The Sources of Long-Run Growth in Spain, 1850–2000

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Between 1850 and 2000 Spain's real output and labor productivity grew at average rates of 2.5 and 2.1 percent. The sources of this long-run growth are investigated here for the first time. Broad capital accumulation and efficiency gains appear as complementary in Spain's long-term growth. Factor accumulation dominated long-run growth up to 1950, while total factor productivity (TFP) led thereafter and, especially, during periods of growth acceleration. The main spurts in TFP and capital coincide with the impact of the railroads (1850s–1880), the electrification (the 1920s and 1950s), and to the adoption of new vintage technology during the Golden Age.

Over the last century and a half, aggregate economic activity in Spain experienced a 43-fold increase, growing at 2.5 percent per year, and per capita GDP was 16 times larger than in 1850, implying an annual rate of 1.9 percent.[1] GDP per hour worked expanded at a faster rate (2.1 percent) as hours of work per person declined. This economic growth, however, did not take place at a steady rate. During the Golden Age (1950–1974), per capita GDP rose seven times faster than in the previous hundred years, and twice as fast as during the last quarter of the twentieth century. Does factor accumulation or

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[1] For the growth estimates, see the text below.

productivity improvement—"abstention" or "ingenuity" to use D. N. McCloskey's words—account for it?[2] In fact, no consensus has emerged about the relative importance of the contributions of factor accumulation and TFP to GDP growth, nor do we know whether a temporal sequence can be established for their relative contributions to growth.[3] Susan Collins and Barry Bosworth have suggested that, in its early stages, growth is primarily associated with capital accumulation, while TFP only emerges later.[4] Studying the sources of Spain's growth over 150 years provides an unusual opportunity to explore these issues.[5]

We use a growth accounting approach which allows us to decompose Spain's long-run growth into the contribution of production factors in terms of quantity and efficiency.[6] The sources of Spain's growth have changed dramatically since 1850. Broad capital accumulation and TFP growth appear complementary in Spain's long-term growth, and our results for Spain confirm Collins and Bosworth's finding of low TFP growth for countries in their early stages of development.[7] Factor accumulation dominated long-run growth up to 1950, while efficiency gains led thereafter and, especially, during periods of growth acceleration. The main spurts in TFP and capital correspond to the impact of the railroad (1850s–1880s), the electrification (the 1920s and 1950s), and the adoption of new vintage technology during the Golden Age (1950–1974).

The rest of the article is divided into three parts. We begin by describing the growth accounting adopted in this article and also present our new database, which comprises new estimates of GDP and of capital and labor inputs, over one-and-a-half centuries. We next discuss the role

[2] McCloskey, "Industrial Revolution."

[3] Cf. Crafts, *British Economic Growth*; and Mokyr, "New Economic History," on the case of Britain and Denison and Poullier, *Why Growth Rates Differ*, pioneering study on Western Europe (but not including Spain) and the United States in the post-World War II era. On developing countries, including and some comparisons with post-World War II Europe, see Krugman, "Myth"; Young, "Tyranny of Numbers"; Collins and Bosworth, "Economic Growth"; Crafts, "East Asian Trend Growth"; and Bosworth and Collins, "Empirics of Growth."

[4] Collins and Bosworth, "Economic Growth," p. 186.

[5] Unfortunately, detailed growth-accounting exercises with long-run evidence are rare. See, for example, Maddison, "Growth and Slowdown"; Matthews, Feinstein, and Odling-Smee, *British Economic Growth*; and Carré, Dubois, and Malinvaud, *French Economic Growth*, for Europe and Kendrick, *Productivity*; and Abramovitz and David, "Two Centuries," for the United States.

[6] This framework does not include a particular growth theory since it only provides a descriptive procedure and it is, therefore, compatible with the alternative specifications of different growth models (Barro, "Growth Accounting"; and Collins and Bosworth, "Economic Growth," p. 139). In this article, we make a historical adaptation of Domar's, "Measurement of Technological Change," and Griliches and Jorgenson's, "Explanation of Productivity Change," approach to measure factor inputs in terms of quality.

[7] As Collins and Bosworth, "Economic Growth," p. 164, point out, technical advances might be embodied in new capital, while increasing TFP might induce greater capital accumulation by raising the returns to capital.

of TFP and factor accumulation in GDP and labor productivity growth. We conclude with some remarks on the significance of the Spanish experience and some questions for future research.

THE “PROXIMATE” SOURCES OF GROWTH: METHODS AND SOURCES

Growth accounting is “a means of allocating observed output growth between the contributions of changes in factor inputs and a residual, total factor productivity, which measures a combination of changes in efficiency in the use of those inputs and changes in technology.”[8] In the growth accounting approach favored by Dale J. Jorgenson, superlative indices are used, as well as heterogeneous measures of factor inputs that make it possible to separate their contribution to growth into quantity and composition changes.[9]

The Translog Index of Total Factor Productivity

The point of departure for our estimate of the sources of long-run growth in Spain is the production function given by

$$Q = F(X, K, L) \tag{1}$$

In which output (Q) is as function of land (X), capital (K), and labor (L) inputs. Specifically,

$$\ln Q = a_0 + a_x lnX + a_k lnK + a_l lnL + \frac{1}{2} b_{xx}(lnX)^2 + \frac{1}{2} b_{kk}(lnK)^2 + \frac{1}{2} b_{ll}(lnL)^2\, b_{xk} lnX\, lnK + b_{xl} lnX\, lnL + b_{kl} lnK\, lnL \tag{2}$$

If we consider two discrete periods of time, we have, after differentiating and taking logarithms,

$$\ln Q_t - \ln Q_{t-1} = \theta_X [\ln X_t - \ln X_{t-1}] + \theta_K [\ln K_t - \ln K_{t-1}] + \theta_L [\ln L_t - \ln L_{t-1}] + TFP_{t-1,t}, \tag{3}$$

[8] Bosworth and Collins, “Empirics of Growth,” p. 114.

[9] The result should be a reduction in the “unexplained residual” (total factor productivity) since the “residual” no longer includes composition (“quality”) changes in inputs. See Jorgenson, “Productivity.” A major difference between Jorgenson’s approach and the conventional approach (as presented, for example, in Denison, *Sources*) is that in the former capital is cross-classified by type of asset and weighted it by its rental rates.

Here θ_i denotes the elasticity of output with respect to each input.[10] Under the assumptions of perfect competition and constant returns to scale these elasticities are equivalent to the share of inputs in total factor payments. Under constant returns to scale, the values of factor shares sum to unity. Weights are then given by the average share of each factor input in total output for the two periods. The translog index of TFP ($TFP_{t-1,t}$) is the difference between the growth rate of output and a weighted average of the growth rates of factor inputs.

The rate of growth of output and of each input *i* between two periods is a weighted average of the growth rates of its *n* quality classes.[11] The respective equations for output, land, capital, and labor are

$$lnQ_t - lnQ_{t-1} = \sum_i [\bar{\theta}Q(lnQi_t - lnQi_{t-1})] \quad (4)$$

$$\ln X_t - \ln X_{t-1} = \sum_i [\bar{\theta}X(\ln Xi_t - \ln Xi_{t-1})] \quad (5)$$

$$lnK_t - lnK_{t-1} = \sum_i [\bar{\theta}K(lnCi_t - lnCi_{t-1})] \quad (6)$$

$$lnL_t - lnL_{t-1} = \sum_i [\bar{\theta}L(lnLi_t - lnLi_{t-1})] \quad (7)$$

where share values are computed as

$$\bar{\theta}ni = 1/2[\theta ni_t + \theta ni_{t-1}], \qquad (i = 1,..i,..n). \quad (8)$$

Capital Input

We develop our measure of capital input (which is an index number of the flow of services provided by the stock of capital) in three successive phases.[12] First, we construct the stock of capital.[13] Second, we

[10] See Christensen, Jorgenson, and Lau, "Transcendental Logarithmic."

