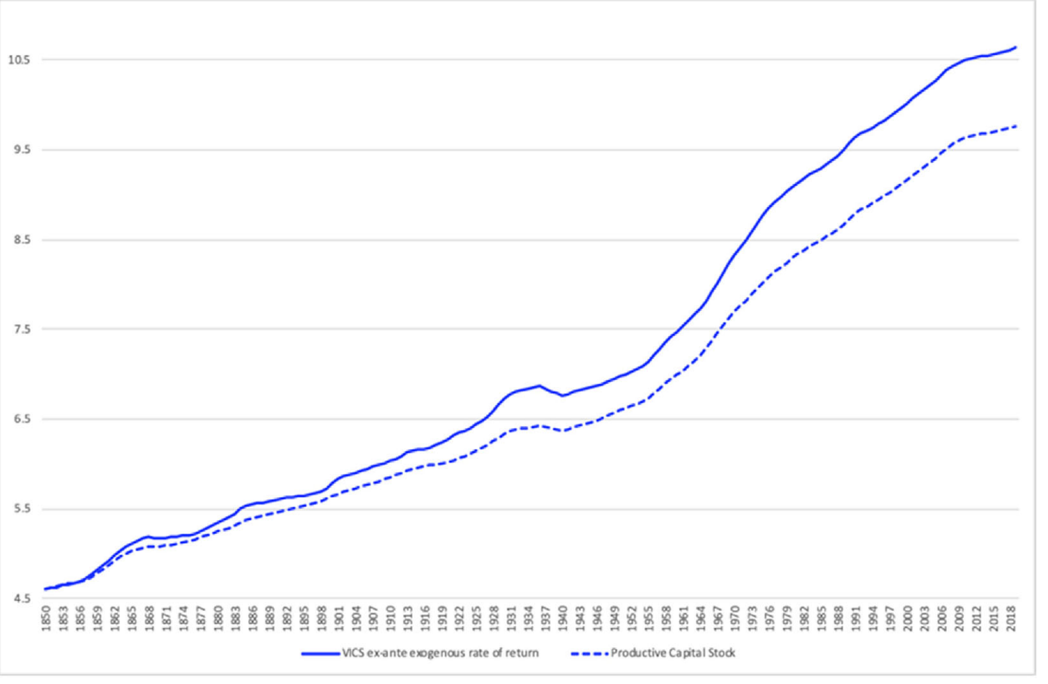

Figure 4. Volume Index of Capital Services and Productive Capital Stock (1850 = 100) (logs). [Colour figure can be viewed at wileyonlinelibrary.com]
Note: Capital services computed with *ex ante* exogenous rate of return.

1950s to the accession to the EU (1985), with singular intensity after 1960. Capital deepening declined afterwards, and only had a spurt during the Great Recession.

2.3 *Land Input*

According to the OECD Manual (OECD, 2009), only land under dwellings and other construction and cultivated land should be considered as sources of capital services. Although we assume land under structures to evolve as structures do and are, hence, included under capital, we consider agricultural land – a non-produced asset that suffers no depreciation –, as an independent factor of production that provides a flow of services into production, an established practice in historical studies.[23]

Assessing the actual amount of land currently in agricultural use represents a challenge and even more difficult is the valuation of land. Lack of annual data on land used prior to 1958, has forced us to accept the data at available scattered benchmarks and derived yearly figures through interpolation. For 1850–2000, we have used Prados de la Escosura and Rosés (2009) estimates, but without any adjustment for the agricultural economic cycle, completed from 2000 onwards with data taken from official surveys on dry and irrigated land by type of use (Encuesta sobre superficies y rendimientos de cultivos en España, ESYRCE). Prices of different types of land for 1931 and 1985 are taken from Prados de la Escosura and Rosés (2009), and those for 2017 come from Encuesta de Precios de la Tierra.

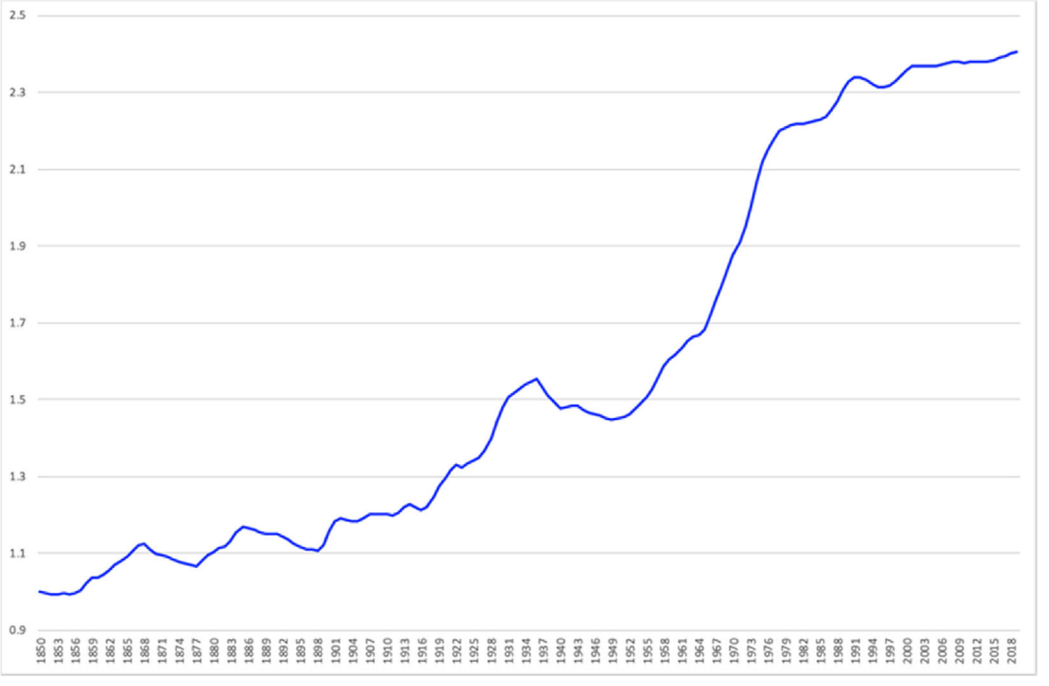

Figure 5. Capital Quality (Computed with Ex Ante Exogenous Rate of Return) (1850 = 1). [Colour figure can be viewed at wileyonlinelibrary.com]

Note: Capital Quality = Ratio of volume index of capital services to productive capital stock.

A land input index has been obtained weighting hectares of land assigned to different types of cultivation over 1850–1931, 1931–2000 and 2000–2019 by their average prices in 1931, 1985 and 2017, respectively. The resulting indices have been, then, spliced into a single Laspeyres index.