[11] By quality classes we mean the different types of assets and workers, in the cases of capital and labor, or the main sectors of economic activity (agriculture, industry, construction, and services), in the case of output. For example, *L* can be viewed as a vector that denotes the quantities of labor of various types, categorized by age, sex, education, and so on. See Barro, "Growth Accounting," p. 121. The share of each quality class in total payments for each input or output provides its weight.

[12] As is usually assumed, capital *input* (*K*) in year *t* is proportional to the *stock* of capital *C* at the beginning of the period *t*. Thus, $K_t = \lambda \cdot C_{t-1}$, where the constant ($\lambda$) transforms the capital *stock* into its services, and where the capital *stock* C_t moves according to the new investments, at constant prices, during the year, and to the depreciation and replacement rates. Cf. Jorgenson, "Productivity."

estimate the rental price of capital (or price of capital services) and the total returns to capital (the value of capital services). Finally, we weight the quantity of each asset by its share in the total returns to capital in order to derive a single capital input index.

Since new additions to the stock of capital (investment, I_t) are directly observable while the stock, C_t, is not, we need to infer the stock of capital (C) for the year t from the accumulation of investment (I) in past years, taking into account that a part of the stock is retired when obsolete.[14] With the perpetual inventory method (PIM), the stock of capital in the year t (C_t) is equal to the weighted sum of the investment realized during this same year and the previous ones, where each generation of capital is weighted by its depreciation rate in period t.[15]

$$C_t = (1 - \delta_t)\, C_{t-1} + I_t \tag{9}$$

Thus the capital stock C in year t is equal to the amount of capital in year $t-1$ multiplied by 1 minus the depreciation rate (δ) of the year t, plus the gross fixed capital formation, I, during the year t.[16] The depreciation rate is inversely related to the asset life, so $\delta = X/T$, where X is a parameter (*declining balance*) and T is the life of each type of asset.[17] This method generates a measure of capital that takes into

[13] We define the *stock* of capital as all tangible goods that can be used during more than one period to produce other goods and services. More specifically, the capital *stock* comprises residential and nonresidential structures, transport equipment, and producer durable equipment (machinery and equipment).

[14] Data on yearly investment (quantities and prices) by type of asset are taken from Prados de la Escosura, *Progreso*.

[15] This is the case under the following assumptions: (1) all durable goods bought in a certain period t form a vintage of capital; (2) the services produced for different vintages of capital in period t are perfect substitutes; and (3) their services are proportional to the initial investment. See Hulten, “Measurement of Capital.”

[16] The use of the PIM method requires, thus, (1) an initial benchmark for the stock of capital; (2) historical series of Gross Fixed Capital Formation by types of assets, at constant prices; and (3) the efficiency of each vintage of capital.

[17] If depreciation is assumed to be arithmetic, X takes the value of 1; if, alternatively, depreciation is assumed to be geometric, X equals 2. In our case, following Jorgenson, “Productivity,” we adopted the “modified” geometric depreciation pattern, in between the arithmetic and geometric patterns. According to Hulten and Wykoff, “Economic Depreciation,” the parameter X is 1.65 for machinery and equipment and 0.91 for buildings and structures. These values were derived from a careful econometric exercise in which a large data base was used. Accepting the X parameter’s values from Hulten and Wykoff, ibid., for historical purposes is arbitrary. Nonetheless, it is worth noting that these parameters have been widely employed in empirical studies as they correspond to the technological frontier to which countries tend to converge. For Spain, the alternative assumptions of X = 1 (arithmetic depreciation) and X = 2 (geometric depreciation) do not lead to significantly different results for the stock of capital. See Prados de la Escosura and Rosés, “Capital Accumulation.”

account the productive capacity of each component and, hence, measures capital stock in *efficiency units*.[18] Since assets lives tend to shorten as one gets closer to the present, three different epochs (1850–1919, 1920–1959, and 1960–2000), with their particular asset lives, are considered for "productive" capital (that is, for all capital assets except residential dwellings).[19]

The second step in developing measures of capital *input* is to construct rental prices for each type of capital asset. In competitive equilibrium, the cost of producing a unit of capital is equal to its price and the expected rent during its life. If we assume that old and new vintages of capital are perfect substitutes, the rental price of capital, p_k, in year *t*, can be estimated as

$$p_k(t) = Pi_{t-1} r_t + \delta pi_t - [Pi_t - Pi_{t-1}] \qquad (10)$$

where p_i is the investment price of the capital good *i*, *r* is the nominal rate of return, and δ is the depreciation rate for the capital good *i*.[20] The rental price of capital asset *i* is thus the sum of return per unit of capital, $Pi_{t-1}\ r_t$, depreciation, $\delta\ pi_t$, and the negative of revaluation, $[pi_t - pi_{t-1}]$.[21]

Multiplying the rental price of capital asset *i* by the quantity of capital stock *i*, we obtain the returns to capital asset *i*. Adding up the returns to each type of asset we derive the total returns to capital, which equals capital property compensation. The shares of each type of asset in total

[18] Hulten, "Measurement of Capital." Unfortunately, we cannot explore all the changes in the composition (quality) of capital since our deaggregation by type of asset in not deep enough.

[19] For each type of capital assets, its life was established from available information. Thus, dwellings are assigned an average service life of 70 years, while for the rest of assets we assumed that service lives decline over time. Thus, for each of the three periods (1850–1919, 1920–1959, and 1960–2000) nonresidential structures were respectively assigned lives of 56, 55, and 40 years; transport equipment, 37, 28, and 15 years; and machinery and equipment, 30, 20, and 15 years. These assumed lives are in line with those used in major historical works (Feinstein, "Sources and Methods," for the United Kingdom; and Jorgenson, "Capital," for the United States) and tend to be on the conservative (high) side when compared with available studies for late-twentieth-century Spain. Further details on the construction of capital measures, including alternative estimates of (gross and net) capital stock constructed using arithmetic depreciation rates, are provided in Prados de la Escosura and Rosés, "Capital Accumulation." The main trends in capital stock and input offered here are robust to these alternative estimates.

[20] Jorgenson, "Productivity"; and Hall and Jorgenson, "Tax Policy."

[21] Jorgenson, "Capital," p. 10. It should be noted that we have already established the depreciation rates and the prices of acquisition of capital for Spain, but we do not know the rates of return. There are two methods for estimating rates of return (*r*). The first uses the long-run interest rate as equivalent to the rate of return to capital under perfect competition. The second derives the rate of return from the share of national income received by the owners of capital assets as a compensation for their property, which can be derived by solving equation 9. The difference between the two estimations represents monopolistic competition rents.

returns to capital will be used as weights in the computation of the capital input index. A capital good with a higher amortization rate receives a larger weight in the index of capital input; a million dollars worth of machinery, for example, is allocated a higher weight than a million dollars worth of dwellings. The implication is that changes in the stock composition from long duration (and low rate of return) to short duration (and high rate of return) capital goods represent an increase in the quality of capital. The final step is to construct a capital input index by combining the quantity of each asset with its share in the total returns to capital as in expression 6.

The ratio between the capital input and the capital stock provides a measure of the capital's composition changes or "quality" of capital. However, the idea that technological change embodied in capital is captured by increases in the "quality" of capital lacks consensus and has been rejected by Alwyn Young and Moses Abramovitz and Paul David, who consider that technological progress embodied in capital will appear in the "residual."[22]

An additional difficulty involved establishing the initial level of capital stock (C_0) for each type of asset *j* in our PIM estimate. We derived this initial stock by assuming that the growth rate of investment during the 1850s was representative of the growth rate of investment prior to 1850.[23] Algebraically,

$$C_{0j} = I_{0j} / (\delta + g) \tag{11}$$

where *C* is the capital stock, *I* the investment rate, δ the depreciation rate, and *g* the rate of growth between 1850–1854 and 1855–1859 for each type of asset *j*. However, it seems plausible that the growth of investment was significantly slower before the 1850s (the decade in which railroads were introduced in Spain) and we have consequently assumed that the initial capital stock would have been twice as high as the figure derived from this computation.[24]

[22] Young, "Tyranny of Numbers," p. 649, argues that if each input *i* is assumed to be identical over time, then increases in the efficiency of the input will appear in the "residual," as happens in our case. Cf. Abramovitz and David, "Two Centuries," p. 23; and Hulten, "Measurement of Capital," p. 134 and "Growth Accounting."

[23] Baigés, Molinas, and Sebastián, *Economía española*; and Young, "Tyranny of Numbers."

[24] This correction in the initial assumption 11 reduces the contribution of capital to GDP growth and, hence, increases that of TFP. Nonetheless, the effect of the assumption about the initial capital stock fades away over time. Cf. Prados de la Escosura and Rosés, "Capital Accumulation."

TABLE 1
CAPITAL STOCK AND INPUT GROWTH, 1850–2000
(annual average logarithmic rates in percent)

	(I) Capital Stock	(II) Capital Input	(III) Capital Quality
1850–2000	3.5	3.7	0.2
Panel A			
1850–1950	2.7	2.8	0.2
1951–1974	6.0	6.4	0.4
1975–2000	4.5	4.7	0.1
Panel B			
1850–1883	3.6	4.0	0.3
1884–1920	2.3	2.4	0.1
1921–1929	3.5	3.9	0.4
1930–1952	1.6	1.5	–0.1
1953–1958	4.5	4.9	0.5
1959–1974	7.0	7.4	0.4
1975–1986	4.5	4.5	0.0
1987–2000	4.6	4.8	0.2

Note: The long periods in Panel A derive from structural breaks in a trend stationary GDP. Phases in Panel B are obtained as deviations from the trend in GDP (Prados de la Escosura, "Growth"). Growth rates are average annual logarithmic rates of change over periods delimited by peak years.
Sources: See the text and Prados de la Escosura and Rosés, "Capital Accumulation."

Finally, the long-run interest rate was used to approximate the rate of return on capital under perfect competition.[25] Table 1 presents the evolution of capital stock and input from 1850 to 2000.[26]

As Table 1, Panel A, shows, the capital input and stock do not follow a steady path. Expansion was more intense during the Golden Age, but did not return to the pre-1950 path of growth thereafter. Different phases of growth can be distinguished that, with the exception of the decade of transition to democracy (1975–1985), match GDP performance (Table 1, Panel B). After an initial period of intense progress up to the early 1880s, capital growth slowed down until World War I, resumed in the 1920s, and

[25] As a proxy for the long-term interest rate, we used the internal rate of return for private assets for the period since 1954 that comes from the MOISSES and BDMORES databases (Dabán et al., "Base de datos"), while the corporate rates of return were employed for 1880–1954 (Tafunell, "Rentabilidad financiera"), and the net rate of return on public debt for 1850–1880 (Tafunell, "Empresa y bolsa").

[26] Three long periods: 1850–1950, 1951–1974, and 1975–2000, can be established in Panel A using the structural breaks in Spanish trend stationary GDP growth (Prados de la Escosura, "Growth"). In Panel B, long swings are estimated as deviations from the established trend in GDP. Growth rates are measured as average annual logarithmic rates of change over periods delimited by peak years.

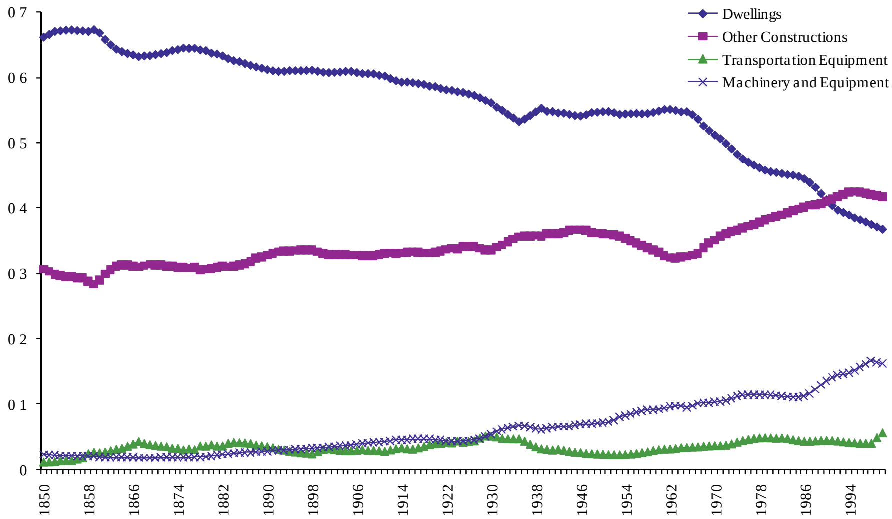

FIGURE 1
THE COMPOSITION OF CAPITAL STOCK, 1850–2000 (1995 pesetas)
(percent)

Source: Prados de la Escosura and Rosés, "Capital Accumulation."

was interrupted from the 1930s to the early 1950s. Since the early 1950s capital accumulation grew at a faster and steadier pace, with a big spurt in the years 1959–1974.

Changes in the composition of capital from residential construction toward nonresidential structures and, especially, machinery and equipment (Figure 1) increased the services provided by the capital stock and reflected a growing gap between the growth rates of capital input and stock (the so-called *quality* of capital) that rose in phases of fast capital growth (Table 1, column 3 and Figure 2). Three periods stand out in which capital quality grew more rapidly than the long-run trend: from the mid-1850s to the early 1880s, when foreign capital was invested in the railroads construction and in mining; the 1920s, when a new wave of foreign capital inflow and the electrification of Spanish economy took place; and the Golden Age (1953–1974), in which Spain completed electrification and replaced the old vintage capital after two decades of international isolation during the Great Depression, the Civil War (1936–1939), and the early Franco regime. It is worth noting that in spite of receiving a large influx of foreign capital since its accession to the European Union (1986), the "quality" of capital did not rise above the