Land input expanded in the late 19th and early 20th century and after declining during the Civil War, recovered in the 1940s. However, hardly any growth is observed thereafter and its contraction over 1986–2007 was partly reversed after the Great Recession (Table 5). Land input per hour worked exhibits negative growth but for 1890–1920 and during phases of employment destruction (1976–1985 and 2008–2013).

3. Sources of Labour Productivity Growth

To establish the contribution of each factor of production to aggregate productivity growth, we need to weight their growth by their output elasticities. Under perfect competition and constant returns to scale, the values of these elasticities correspond to factor shares in GDP.[24] Although, the Spanish economy was far from fully competitive over time, we follow the usual practice (OECD, 2019) and accept this oversimplifying assumption, although it will bias our TFP estimates.[25]

We computed the labour share by dividing total labour compensation (see Subsection 2.1) by GDP at market prices.[26] Then, the share of other factors, that is, 1 less the labour share, needs to be distributed between capital and land. Lack of information on land rents led us to estimate land compensation as a

Table 4. Capital Input[a] Growth, 1850–2019.

	(Annual average logarithmic rates %)			
	Productive capital stock	Capital quality	Capital input	Capital input/hour
1850–2019	3.0	0.5	3.6	3.1
1850–1872	2.2	0.4	2.6	2.0
1873–1892	1.9	0.2	2.2	2.1
1893–1913	2.1	0.3	2.4	1.8
1914–1919	1.2	0.7	2.0	1.6
1920–1929	3.0	1.3	4.2	3.6
1930–1935	2.0	1.1	3.2	1.6
1936–1939	−0.8	−0.9	−1.7	−1.1
1940–1945	1.4	−0.3	1.1	0.4
1946–1953	2.5	0.1	2.6	1.3
1954–1958	4.6	1.4	6.1	5.3
1959–1975	6.6	1.7	8.3	8.1
1976–1985	4.7	0.5	5.2	8.3
1986–2007	4.6	0.3	4.9	2.5
2008–2013	2.7	0.0	2.7	5.7
2014–2019	1.4	0.2	1.6	−0.6

[a]Computed with an ex ante exogenous rate of return.
Source: Prados de la Escosura (2020).

Table 5. Land Input Growth, 1850–2019.

	(Annual average logarithmic rates %)	
	Land input	Land input/hour
1850–2019	0.2	−0.3
1850–1872	0.0	−0.7
1873–1892	0.1	0.0
1893–1913	0.9	0.3
1914–1919	0.6	0.2
1920–1929	0.4	−0.2
1930–1935	0.5	−1.1
1936–1939	−1.4	−0.8
1940–1945	0.7	0.0
1946–1953	0.5	−0.8
1954–1958	0.0	−0.7
1959–1975	0.1	−0.1
1976–1985	0.0	3.0
1986–2007	−0.3	−2.7
2008–2013	0.1	3.1
2014–2019	0.5	−1.6

Source: See the text.

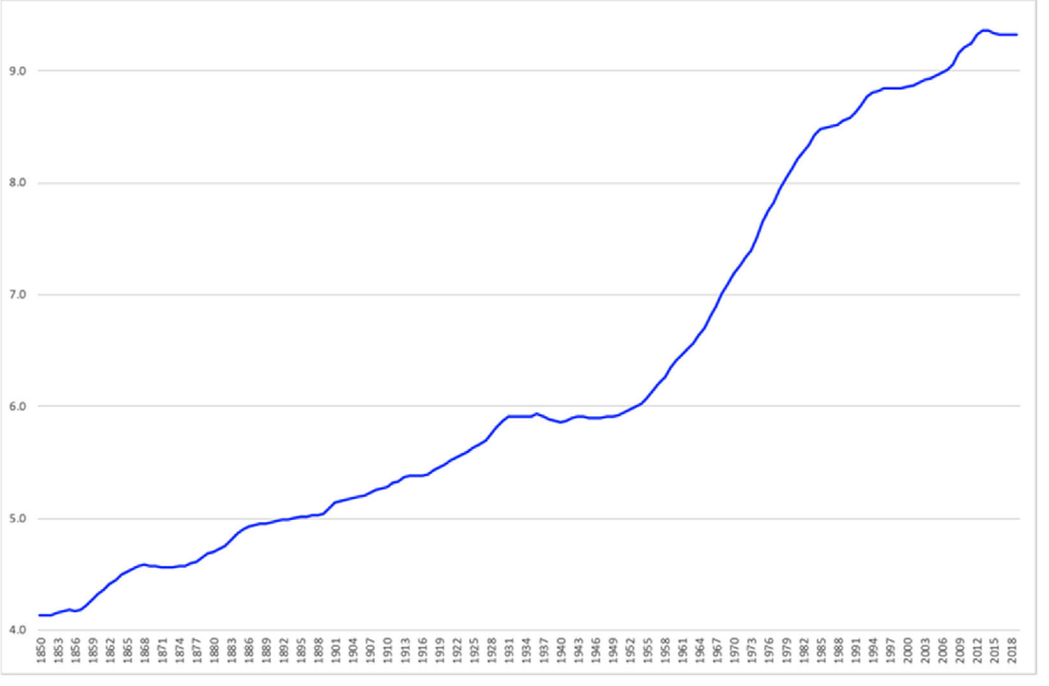

Figure 6. Capital Deepening (2010 = 100) (Natural log of the level times 100). [Colour figure can be viewed at wileyonlinelibrary.com]

Note: Volume index of capital services (ex ante exogenous rate of return) per hour worked.

residual assuming that the difference between agricultural value added and labour outlays accrued to land property. This estimate provides, however, an upper bound for the land share as it assumes no returns to capital in agriculture.[27] The share of capital was, then, derived as a residual after subtracting labour and land returns from GDP.

Although, on average, factor shares conform to the stylized fact of two-thirds corresponding to labour and one-third to property owners (capital and land), factor shares are far from stable over time, contradicting Kaldor's (1957: 592) stylized fact (Figure 7). Labour and capital shares evolved as mirror images. Capital compensation increased its contribution to GDP, while labour reduced it, between 1880 and World War I and from 1960 onwards, and during a short episode in the late 1940s and early 1950s: Conversely, while the capital share declined in the Interwar years (1919–1935) and, again, in the late 1950s, the labour share rose.