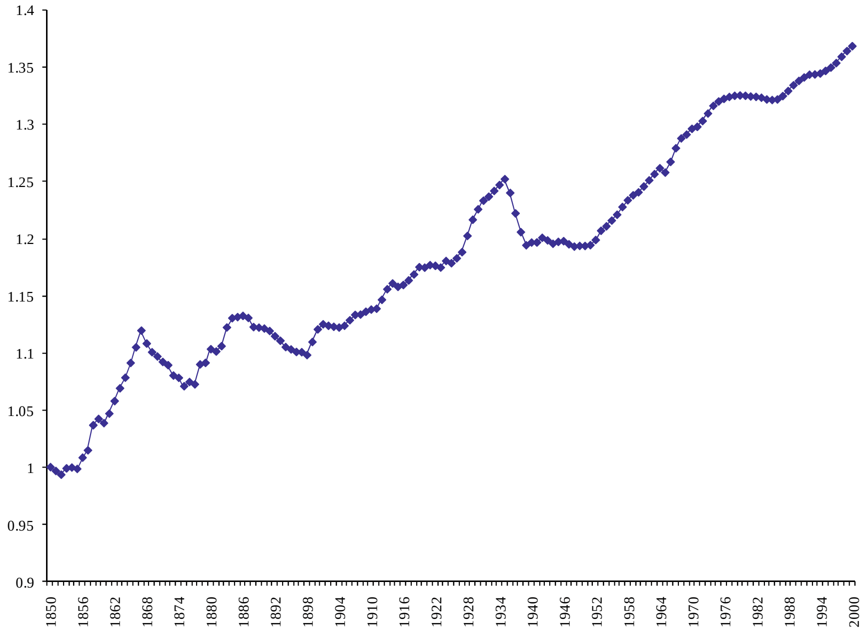

FIGURE 2
QUALITY OF CAPITAL, 1850–2000 (1850 = 1)

Note: By quality of capital is meant the ratio between the capital input and the capital stock. An increase in the quality of capital represents changes in the stock composition from long duration (and low rate of return) to short duration (and high rate of return) capital goods.
Source: Prados de la Escosura and Rosés, "Capital Accumulation."

historical trend rate over 1986–2000, suggesting a weak and delayed impact of information technology.[27]

Land Input

Often in growth accounting exercises land is considered together with the capital stock because it is hard to determine the actual amount of land in use.[28] Establishing the price of unimproved land, which is the relevant one, is also a major obstacle since the market price of land includes improvements, which are a capital input. Nonetheless, following the usual

[27] See Mas and Quesada, "ICT and Economic Growth"; and Timmer and van Ark, "Information and Communication Technology."
[28] Cf. Matthews, Feinstein, and Odling-Smee, *British Economic Growth*, p. 205; and Maddison, "Growth and Slowdown," p. 660. In Spain, San Juan, *Eficacia y rentabilidad*, does not distinguish between land and capital and includes land in the capital stock.

practice in historical research, we consider land as an independent factor of production.[29]

Since we found it impossible to distinguish the part that corresponded to capital incorporated into the improved land, we settled for a crude estimate of the land stock. The first step was to elaborate yearly figures for the stock of land. Unfortunately, estimates for total agricultural land only exist at some benchmarks before the late 1950s that we have interpolated to derive annual figures and, then, adjusted for the economic cycle with the deviations from the Hodrick-Prescott trend in agricultural output.[30] Next, we converted hectares of land into a stock by weighting each type of land by its price at two different benchmark years (1931 and 1985) and splicing the resulting quantity indices into a single Laspeyres index for the entire period considered.[31] Since the land stock grew little over the long run (Table 2), and certainly much less than capital and labor, its inclusion in the growth accounting exercise pushes TFP growth upwards.[32]

Labor Input

The appropriate measure of labor input is the flow of services for production emanating from this factor.[33] Hence, our task is to estimate

[29] See, for example, Crafts, *British Economic Growth*; and Antrás and Voth, "Factor Prices." Bosworth and Collins, "China and India," also include land as an independent factor for present-day developing countries.

[30] The benchmarks correspond to the following years, 1834, 1860, 1891–1895, 1897–1901, 1909–1913, 1920–1922, 1929–1933, 1950, and 1958. The sources from which our estimates have been constructed are Garrabou and Sanz, *Historia Agraria*, for 1834 and 1860; Simpson, *Spanish Agriculture*, for 1891–1895 to 1929–1933; Banco Urquijo, *Riqueza*, for 1920; and O'Brien and Prados de la Escosura, "Agricultural Productivity," background computations, for 1891–1980; Hayami and Ruttan, *Agricultural Development*, and Prasada Rao *Intercountry Comparisons*, provide international comparable aggregate land estimates for 1960 and at five year benchmarks for 1970–1990, respectively. Fortunately for main crops (major cereals, roots, fruit trees, vine and olive) annual figures are available (Barciela et al., "Sector agrario"). Agricultural output comes from Prados de la Escosura, *Progreso*.

[31] Indices with fixed weights (land prices) for 1931 and 1985 were respectively constructed for 1850–1958 and 1958–2000 and, then, spliced into a single quantity index of the stock of agricultural land. Land prices for 1931 and 1985 come from Bringas, *Productividad de los Factores*; and Ministerio de Agricultura, *Estadística Agroalimentaria*, respectively. There are minor differences between the stock estimates (Laspeyres index) and the number of hectares index at least until the 1960s, which suggests that only minor composition changes took place over the first hundred years considered.

[32] Contrary to Matthews, Feinstein, and Odling-Smee's *British Economic Growth*, p. 206, suggestion, adding land reduces factor input growth and, hence, increases that of TFP.

[33] It is usually assumed that such a flow is proportional to the hours of work involved. That is,

$$L_t = \lambda H_t, \tag{12}$$

TABLE 2
CHANGE IN THE LAND STOCK, 1850–2000
(annual average logarithmic rates in percent)

1850–2000	0.2
Panel A	
1850–1950	0.2
1951–1974	1.0
1975–2000	–0.4
Panel B	
1850–1883	0.1
1884–1920	0.8
1921–1929	1.0
1930–1952	0.2
1953–1958	–2.2
1959–1974	1.0
1975–1986	–1.0
1987–2000	0.1

Sources: See the text and note to Table 1.

the labor force cross-classified by as many attributes as possible to capture its heterogeneity. Although census and survey data from 1850 to 1954 do not make it possible to match a worker's individual income with his or her age or education, we have been able to classify the population by gender, two different age attributes (adult, child), branch of activity, income, and hours worked.[34] The first step in the construction of labor input series was to put together yearly employment figures for the four main sectors of the economy (agriculture, forestry, fishing, industry construction, and services) on the basis of population censuses.[35] Employment in these four large sectors was then distributed into their branches. Up to 1955 population censuses allowed us to cross classify working population into 19 industries up to 1900, 21 industries for

where L is labor input in year t, H is the measured work hours, and λ_i is a constant which transforms the quantity of labor into its services.

[34] As a sensitivity test, in Prados de la Escosura and Rosés, "Proximate Causes," we provide alternative labor input estimates on the basis of educational attainment data.

[35] Major shortcomings in Spanish census data had forced us to make some tough choices. The economically active population (EAP) is only available at benchmark years. Yearly EAP figures were obtained through log-linear interpolation of observations from census years. Later, employment for each major sector of economic activity was derived by adjusting yearly EAP series to the economic cycle. Since female EAP figures for agriculture are inconsistent across censuses, women in agriculture were assumed to allocate their time in a way that made female labor a fixed fraction of male labor in the agricultural sector. Moreover, agricultural male EAP figures at census years were corrected by assuming that the share of male EAP in agriculture was proportional to the share of rural in total population. A detailed discussion is offered in Prados de la Escosura and Rosés, "Proximate Causes."