We can now compute the proximate sources of labour productivity growth using a Törnqvist index,

$$\begin{aligned}\ln\left(LP^t/LP^{t-1}\right) &= \sum \bar{v}^{k,t}\left[\ln\left(KS^t/KS^{t-1}\right)-\ln\left(LQ^t/LQ^{t-1}\right)\right]\\ &+\sum \bar{v}^{x,t}\left[\ln\left(X^t/X^{t-1}\right)-\ln\left(LQ^t/LQ^{t-1}\right)\right]\\ &+\sum \bar{v}^{l,t}\left[\ln\left(LI^t/LI^{t-1}\right)-\ln\left(LQ^t/LQ^{t-1}\right)\right]+\ln\left(TFP^t/TFP^{t-1}\right) \qquad (17)\end{aligned}$$

where $\bar{v}^{i,t} = 1/2\ (v^{i,t-1} + v^{i,t})$ the 2-year average share of each factor of production in GDP at market prices.

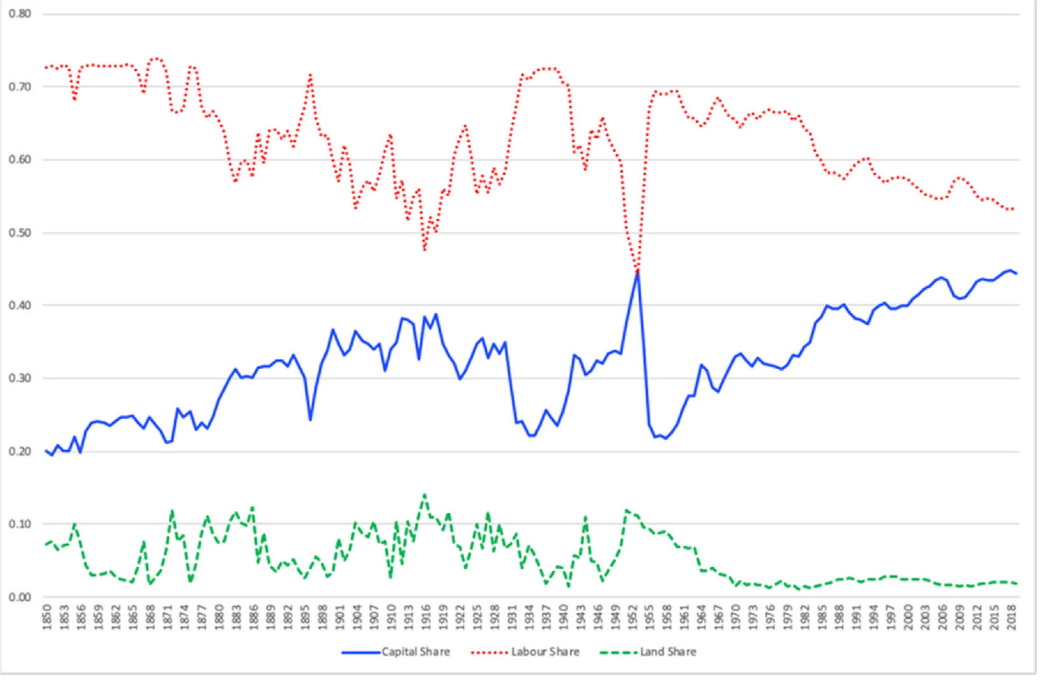

Figure 7. Three Factor Shares (% GDP). [Colour figure can be viewed at wileyonlinelibrary.com]

Total factor productivity (*TFP*) growth is, then, derived as a residual,

$$\ln\left(TFP^t/TFP^{t-1}\right) = \ln\left(LP^t/LP^{t-1}\right) - \left\{\sum \bar{v}^{k,t}\left[\ln\left(KS^t/KS^{t-1}\right) - \ln\left(LQ^t/LQ^{t-1}\right)\right] + \sum \bar{v}^{x,t}\left[\ln\left(X^t/X^{t-1}\right) - \ln\left(LQ^t/LQ^{t-1}\right)\right]\right\} \quad (18)$$

and the TFP index is obtained as its exponential.

Table 6 presents the breakdown of the average logarithmic growth rate of GDP per hour worked into the contribution of factor accumulation and efficiency gains (TFP) and offers two alternative estimates of TFP growth derived with income- and an education-based labour quality series, respectively. Figure 8 provides the yearly evolution of TFP using both indices.

Over 1850–2019, capital deepening contributed half the growth of labour productivity and efficiency gains about one-third, with the remainder attributable to labour quality. A glance at the evolution of labour productivity allows to distinguish different phases of growth, three of them with TFP significant contributions. Between mid-19th century and World War I a phase of progress from 1850 to the early 1890s gave way to another of sluggish performance until 1919. Efficiency gains accounts for the growth differential between the two phases. While capital contribution was steady during these 70 years, TFP only expanded during 1850–1892, providing half the growth of labour productivity (slightly less when education-based labour quality is used in the computation).

Table 6. Labour Productivity Growth and Its Sources, 1850–2019.

	(Annual average logarithmic rates %)			Income-based		Education-based	
	GDP/hour worked	Land input/hour	Capital input/hour	Labour quality	TFP	Labour quality	TFP
1850–2019	1.9	0.0	1.0	0.2	0.7	0.3	0.6
1850–1872	1.1	0.0	0.5	0.1	0.5	0.1	0.5
1873–1892	1.2	0.0	0.6	0.0	0.6	0.2	0.4
1893–1913	0.6	0.0	0.6	0.1	−0.1	0.0	0.0
1914–1919	0.1	0.0	0.6	0.1	−0.6	−0.1	−0.4
1920–1929	3.5	0.0	1.2	0.4	1.9	0.1	2.2
1930–1935	−1.6	−0.1	0.5	0.7	−2.7	0.3	−2.3
1936–1939	−5.9	0.0	−0.3	−0.9	−4.7	−0.1	−5.5
1940–1945	2.1	0.0	0.1	−0.2	2.2	−0.2	2.2
1946–1953	2.1	0.0	0.5	0.1	1.6	0.5	1.2
1954–1958	4.9	−0.1	1.4	0.6	3.0	0.4	3.3
1959–1975	6.1	0.0	2.4	0.8	2.9	0.5	3.3
1976–1985	5.3	0.0	2.7	0.7	1.8	0.8	1.8
1986–2007	1.2	−0.1	1.0	0.1	0.2	0.6	−0.3
2008–2013	1.6	0.0	2.4	0.2	-1.0	0.3	−1.1
2014–2019	0.5	0.0	−0.3	0.0	0.8	0.6	0.2

Source: See the text.