1900–1910, 22 for 1911–1950, and 24 thereafter.[36] Lack of data for 1850–1900 forced us to breakdown manufacturing employment into its branches by assuming that its distribution in 1900 was representative of the entire period.[37]

The second step was to convert the data on the number of workers into days and then hours worked per year for the period 1850–1954. We assumed that each full-time worker was employed 270 days per annum in industry and services. Such a figure results from deducting Sundays and religious holidays plus an allowance for illness.[38] This assumption is consistent with contemporary testimonies and supported by the available evidence.[39] In agriculture, however, contemporary and historians' estimates point to a lower figure for the working days per occupied.[40] Throughout most of the nineteenth and early twentieth century, peasants were only fully employed during the summer; they were idle for up to four months every year and worked outside agriculture. Therefore, we assumed that each male worker devoted 240 of his 270 days to farming and the 30 remaining days to services. The resulting figures for hours per worker/year declined over time (Figure 3) and varied greatly.[41]

[36] Population censuses are available in Spain for 1860, 1877, 1887, 1900, 1910, 1920, 1930, 1940, and 1950.

[37] Unfortunately, we cannot carry out a sensitivity test for the consequences of such an arbitrary assumption. However, since agriculture and services provided most of the employment prior to 1900 (above 80 percent), the bias introduced by our assumption should not be very large. The fact that the number of hours worked across manufacturing industries did not change significantly during the late nineteenth century also works to reduce the size of the bias. Employment data on mining and construction is drawn from Chastagnaret, *L'Espagne*; and Prados de la Escosura, *Progreso*, respectively.

[38] Interestingly enough, a similar number of days is obtained for the 1960s and early 1970s. For example, for 1973, the Conference Board, on the basis of OECD data, estimated 2,005 hours worked per person in Spain, while ILO reckoned that, on average, Spanish workers spent 44.2 hours per week at their place of work. This means that, on average, Spaniards worked 272 days per year. See Prados de la Escosura and Rosés, "Proximate Causes."

[39] Soto Carmona, *Trabajo industrial*, p. 608, pointed out that, on average, the number of days worked per occupied up to 1919 ranged between 240 and 270.

[40] Day laborers, according to García Sanz, "Jornales agrícolas," p. 63, worked an average of 242 days per year in mid-nineteenth-century Spain. Gómez Mendoza, *Ferrocarriles*, p. 101, estimated that a farm laborer worked 210 days out of 300 working days per year in the late nineteenth century. Vandellós, "Richesse et Revenue," reckoned that, in 1914, the average number of days worked per year in agriculture was 250. Simpson, "Technical Change," estimated labor requirements in Andalusia's agriculture between 1886 and 1930 and obtained even lower figures, ranging from 108 to 130 days.

[41] For the pre-1954 era, our main sources are Caballero, *Memoria*; Huberman, "Working Hours"; Domenech, "Working Hours"; Silvestre, *Migraciones*; and Soto Carmona, *Trabajo*. See the detailed explanation in Prados de la Escosura and Rosés, "Proximate Causes."

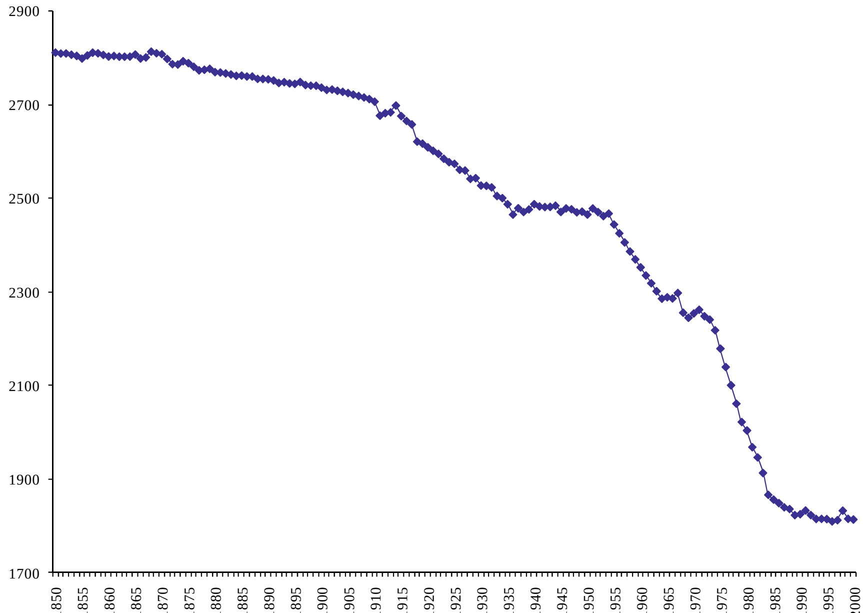

FIGURE 3
HOURS PER WORKER-YEAR, 1850–2000
(semilog scale)

Note: See the text and Prados de la Escosura and Rosés, "Proximate Causes."

The amount of labor, measured by total hours worked, presents a moderate increase over the long run (Figure 4).[42] Labor force grew moderately up to World War I while it accelerated during the 1920s and early 1930s, partly as a result of population growth and rural-urban migration. Labor quantity rose again during the Golden Age (1951–1974). The "transition to democracy" decade (1975–1986) witnessed a dramatic employment destruction driven by the oil shocks and the exposition of traditionally sheltered industrial sectors to international

[42] For the post-1954 period, labor force data comes from the MOISSES database (1954–1963), Instituo Nacional de Estadística (INE), *Población Activa* (1964–1980), and from the official national accounts (1980–2000). Fundación BBV, *Renta nacional*, allowed us to distribute labor force across industries. Workers within each industry were, then, distributed into four occupational categories on the basis of Instituto Nacional de Estadística (INE) information. Finally, workers were transformed into hours worked by assuming that, in each sector, all employees worked the same number of hours per year.

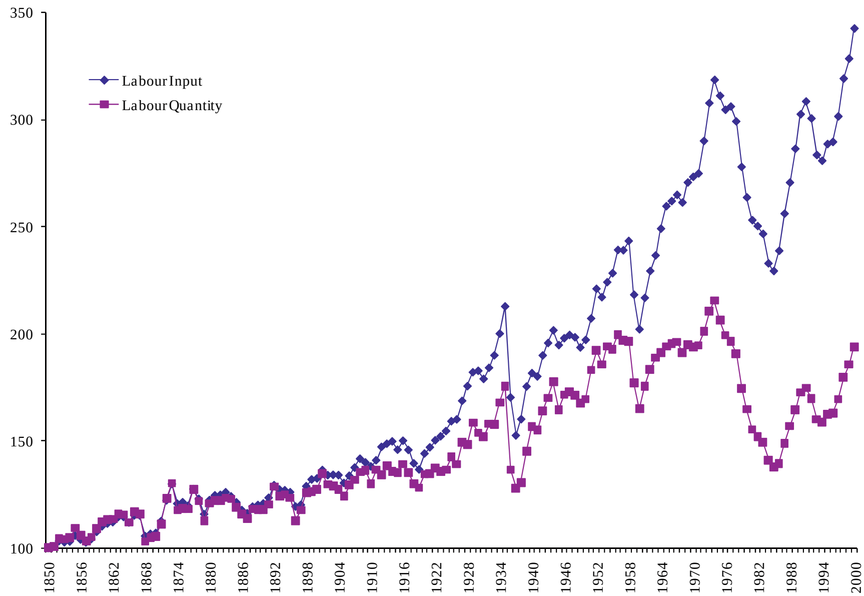

FIGURE 4
LABOR INPUT AND QUANTITY, 1850–2000 (1850=100)
(semilog scale)

Notes: Labor quantity is the unweighted hours worked. Labor input, adds labor quantity and labor quality, which measures skills or human capital.

competition. Labor market deregulation, a marked increase in female participation rate, and the arrival of immigrants—only in the last decade of the twentieth century—are beneath the rise in employment since 1987. Population growth and the decline in hours per worker explain, in a proportion of two to one, most of the moderate increase in the labor quantity over the long run. Hours per worker and per year shrank from 2,800 at mid-nineteenth century to 1,800 by the end of the twentieth century (Figure 3).[43]

Throughout the hundred and fifty years of modern economic growth considered here, the rise of the quantity of labor measure in the total amount of hours worked was mainly determined by population growth.