The 1920s witnessed a vigorous performance of labour productivity more than trebling pre-1890 growth. Capital deepening doubled its pace and contributed one-third of labour productivity growth. However, TFP was the main driver, with its contribution ranging from half to two-thirds of labour productivity growth (depending on whether it is derived with income- or education-based labour quality). During the 1930s, TFP collapse accounted almost exclusively for the decline in labour productivity while labour quality had a minor contribution to mitigate its contraction. TFP made also the largest contribution to its post-Civil War recovery.

Output per hour worked grew exceptionally fast during 1954–1985 (5.7%), a period that encompasses the Golden Age and the 'transition to democracy' decade. Efficiency gains contributed nearly half of its growth and physical capital accounted for another two-fifths. A closer look reveals that during the Golden Age (1954–1975) TFP contributed over half labour productivity growth, and one-third in the 'transition to democracy' decade, while the contribution of capital deepening rose from over one-third in the Golden Age to half in the 'transition' years.

Then, between Spain's accession to the European Union (1985) and the eve of the Global Financial Crisis (2007) labour productivity growth shrank to less than one-fourth, becoming largely extensive, rather than intensive. Capital provided four-fifths of the sluggish output per hour growth and TFP contributed less than one-fifth or negatively depending on whether it was estimated using income- or education-based labour quality. Only in the latter case, labour quality would have complemented capital's contribution. Sluggish labour productivity growth played, thus, a secondary role in a long phase of robust (absolute and per capita) GDP growth which was driven by the increase in hours worked per person resulting from higher employment.

The Great Recession (2008–2013) was another episode in which capital drove the mild acceleration in labour productivity growth, while TFP growth was negative. However, in the post-2013 recovery, TFP

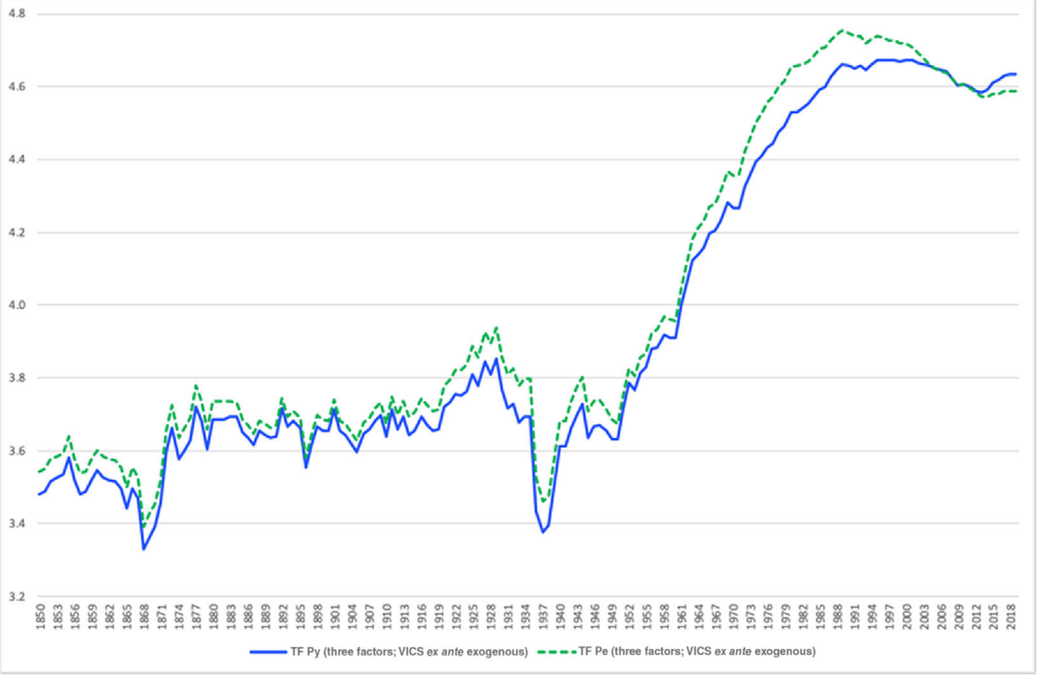

Figure 8. Total Factor Productivity: Estimated with Income- and Education-Based Labour Quality (2010 = 100) (logs). [Colour figure can be viewed at wileyonlinelibrary.com]
Note: TFPy and TFPe represent Total Factor Productivity derived with income- and education-based labour quality, respectively.

has led the paltry labour productivity growth (together with labour quality when it is derived using the education-based approach) as the contribution of capital turned negative. Again, it was the increase in hours worked per person, as employment recovered, what allowed GDP to rebound after the Financial Crisis.

As human capital is a main factor in narratives of economic growth, the role of labour quality in Spain's long-run growth deserves some comments. If we follow the education-based approach, labour quality added to labour productivity growth from the mid-20th century onwards, and made a significant since Spain's accession to the European Union (1985), representing one-half of physical capital's contribution. Such an optimistic outcome needs to be set against reservations with regard to education attainment as a measure of human capital; in particular, its demand as a high-income elastic consumption good. The income-based approach, although upwards biased as it assumes perfect competition, suggests, instead, that labour quality contributed to labour productivity growth during the Golden Age and the 'transition to democracy' decade, but not thereafter. We find the latter a more persuasive story.

We have replicated the growth accounting exercise using only two factors of production, as it is conventionally done (assuming that the share of capital is 1 less the share of labour), in order to provide a robustness test for our results. Figure 9 presents the evolution of TFP that results from growth accounting exercises with two and three factors of production for both estimates with income- and education-based labour quality. Both sets of estimates follow the same pattern but the two-factor estimates present a higher level relative to 2010, the benchmark year. This implies slower TFP growth, especially until 1960, which results from the fact that capital input, that grows much faster than land input, receives a larger weight

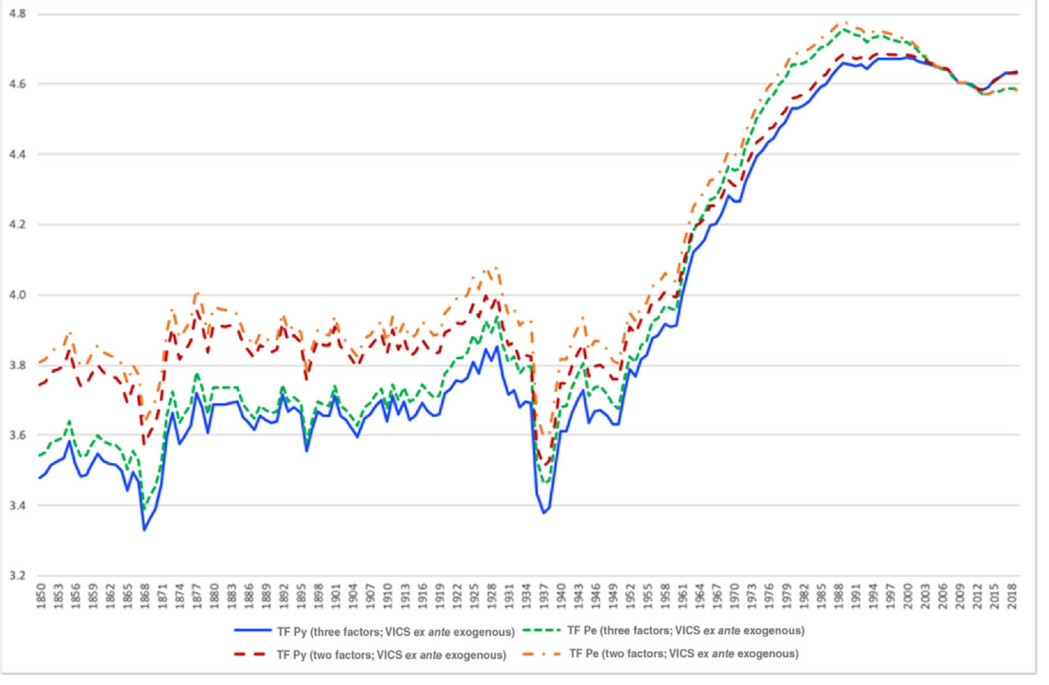

Figure 9. Total Factor Productivity: Estimated with Three and Two Factors of Production and Income- and Education-Based Labour Quality (2010 = 100) (logs). [Colour figure can be viewed at wileyonlinelibrary.com]

(as includes the land share in GDP) in the growth accounting exercise (Table 7). An implication of this comparison is that growth accounting exercises for developing economies that neglect the land input, over-exaggerate the share of capital and, hence, underestimate TFP growth.

How do our results for the evolution of the TFP compare to earlier studies? Figure 10 compares our new estimates, derived with both the income- and education-based labour quality with those by Prados de la Escosura and Rosés (2009) for 1850–2000, derived with income-based labour quality, and Bergeaud *et al.* (2016), updated estimates, using 2000 as reference. These two series present a close evolution until the last quarter of the 20th century, as they rely on the same sources.[28] When compared to our new estimates, a similar evolution is observed but faster growth during the 1960s and early 1970s that, in the case of Prados de la Escosura and Rosés (2009) continues during the ‘transition to democracy’ years. It is also worth mentioning that Bergeaud *et al.* series presents a sharp deceleration after 1986 but still some progress, unlike the stagnation or negative TFP growth in the rest of the estimates.

Another possible comparison referring to the post-1950 era is provided in Figure 11, which presents our new estimates along those provided by the Penn World Tables 9.1 (Feenstra *et al.*, 2015, updated) for the post-1954 era, and the Conference Board (2019) for 1990–2018. In both cases, TFP is derived using education-based labour quality. The Conference Board’s TFP series match closely our own education-based estimates, while the Penn World Tables series adopt an intermediate position between our two set of estimates. Although there noticeable differences in the pace of growth, their trends are largely coincidental, with the PWT 9.1 series showing, like our estimates with income-based labour quality, sustained

Table 7. Labour Productivity Growth and Its Sources, 1850–2019: Two Factors of Production.

	(Annual average logarithmic rates %)		Income-based		Education-based	
	GDP per hour worked	Capital input/hour	Labour quality	TFP	Labour quality	TFP
1850–2019	1.9	1.1	0.2	0.5	0.3	0.5
1850–1872	1.1	0.5	0.1	0.4	0.1	0.4
1873–1892	1.2	0.8	0.0	0.4	0.2	0.2
1893–1913	0.6	0.7	0.1	−0.2	0.0	−0.1
1914–1919	0.1	0.8	0.1	−0.7	−0.1	−0.5
1920–1929	3.5	1.5	0.4	1.6	0.1	1.9
1930–1935	−1.6	0.6	0.7	−2.9	0.3	−2.5
1936–1939	−5.9	−0.3	−0.9	−4.7	−0.1	−5.5
1940–1945	2.1	0.2	−0.2	2.2	−0.2	2.2
1946–1953	2.1	0.6	0.1	1.5	0.5	1.1
1954–1958	4.9	1.8	0.6	2.4	0.4	2.7
1959–1975	6.1	2.7	0.8	2.6	0.5	3.0
1976–1985	5.3	2.9	0.7	1.7	0.8	1.7
1986–2007	1.2	1.0	0.1	0.1	0.6	−0.4
2008–2013	1.6	2.5	0.2	−1.0	0.3	−1.1
2014–2019	0.5	−0.3	0.0	0.8	0.6	0.2

TFP growth until 1989 and, then, mild but steady decline until 2013, while the Conference Board series stresses the post-1990 fall, as do our TFP estimates derived with education-based labour quality.

How does Spain compare to other countries during phases of TFP acceleration such as the 1920s of the Golden Age (1950–1973)? Although methodological differences may bias the results, a face value comparison provides some informative results.[29] In the 1920s, when contrasted with other Peripheral European countries, TFP growth appears more intense in Spain than Portugal and Turkey, but less than in Italy. Portugal's yearly growth was below 1% and negative in Turkey, while in Italy and Spain reached 2.5% and at 1.9–2.2% (depending on the use of income- or education-based labour quality), respectively.[30] Moreover, TFP grew faster in Spain than in the United Kingdom and the United States. However, during 1850–1890, the previous phase of TFP acceleration, Spain's TFP growth was lower than in the United Kingdom but higher than in the United States and Italy.[31]

In the Golden Age, the yearly rate of growth in Spain (2.9–3.3% over 1954–1975) was, again, above those of Portugal (1.5%) and Turkey (0.8%), but below Italy's (4.0%), although, Spain TFP behaved better than Italy's in the late 1970s and 1980s.[32] Spain also exhibited faster TFP growth than the leading socialist countries of Central and Eastern Europe, Czechoslovakia, Hungary and Poland, which grew at 1.3%, 2.1% and 1.9%, respectively, during 1950–1970 (Vonyó and Klein, 2019: 335). If we extend the comparison to South East Asia, where TFP acceleration started after 1960, we observe that Spain's rate of growth (2.5–2.7% in the years 1959–1985) was higher than in Hong Kong, South Korea and Taiwan, 2.3%, 1.7% and 2.1%, respectively, over 1966–1991 (Young, 1995, p. 672). Finally, if the contrast is carried out with the advanced economies, it emerges that TFP grew faster in Spain than in the United States (2.1%) and the United Kingdom (1.9%), similarly to Germany and Japan (3.3% and 3.2%), but slower than in France (3.6%).[33]

It can be, then, concluded that Spain compared to the best performers during phases of generalized TFP growth acceleration such the 1920s and the 1950–1975 years.