[43] The decline in the number of daily hours worked per occupied led Denison (*Sources*) to introduce the caveat that the effort per hour was inversely related to the number of hours worked. Employment rather than hours worked then becomes the relevant indicator of the quantity of labor in growth accounting (Gordon, "U.S. Economic Growth," p. 124). Here, however, we follow the conventional approach and use total hours worked as a measure of the labor quantity.

However, a closer look reveals how other factors at work conditioned its evolution across different long swings. For example, the declining hours per worker/year over 1914–1936, a result of the gradual adoption of the eight hours per day standard associated to increasing urbanization and structural change. In the 1920s falling hours per worker went hand-in-hand with a significant increase in the employment rate, also linked to structural transformation. Between the early 1930s and 1950s the rising share of the working-age population, a result of the demographic transition, made up for the contraction in participation and employment rates. In the Golden Age, the growth in total hours worked was slowed by a significant fall in annual hours worked per employed person and a rise in the dependency rate (the ratio of nonworking to working-age population). Later, during the "transition to democracy" (1975–1986), a dramatic contraction in the quantity of labor took place as a result of the surge in unemployment, a fall in the participation rate, and a decline in yearly hours per worker. Since Spain's entry in the European Union (1986), the brisk recovery in the participation and employment rates help explain the increase in the total hours worked.

The third phase in the construction of the labor input is to weight each category of workers by its average nominal earnings.[44] The quality and availability of wage data necessary to construct these estimates vary enormously through time.[45]

Figure 4 reports the evolution of labor input and labor quantity (unweighted hours worked) from 1850 to 2000. Although the evolution of labor input generally parallels that of labor quantity, the labor input does grow more rapidly because of shifts in labor composition ("quality"), which capture improvements in workers' skills and, hence, human capital.[46] Three phases stand out in the evolution of the labor input: the 1920s, the Golden Age, and 1986–2000 (Table 3). Labor quality improvements contributed significantly to labor input growth in the interwar and the Golden Age and compensated for a decline in labor quantity during the "transition to democracy" (1975–1986). But it added little following Spain's accession to the European Union in 1986.[47]

[44] For self-employed workers, we have assumed that their labor cost was equal to those of the average worker in their industry (Cf. Prados de la Escosura and Rosés, "Wages").

[45] Due to data availability, four periods have been considered, 1850–1908, 1908–1920, 1920–1954, and 1954–2000. See Prados de la Escosura and Rosés, "Proximate Causes," for a discussion of the sources and procedures used to computing wage earnings.

[46] Labor quality is derived as the ratio between the labor input and the labor quantity.

[47] This counterintuitive result for the post-1986 period raises the question of whether our labor input measure using the Jorgenson approach actually captures improvements in human capital affecting the labor force. Since human capital is usually approximated through education measures, we have constructed alternative estimates of the quality of labor using educational attainment. The results are similar. Our alternative human capital measure used data on age

TABLE 3
LABOR QUANTITY, QUALITY, AND INPUT GROWTH, 1850–2000
(annual average logarithmic rates in percent)

	(I) Labor Quantity	(II) Labor Quality	(III) Labor Input [(I)+(II)]
1850–2000	0.4	0.4	0.8
Panel A			
1850–1950	0.5	0.2	0.7
1951–1974	1.0	1.0	2.0
1975–2000	–0.4	0.7	0.3
Panel B			
1850–1883	0.6	0.1	0.7
1884–1920	0.2	0.1	0.4
1921–1929	1.8	0.8	2.6
1930–1952	0.8	0.0	0.8
1953–1958	0.4	1.2	1.6
1959–1974	0.6	1.1	1.7
1975–1986	–3.6	1.2	–2.4
1987–2000	2.4	0.2	2.6

Note: Labor Quantity is the unweighted hours worked; Labor Quality, improvements in labor's skills (human capital); Labor Input, which adds up labor quantity and quality, is the flow of services emanating from labor.
Sources: See the text and Prados de la Escosura and Rosés, "Proximate Sources," and the note to Table 1.

Factor Shares

In addition to the real factor inputs described above, we need to know the elasticity of output with respect to each input (θ_i) in order to compute the sources of growth. Under the restrictive assumption of perfect competition and constant returns to scale, these elasticities can be proxied by the share of each factor's returns in national income. Such an assumption might be objectionable as restrictions on competition and monopolistic practices are common in Spanish history.[48] If monopolists earned rents, our "naive" results (obtained under the assumption of

structure (as a measure of experience) and years of education attained, calibrated with the parameters from a Mincer equation for Spain in the early 1990s. The results agree with our figures except for the 1920s, when educational attainment figures show no improvement. However, our labor quality estimates seem to be more consistent with the evidence on growth and structural change for the 1920s. There are also discrepancies for the period 1987–2000, when the labor quality shows a higher growth (0.9 percent) in the Mincer approach than in our approach (0.2 percent). See Prados de la Escosura and Rosés, "Proximate Causes," for a more detailed discussion.

[48] Cf. Fraile, *Industrialización* and *Retórica*.

perfect competition) would bias total factor productivity growth.[49] Yet, even if this were the case, our results (as we shall see) would not be significantly altered.

Up to 1954 labor returns were directly estimated. From 1954 onwards we derived factor shares from the official national accounts that we previously spliced together.[50] To measure labor income correctly, it is crucial to establish what proportion of the income of proprietors, unpaid family workers, self-employed, and retired workers represent returns to labor.[51] We have assumed that entrepreneurs and self-employed workers have a labor income equal to the average compensation of employees in their corresponding industry.[52] Dividing total labor (including self-employed) compensation by GDP, we obtained the share of labor. The lack of information on land rents forced us to derive the land share as the residual after deducting labor outlays from agricultural gross value added. This method implies no returns to capital from agriculture and, hence, tends to overstate the share of land in GDP.[53] The share of capital was then obtained as a residual after deducting labor and land returns from GDP at factor costs.[54]

Figure 5 shows the evolution of the shares of land, capital, and labor in GDP. On average, for the one-and-a-half centuries considered, our factor shares are 0.08 for land, 0.24 for capital—that is, 0.32 for property—and 0.68 for labor, that roughly match the 1/3 and 2/3 weights conventionally employed in growth literature. Average shares vary, with labor fluctuating around two-thirds, except in the phase of accelerating growth, 1959–1974, and during the critical years of the "transition to democracy," 1975–1986 (Table 4). Interestingly, the peak of labor share corresponds to years in which skilled workers represented a larger proportion of the labor force and income inequality was lower.[55]

[49] Relaxing the assumption of constant returns to scale will also affect our TFP estimates, for our "residual" would overexaggerate TFP growth if the Spanish aggregate production function exhibits increasing returns to scale (Young, "Tyranny of Numbers," p. 648). Suárez, "Economías de escala," rejects increasing returns for Spain between 1965 and 1990.

[50] See Prados de la Escosura and Rosés, "Proximate Causes."

[51] See Prados de la Escosura and Rosés, "Wages."

[52] Kuznets, *Modern Economic Growth*. This is a common procedure in growth accounting (Jorgenson, "Productivity").

[53] Because the agricultural sector shrank in importance during the second half of the twentieth century, the resulting upwards bias in our TFP growth estimates should not be large.