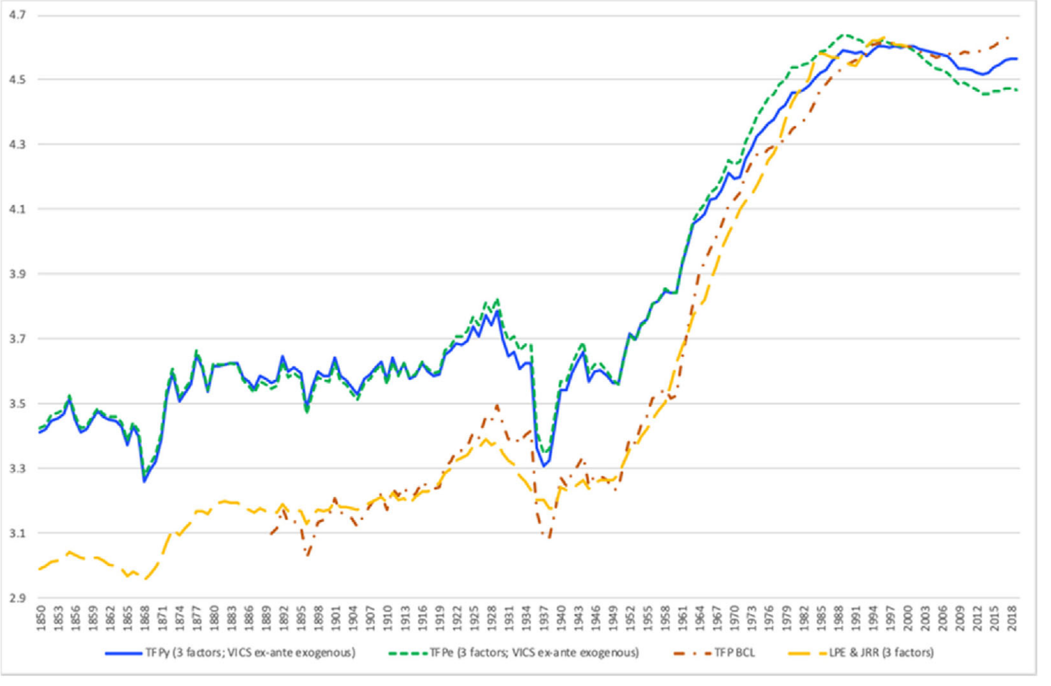

Figure 10. Long-Run Trends in Total Factor Productivity: Comparative Estimates (2000 = 100) (logs). [Colour figure can be viewed at wileyonlinelibrary.com]
Note: New Estimates derived with income- and education-based labour quality.

If we now turn to the long phase of TFP deceleration since 1986, what does explain the shift from efficiency gains to capital deepening as labour productivity's main driver? The fact that TFP growth halted help explain the shift, but why TFP did it? A convergence hypothesis can be entertained. As TFP grew sharply over three decades (Figure 8), Spain got closer to the technological frontier and achieving further efficiency gains became more difficult. Furthermore, once and for all structural change associated to the shift of resources from sectors of low or slow growing productivity to those of high, or fast growing productivity (i.e. labour moving from agriculture into manufacturing) had already taken place by the time Spain joint the EU. Hence, Spain's potential for catching up would have been exhausted and TFP growth slowed down adjusting to its pace in advanced economies.

Table 8 compares levels of output per hour worked in 1990 (expressed in 2019 EKS U.S. dollars) in OECD countries (ranked from top to bottom) to their TFP growth rates since 1990 using the Conference Board (2020) data set. In both periods considered, the one of expansion, 1990–2007, and the entire time span 1990–2019, Spain had TFP poorest performance, and all countries with higher initial levels of output per hour worked than Spain in 1990 exhibit faster TFP growth in both periods. Such results reject, therefore, the convergence hypothesis.[34]

Alternative explanations have been put forward to explain why during the last three decades labour productivity growth has slowed down in Spain and become extensive rather than intensive. It has been hypothesized that as resources were re-allocated towards sectors that attracted less innovation (from traded to non-traded sectors, i.e. low-skill services and construction) aggregate efficiency declined. Specifically, Díaz and Franjo (2016) blame investment in residential structures, stimulated by favourable

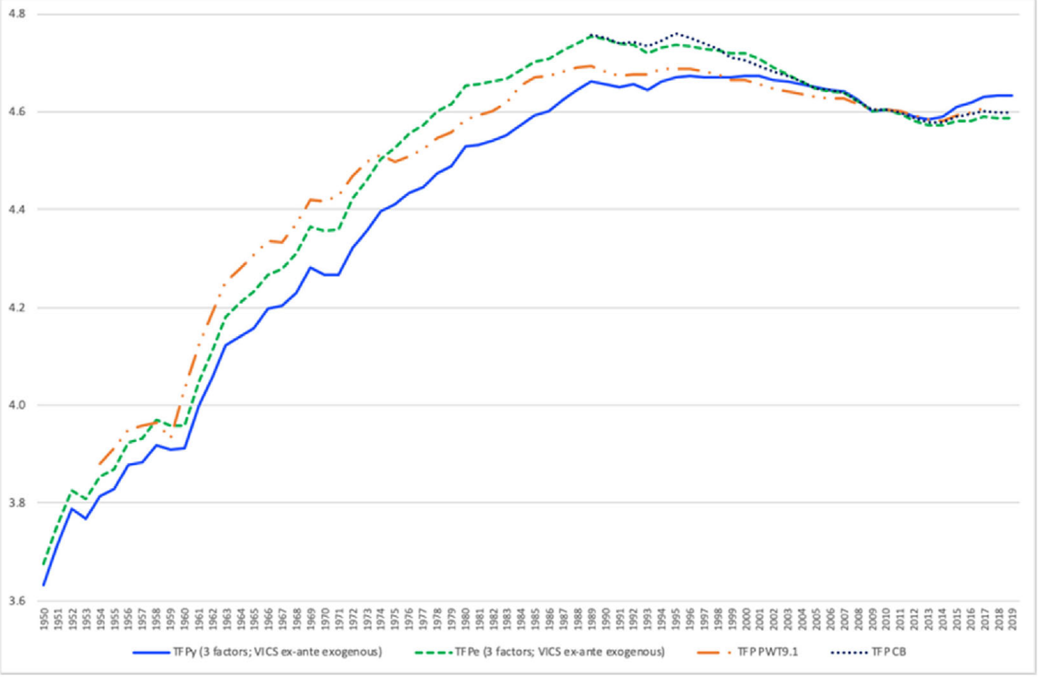

Figure 11. Total Factor Productivity Since 1950: Alternative Estimates (2010 = 100) (logs). [Colour figure can be viewed at wileyonlinelibrary.com]

Note: New Estimates derived with income- and education-based labour quality.

relative prices and subsidies, together with low investment-specific technical change (ISTC), for the TFP slowdown. Pérez and Benages (2017) stress the low investment on intangibles and the excess capacity and limited use of their capital by predominant small firms. And Cuadrado *et al.* (2020) complete the picture by pointing to the limited exploitation of new technologies as a result of workers' low skills. The recovery of the share of structures in net capital stock and its substantial contribution to total value of capital services in the early 21st century supports these assertions (Prados de la Escosura, 2020). Moreover, the low ISTC is consistent with the deceleration of capital 'quality' since 1990 (Figure 5).

García-Santana et al. (2020) offer a nuanced view of the TFP slowdown in which it is allocative inefficiency across firms, rather than across sectors, what accounts for it.[35] Moreover, they find that government regulation (cronyism) is its ultimate determinant. Looking at the context in which this misallocation has taken place, Gopinath *et al.* (2015) argue that, by lowering interest rates and encouraging an inflow of capital, the adoption of the Euro may have been partly responsible for the allocation of capital to less productive firms and, hence, the low TFP growth.

Furthermore, firms' low expenditure on research and development and low investment in intangible capital which hampers TFP (Corrado et al., 2013) are associated to regulatory restrictions to competition in product and factor markets (Alonso-Borrego, 2010). Specifically, retail trade regulation, the costs of firm creation, lack of flexibility in the labour market, bankruptcy legislation and judicial procedures all militate against competition (Mora-Sanguinetti and Fuentes, 2012).

Table 8. Labour Productivity in 1990 (2019 EKS U.S.$) and TFP Growth 1990–2019 (%).

	Output per hour worked 1990	TFP growth (%) 1990–2007	TFP growth (%) 1990–2019
Norway	59	0.7	−0.1
Belgium	58	0.0	−0.3
Switzerland	57	−0.2	−0.3
The Netherlands	57	0.3	0.0
Denmark	56	0.2	0.0
France	53	0.2	−0.1
Italy	51	0.1	−0.2
Germany	48	0.4	0.2
United States	48	0.7	0.5
Austria	46	0.2	−0.1
Spain	**45**	**−0.7**	**−0.5**
Sweden	43	0.5	0.1
Canada	42	0.0	−0.1
Finland	40	1.4	0.5
Australia	39	−0.2	−0.3
United Kingdom	39	0.8	0.4
Ireland	36	1.3	0.6
Israel	35	−0.2	−0.2
Singapore	34	0.3	−0.3
New Zealand	34	0.2	0.1
Japan	31	−0.5	−0.3
Greece	31	0.3	−0.5
Portugal	27	−0.1	−0.3
Czech Republic	24	0.3	0.1
Hungary	21	0.8	0.4
Taiwan	18	2.3	1.8
Slovak Republic	17	0.5	0.4
Poland	16	1.0	1.0
South Korea	12	2.3	1.7

Source: Conference Board (2020).

4. Concluding remarks

The current productivity slowdown has stimulated research on the causes of growth. This paper has explored long-term growth and its proximate sources in Spain. We found that labour productivity dominated GDP long-run growth. Half the increase in labour productivity came from capital deepening and one-third from efficiency gains. In phases of labour productivity acceleration, TFP was its driving force and a complementarity existed between capital deepening and efficiency gains. Moreover, Spain was among the best performers during phases of generalized TFP acceleration as the 1920s and the Golden Age.

Since the mid-1970s the Spanish economy has been unable to combine employment creation and labour productivity growth and capital deepening, a finding consistent with the fact that expanding sectors that created more jobs experienced slower output per hour growth as were less successful in attracting investment and technological innovation. During the ‘transition to democracy’ decade, labour productivity continued thriving since deep structural change and industrial re-structuring eliminated sheltered low-productivity industries.

Labour productivity slowdown only began after Spain's accession to the European Union, associated to deceleration in capital deepening and TFP stagnation. GDP growth became extensive largely depending on the increase in hours worked per person as employment grew until the Global Financial Crisis. Capital misallocation and low investment on intangibles and ISTC affecting negatively capital deepening and TFP growth resulted from obstacles to competition in product and factor markets, subsidies and cronyism.

Do, then, restrictions to economic freedom, regulation and worsening property rights, in particular, help explain the poor labour productivity performance during the last three decades? Furthermore, does economic freedom constitute an ultimate determinant of capital deepening and TFP growth over the long run? Testing this proposition demands further research.

Notes

1. Different phases in GDP growth are defined as deviations from trend estimates with structural breaks.
2. Here we go beyond the OECD convention that labour input is represented by the number of hours worked (cf. OECD, 2019, p. 122).
3. However, this is a simplified approach that results from the lack of reliable and consistent data. See the alternative approaches to assess human capital via cost-based (namely, evaluating human capital based on costs of education and rearing) and income-based (i.e. assessing human capital as the discounted lifetime labour income) measures in Le et al. (2003) and Oxley et al. (2008).
4. From 1954, Prados de la Escosura and Rosés (2010) distributed workers for each industry into four occupational categories (unskilled and skilled operatives, technicians and managers).
5. The number of sectors distinguished is 56 for 1985–1995 and 63 from 1995 onwards. There are no significant discrepancies between our results and those in Prados de la Escosura and Rosés (2010) for 1985–2000.
6. This implies arbitrarily assuming homogenous quality within each sector. Fortunately, there are no significant discrepancies between our results and those in Prados de la Escosura and Rosés (2010) for 1985–2000.
7. In order to provide a single employment series from different national accounts benchmark series, we followed the splicing procedure (interpolation) used in Prados de la Escosura (2016, 2017).
8. This has been a commonly used procedure (cf. Kuznets, 1966, Jorgenson, 1990 and OECD, 2019). In using this procedure, the more disaggregated the set of industries for which the exercise is carried out, the more accurate the estimate.
9. Using this approach, as in Mulligan and Sala-i-Martín (1997), we exclude the contribution of physical capital to labour income (see the discussion in Oxley et al., 2008, pp. 301–302). It could be argued that that as this index captures the employment shift towards sectors with higher relative wages, it actually represents an improvement in resource allocation rather than in labour quality. We owe this remark to Lorenzo Serrano. In our view, improving factor allocation and labour quality are not excluding consequences of the employment shift.
10. Again, we follow an over-simplified approach due to lack of homogeneous data for such a long time span. On the use of education as a proxy for human capital, see the surveys in Wössmann (2003), Fraumeni (2015) and Liu and Fraumeni (2020) and the contrast between education-based and cost- and income-based approaches in Oxley et al. (2008).
11. This rate of return matches that obtained Montenegro and Patrinos (2014) for Spain, 2004–2008. See the discussion in Collins and Bosworth (2003) and Psacharopoulos and Patrinos (2004). Prados de la Escosura and Rosés (2010) explored alternative rates of return but the results do not differ significantly from each other until the late 20th century.
12. Cf. Rosés (1998) for labour quality in mid-19th century Catalan textile industry.