[54] Although we have estimated the sources of growth using three independent factors of production land, capital, and labor, in Prados de la Escosura and Rosés, "Proximate Causes," we replicate the computation using only capital and labor.

[55] Prados de la Escosura, "Inequality, Poverty." A rise in income inequality took place in the late 1990s, partly resulting from an improvement in the returns to property income (Alvaredo and Saez, "Income and Wealth").

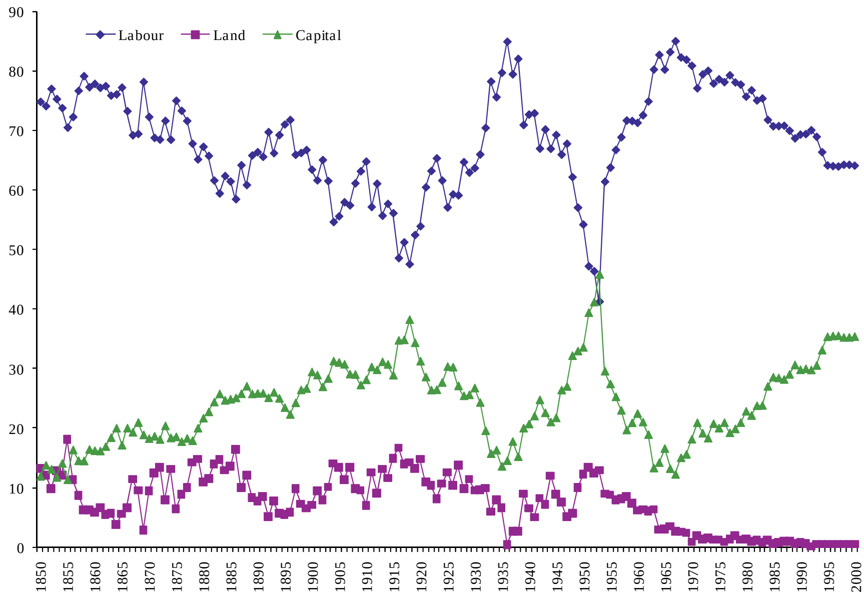

FIGURE 5
FACTOR SHARES IN GDP, 1850–2000
(percent)

Note: See the text and Prados de la Escosura and Rosés, "Proximate Causes."

The relative instability of the factors shares contrasts with the conventional assumption of stability. This is largely a consequence of data limitations, but the share fluctuations can be explained. Between mid-nineteenth century and World War I, the growing importance of capital can be attributed to rising investment rates and technological change favoring capital. The rise in inequality (from the late 1890s to the end of World War I) coincided with a return to strict protectionism, which favored land owners.[56] In the interwar years, the labor share grew significantly. Institutional labor market reforms favoring workers, especially the reduction in the number of working hours per day and the increasing voice of trade unions, contributed to a rise in wages relative to property incomes. Also the increase in the human capital endowment of the workforce influenced the expansion of labor. The early years of Franco's regime witnessed a sharp decrease in the labor share, an

[56] See Sánchez-Alonso, "European Emigration."

TABLE 4
AVERAGE FACTOR SHARES, 1850–2000
(percent)

	(I) Capital	(II) Land	(III) Labor
1850–2000	24.0	7.5	68.4
Panel A			
1850–1950	23.4	9.7	66.9
1951–1974	22.2	5.7	72.1
1975–2000	28.1	0.8	71.1
Panel B			
1850–1883	17.7	9.9	72.4
1884–1920	28.3	10.6	61.1
1921–1929	27.5	10.9	61.6
1930–1952	23.9	7.8	68.4
1953–1958	28.4	9.2	62.3
1959–1974	17.6	3.5	78.9
1975–1986	23.1	1.1	75.8
1987–2000	32.4	0.6	67.1

Sources: See the text and note to Table 1.

outcome of dictatorship's economic policy that implied a redistribution of income towards property owners. Since the mid-1950s a rapid increase in labor share took place that peaked by the late 1960s, when pre-Civil War levels were recovered. The elevated labor shares reflected human capital accumulation and the more liberal economic policies that accompanied growth and structural change in the late Francoist regime. Since the early 1970s, however, the capital share in GDP has tended to grow at expenses of labor.

MAIN TRENDS IN TOTAL FACTOR PRODUCTIVITY

The sources of long-run growth in Spain are displayed in Table 5.[57] Over the one-and-a-half century considered, TFP and broad capital (physical and, to less extent, human capital) appear to be equally responsible for GDP growth. The early 1950s represent a divide between a hundred years of moderate growth dominated by factor accumulation, and half a century of fast growth led by total factor productivity, with 70 percent of the more rapid GDP growth after 1950 coming from efficiency gains.

[57] In Prados de la Escosura and Rosés, "Proximate Causes," we have carried out a growth accounting using fixed factor shares (their average over the hundred and fifty years considered here) as a sensitivity test. It turns out that the alternative use of fixed factor shares across long swings does not greatly change the results.

TABLE 5
SOURCES OF GDP GROWTH, 1850–2000
(annual average logarithmic rates in percent)

	(I) GDP	(II) Land	(III) Capital Stock	(IV) Capital Quality	(V) Labor Quantity	(VI) Labor Quality	(VII) TFP
1850–2000	2.5	0.0	0.8	0.1	0.3	0.3	1.1
Panel A							
1850–1950	1.4	0.0	0.6	0.0	0.3	0.1	0.3
1951–1974	6.5	0.1	1.2	0.1	0.7	0.8	3.7
1975–2000	3.0	0.0	1.2	0.0	–0.4	0.5	1.7
Panel B							
1850–1883	1.8	0.0	0.6	0.1	0.5	0.0	0.6
1884–1920	1.3	0.1	0.6	0.0	0.1	0.1	0.2
1921–1929	3.8	0.1	1.0	0.1	1.1	0.5	1.1
1930–1952	0.8	0.1	0.5	0.0	0.4	0.0	–0.1
1953–1958	4.7	–0.2	1.3	0.1	0.2	0.8	2.4
1959–1974	6.9	0.1	1.2	0.1	0.5	0.9	4.2
1975–1986	2.5	0.0	1.0	0.0	–2.8	0.9	3.4
1987–2000	3.5	0.0	1.5	0.1	1.6	0.2	0.2

Sources: See Tables 1–4 and the text and note to Table 1.

A closer look at long swing intervals reveals that prior to 1950, total factor productivity played a far from negligible role in 1850–1883 and the 1920s (Table 5). As a source of growth, TFP may actually be underestimated as it does not include the additional capital accumulation that results from a productivity increase.[58]

Total factor productivity led GDP growth during 1953–1986, a period that included both the Golden Age and the decade of sluggish growth during the transition from dictatorship to democracy. TFP contributed to more than half of GDP growth during the Golden Age, and two-thirds to its acceleration over the previous hundred years, a large role by historical standards. In fact, about two-thirds and four-fifths of the acceleration in GDP growth in 1953–1958 and 1959–1974 over the previous long swings (1930–1952 and 1953–1958, respectively) were due to TFP, and in 1975–1986 efficiency gains prevented a GDP contraction. Since Spain has joined the European Union (1986), employment creation and the recovery of physical capital accumulation has offset the slowdown in total factor productivity.

How do our results compare with those of empirical economists for the post-1964 era? A glance at Table 6 suggests that our growth rates

[58] See Hulten and Srinivasan, "Indian Manufacturing."

TABLE 6
TFP GROWTH, 1965–2000: ALTERNATIVE ESTIMATES
(annual average logarithmic rates in percent)

	1965–1974	1975–1986	1987–2000
Myro	4.1	2.6	
Suárez	3.8	1.6	
Hofman (raw)		1.6	
Hofman (adjusted)		0.4	
Cebrián	4.2		
Mas and Quesada*			–0.6
Timmer, Ypma, and van Ark*			0.4
Our estimates	3.7	3.4	0.2

* Excluding residential structures from capital input.
Sources: Suárez, "Economías de escala"; Hofman, "Economic Development": 256, 1973–1989; Myro, "Evolución de la productividad": 1966–1974, 1975–1981; Cebrián, "Fuentes del crecimiento": 1964–1973; Timmer and Van Ark, "Information and Communications Technology"; Mas and Quesada, *Nuevas tecnologías*: 283, 1985–2002; for our estimates, see Table 5 and the text.

are in line with those available for 1965–1974 and for 1987–2000. And they too suggest that TFP growth slowed after Spain's admission into the European Union.

Modern economic growth is associated with improvements in GDP per head but, so far, the discussion has been focused on absolute GDP trends. We need, therefore, to establish the connection between increases in per capita GDP and efficiency gains. Table 7 provides an intermediate stage, namely, the decomposition of output per head into hours per person and output per hour. Although hours worked per person declined in the long run trend, the 1920s and the post-1986 years show a marked increase in the labor quantity per head. Labor productivity, in turn, grew at a modest pace before 1920 and since 1987, and stagnated in the 1930s and 1940s. But it experienced impressive gains between 1953 and 1986. Sluggish labor productivity lies beneath weak improvements in GDP per head, with the exception of the last quarter of the twentieth century when labor quantity and productivity evolve inversely. Hours worked dropped during the "transition to democracy," but the decline was more than offset by the productivity surge associated to industrial restructuring and shifts of resources away from agriculture and traditional industrial sectors. Since 1987 the productivity slowdown has been compensated by a strong increase in hours worked. As Riccardo Faini put it for the Euro zone, Spain seems to have been unable to combine employment and productivity growth since the mid-1970s.[59]

[59] Faini, "Europe," p. 80.

TABLE 7
PER CAPITA GDP GROWTH AND ITS COMPONENTS, 1850–2000
(annual average logarithmic rates in percent)

	(I) Per Capita GDP	(II) Hours Worked/Population	(III) GDP per Hour Worked
1850–2000	1.9	–0.2	2.1
Panel A			
1850–1950	0.8	–0.1	0.9
1951–1974	5.5	0.0	5.5
1975–2000	2.6	–0.8	3.4
Panel B			
1850–1883	1.4	0.2	1.2
1884–1920	0.7	–0.3	1.0
1921–1929	2.8	0.8	2.0
1930–1952	0.0	0.0	0.0
1953–1958	3.9	–0.5	4.3
1959–1974	5.8	–0.5	6.3
1975–1986	1.8	–4.4	6.1
1987–2000	3.3	2.2	1.1

Sources: See the text, Prados de la Escosura and Rosés, "Proximate Sources," and the note to Table 1.

Labor productivity trends are determined, in turn, by human and physical capital/labor ratios and efficiency gains. Table 8 provides the decomposition of labor productivity growth. The main result is that TFP accounts for half the increase in labor productivity over the one-and-a-half centuries considered. Furthermore, the fluctuations in labor productivity growth parallel changes in TFP.

CONCLUSION

The main arguments of the article can now be restated. First of all, factor accumulation, especially capital, and TFP growth seem to have been complementary for GDP and labor productivity growth over the long-run Spanish experience suggests a two-stage process in which improving efficiency appears as a complex learning process that takes place once growth has been initiated by allocating additional capital and labor to production.[60] Abstention, rather than ingenuity, dominated

[60] New investment opportunities that increase capital accumulation as a result of technological change and exogenous increases in investment that raise TFP growth as new capital vintages appear offer ways for their interaction (Crafts, "Productivity," pp. 522–23). As Collins and Bosworth, "Economic Growth," p. 164, point out, technical advances might be

TABLE 8
SOURCES OF LABOR PRODUCTIVITY GROWTH, 1850–2000
(annual average logarithmic rates in percent)

	(I) GDP per Hour Worked	(II) Land	(III) Capital Input	(IV) Labor Quality	(V) TFP
1850–2000	2.1	0.0	0.8	0.2	1.1
Panel A					
1850–1950	0.9	0.0	0.5	0.1	0.3
1951–1974	5.5	0.0	1.2	0.6	3.7
1975–2000	3.4	0.0	1.4	0.4	1.7
Panel B					
1850–1883	1.2	–0.1	0.6	0.0	0.6
1884–1920	1.0	0.1	0.6	0.1	0.2
1921–1929	2.0	–0.1	0.6	0.5	1.1
1930–1952	0.0	0.0	0.2	0.0	–0.1
1953–1958	4.3	–0.2	1.3	0.8	2.4
1959–1974	6.3	0.0	1.2	0.9	4.2
1975–1986	6.1	0.0	1.9	0.9	3.4
1987–2000	1.1	0.0	0.8	0.1	0.2

Sources: Column I is derived from Table 7. For other figures, see Table 5 and the text and note to Table 1.

long-run growth in Spain up to 1950. Thereafter, TFP growth, a "free lunch" to use Joel Mokyr's words, drove economic progress. Our results therefore run counter to P. Krugman's intuition that growth on the basis of capital accumulation ultimately slows.[61]

Second, we accept that our growth accounting yields only a range of best estimates and that our coverage of factor accumulation is far from perfect. However, it is important not to exaggerate the skepticism. Alternative measures of factor accumulation and factor shares lead to similar results for TFP growth.

Third, our results do not appear unusual in international perspective, where there is growing evidence suggesting that factor accumulation

embodied in new capital, while increasing TFP might induce greater capital accumulation by raising the returns to capital.

[61] Mokyr, *Lever of Riches*, p. 3; and Krugman, "Myth," pp. 77–78. Slower TFP growth since 1986 may, of course, make Krugman's prediction come true in the near future.

[62] Grossman and Helpman, *Innovation and Growth*, p. 26.

[63] Crafts, "Productivity," p. 533.

[64] Kendrick, *Productivity Trends*; and Abramovitz and David, "Two Centuries," p. 35.

[65] Lains, "Catching Up"; and Altug, Feliztekin, and Pamuk, "Sources."

[66] Collins and Bosworth, "Economic Growth," p. 159. Young, "Tyranny of Numbers," pp. 657–61 and "Razor's Edge."

[67] Crafts, "Productivity."

[68] Abramovitz, "Catching Up"; and Collins and Bosworth, "Economic Growth."

prevailed over efficiency gains in the early stages of development. Factor accumulation seems to play a role during the transitional phase to long-run growth.[62] Once modern economic growth is under way, TFP tends to perform a more significant part. Indeed, TFP provided at least one-quarter of British GDP growth between 1780 and 1860, a proportion that increases to three-eighths when embodied technological change is taken into account.[63] Slow TFP growth has also been confirmed for the nineteenth century in the United States.[64] Long-run assessments for countries in the European Periphery such as Portugal and Turkey show similar results.[65] During the last four decades of the twentieth century, developing countries exhibited growth rates dominated by factor accumulation.[66] In modern Spain, as in Britain during the Industrial Revolution, TFP accounted for most of labor productivity acceleration.[67] Does the ability to absorb and to adapt productively foreign ideas and technology depend on a country's development level?[68] Comparative historical research will be needed before this hypothesis can be put to the test.

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