13. Labour market rigidities, the quality of education and over-qualification in terms of formal education may also help explain the limited effect of education on the quality of labour.
14. The contrast between income- and education-based estimates in other countries shows the same pattern of lower labour quality growth when the former approach is used (cf. Prados de la Escosura and Rosés, 2010).
15. In this section, we draw on Prados de la Escosura (2020).
16. Biological resources and intellectual property products have been included under 'machinery and equipment' as information on these two assets is only available in national accounts since 1980. A practice shared by Conference Board (2019). No distinction has been made between ICT and non-ICT assets due to dearth of data in national accounts and to our purpose to provide homogeneous long-run series.
17. There is no concluding evidence that service lives fall over the long run, as offsetting tendencies are at work (OECD, 2009). Maddison (1995) also used fixed average lives for his historical estimates.
18. These service lives are in line with the average lives for the more detailed breakdown of assets in Pérez et al. (2019).
19. We have made an allowance for the destruction of capital stock resulting from the Spanish Civil War (1936–1939). Specifically, historical estimates have been adopted for other construction and machinery and distributed it at constant yearly rates over 1936–1939, while for dwellings and transport equipment GFCF series with the PIM captures capital stock destruction well. The resulting figures imply a 4.9% contraction of the total net capital stock between 1935 and 1939 which, by asset type, represented a fall of 2.0% (dwellings), 6.8% (other construction), 13.7% (machinery) and 30.4% (transport equipment).
20. It is worth noting that while to derive the net capital stock the cumulating flow of investment is corrected for retirement and depreciation, in the case of productive capital only efficiency losses are detracted. In practical terms, their difference results from the fact that the net capital is valued at the end of the year and the productive capital represents the average value in the year.
21. Although ideally an *ex post* endogenous rate of return may be preferable as it equals the value of capital services to capital compensation in national income, the use of an *ex post* endogenous rate of return is very data demanding. It requires a complete coverage of all assets and a distinction between market and government sectors that we cannot meet.
22. This is close to the average real rate of return of bank deposits in Spain since 1850 (4.5%). Alas, when using an ex ante rate of return the resulting value of capital services does not match capital compensation in national income (cf. Prados de la Escosura, 2020).
23. We follow Prados de la Escosura and Rosés (2009) here. Crafts (2018) and Antràs and Voth (2003) also consider land as an independent production factor in their studies of Britain's Industrial Revolution. In growth accounting exercises for nowadays' developing countries, land is often included separately from capital (cf. Bosworth and Collins, 2007).
24. Assuming constant returns to scale for each factor of production we impose output elasticities to add up to 1, $\alpha + \beta + \gamma = 1$.
25. Were there competitive monopolistic rents, TFP growth obtained under the assumption of perfect competition would be biased downwards, as the capital share in GDP – by including competitive monopoly profits – would overstate the elasticity of output with respect to capital. Conversely, had the aggregate production function increasing returns to scale, TFP growth would be over-exaggerated (Young, 1995, p. 648).
26. Computing the labour share in terms of GDP at market prices implies that net taxes on products and imports (taxes minus subsidies) are attributed to capital income. This procedure is used by Conference Board (2017, p. 32).
27. Given the sharp drop in the relative size of agriculture in the late 20th century, the resulting bias in our TFP growth estimates should not be large.

28. Bergeaud et al. (2016, updated) use GDP from the Maddison Project Data set (that comes from Prados de la Escosura, 2017), investment (up to 1980) and employment (up to 1950) from Prados de la Escosura (2003), and hours worked from Prados de la Escosura and Rosés (2010). For the rest of the years, they seem to rely on OECD statistics. They provide no sources and procedures for estimating human capital.
29. Differences extend to the way capital and labour inputs are computed, the number of factors considered and the use of fixed or variable factor shares. Whenever possible, we have chosen the TFP estimates obtained with the closer methodology (i.e. those that take into account capital and labour quality). We have restricted the comparison to historical estimates carried out for individual countries.
30. Data come from Lains (2003, p. 277), for Portugal, 1910–1934 (0.7%); Altug *et al.* (2008, p. 409) for Turkey, 1914–1929 and Giordano and Zollino (2020) for Italy, 1919–1929.
31. Data for the United Kingdom come from Crafts (2020, tables 2 and 3) for 1924–1937 and 1856–1889; for the United States, from Crafts and Woltjer (2020, table 6) for 1919–1929, and Abramovitz and David (2001), for 1855-1890 and Giordano and Zollino (2020) for Italy, 1861–1896
32. Data come from Lains (2003, p. 277), for Portugal, 1947–1973; Altug *et al.* (2008, p. 409) for Turkey, 1950–1979 and Giordano and Zollino (2020) for Italy, 1951–1973 and 1974–1993.
33. Data come from Crafts (2020) for the United Kingdom, 1950–1973; Crafts and Woljter (2020) for Germany and France, 1950–1974 (Table 1) and the United States, 1948–1973 (Table 6) and Fukao et al. (2020) for Japan, 1950–1970 (Table 1).
34. TFP growth rates for Spain computed by Conference Board are close to our estimates using the education-based approach to obtain labour quality (which is the approach employed by Conference Board), −0.7% and −0.6% for 1990–2007 and 1990–2019, respectively. Nonetheless, TFP growth derived with income-based labour quality is −0.1% for each of these periods.
35. Moral-Benito (2018) finds that firms' high capital deepening during the Great Recession and low capital deepening thereafter underlies the TFP contraction during the Great Recession and its rise during the economic recovery.

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Supporting Information

Additional supporting information may be found online in the Supporting Information section at the end of the article.

Appendix Table A.1 Real GDP and its Composition, 1850-2019 (2010=100).
Appendix Table A.2 Hours Worked per Person and its Composition, 1850-2019 (2010=100).
Appendix Table A.3 Labour Input and its Composition, 1850-2019 (2010=100).
Appendix Table A.4 GDP per Hour Worked and its Sources, 1850-2019 (2010=100).