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THE IMPACT OF INVESTMENT IN EDUCATION ON ECONOMIC DEVELOPMENT: SPAIN IN
COMPARATIVE PERSPECTIVE (1860-2000)

ABSTRACT

Throughout the 19th century and until the mid-20th century, in terms of long-term investment in human capital and, above all, in education, Spain lagged far behind the international standards and, more specifically, the levels attained by its neighbours in Europe. In 1900, only 55% of the population could read; in 1950, the figure was 93%. This no doubt contributed to a pattern of slower economic growth in which the physical strength required for agricultural work, measured here through height, had a larger impact than education on economic growth. It was not until the 1970s, with the arrival of democracy, that the Spanish education system was modernized and the influence of education on economic growth increased.

Keywords: employment structure, human capital, educational offer, economic growth.

JEL Codes: I2, I1, J3, J8, N3

Acknowledgements: I would like to thank Xavier Tafunell for providing me with the time series from *Estadísticas Históricas de España* in Excel format, and Mehregan Ameri for her help in obtaining statistically significant results.

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1. INTRODUCTION: THE ROLE OF HUMAN CAPITAL IN ECONOMIC GROWTH

Beginning in the 1960s, with the contributions of Becker (1964), Barro (2011), Lucas (2002), and Barro and Sala i Martin (2004), among others, theoretical economics began to grow more sophisticated, incorporating human capital as an endogenous factor of economic growth. Previously, economic theory had only considered exogenous factors (land, labour and physical capital) as factors of production to be used to analyse growth. Human capital's defining feature is its multiplier effect on the productivity of the labour factor. Moreover, when added to physical capital, it removes the restriction of diminishing returns in the absence of technological change and paves the way for sustained long-term growth even when no exogenous technological change has taken place, thereby altering the characteristics of the production function. Therefore, in keeping with recent work by theoretical economists, human capital has emerged as an important factor for explaining economic growth.

Human capital theory became relevant once access first to primary and secondary education and then to universities became widespread and educational institutions became more accessible. As can be seen in Table 1, this did not occur in most European countries until the 20th century. Among the data shown in Table 1, the differences between the literacy rates in northern

and southern Europe are especially sharp, with the countries in the south registering lower ones. This is typical of underdeveloped agricultural economies, in which there is no need to read manuals or instructions to operate machinery. In the absence of educational institutions, people entered the factory system through the mentoring system and on-the-job training so typical of 19th-century factories, where productivity gains were achieved by dint of daily trial and error.

TABLE 1. LITERACY RATES (%) IN EUROPE

	UK	FRANCE	GERM.	NETH.	SWEDEN	ITALY	SPAIN	RUSSIA
1820	53	38	65	67	75	22	20	8
1870	76	69	80	81	80	32	30	15

Source: Pamuk, van Zanden, 2011.

Human capital theory, as formulated by Becker (1964), is associated with an investment in present-day education with a view to increasing future income. If the education is general, applicable at any company, the worker pays for the cost. If it is specific, useful only to one company, the training costs are shared by the worker and the employer. According to Becker, the greater the value of the investment and the more specific it is in nature, the greater, in relative terms, the resulting increase in future income will be.

As noted, due to its nature, the importance of human capital theory has changed over time. It was not until, above all, the second and third industrial revolutions that it even made sense to apply it. During the second industrial revolution, characterized by the introduction of electricity and combustion engines, the large size of the companies and the revolution this entailed in their management called for the incorporation of educated middle and senior managers in the pay scale. During the second wave of globalization and the third industrial revolution, the increased efficiency of communications and computing brought world markets closer together. Higher levels of education

were required to manage the resulting new business networks, which, in turn, adopted more flexible organization structures. This necessitated the spread of university studies to produce people able to organize and manage industrial production and services in a world in which such things were increasingly complex. In other words, the demand for human capital grew over the course of the 20th century. In contrast, during the first industrial revolution, what mattered most was physical endurance and training to develop manufacturing technologies. Due to the relative abundance of available labour and the few management problems faced by 19th-century factories, they demanded little formal human capital; instead their human capital was mostly informal, the result of on-the-job experience with production.

1.a. Quality of life and the supply of human capital in 19th-century Spain

To estimate the quality of life in Spain, we used one of the main indicators thereof: height. Section 3 will show its impact on real salary levels. Height is a good indicator of the satisfactory or unsatisfactory nature of childhood and adolescent nutrition, as well as of whether the work performed by children is harmful to their health. It is likewise a good indicator of workers' physical resilience with regard to performing jobs that, as noted, required considerable stamina. Recently, Martínez-Carrión, Puche-Gil, and Cabañete-Cabezuelos (2013) have shown a negative correlation between child labour and height. By definition, child labour also has a very high opportunity cost in terms of human capital, as children who are working are unable to attend school. Moreover, in the 19th century, children worked in both agricultural and urban industrial contexts from the age of 7 (Reher and Camps, 1991; Camps, 2011; Borrás, 1996). However, the work was undeniably much harder in the "satanic mills", where the disciplinary standards and material circumstances required people to work non-stop even in the absence of a foreman (Camps, 1995). Such child labour

can be considered a health risk affecting physical growth. In fact, together with income, nutrition, and environmental and hygiene conditions, child labour is one of the most decisive factors in determining height. According to the available evidence on the main European and Spanish industrial regions, the average height of workers decreased during the Industrial Revolution (see Martínez-Carrión et al., 2013, p. 7). The Spanish case has been amply addressed by Martínez-Carrión in several papers showing that average heights in the country's industrial regions fell in the 19th century, in contrast with the evolution of per capita GDP. In other words, one could argue, based on height, that over the 19th century, child labour, among other things, led to a decline in the quality of life in the industrial and mining sectors. Child labour, which also occurred in agriculture, can explain Spain's high illiteracy rates.

With regard to the educational offer, the enrolment rate was 38.1% in 1860 and 47% in 1900 (Nuñez, 2005), primarily at public schools. It is well known that 19th-century Spain suffered from chronic indebtedness, going so far as to mortgage the subsoil as collateral for payment of its foreign debts (Nadal, 1975). In fact, the situation was quite similar to that of today's third-world countries, in which foreign debt and the risk premium prevent the public treasury from making productive investments. Consequently, in this period, the education on offer was insufficient and poor quality, as also reflected by the low literacy rates, all of which further contributed to the lag in the Spanish economy.

1.b. Standards of living and the supply of human capital in the 20th century

The different quality-of-life indicators show a gradual improvement over the course of the 20th century. In fact, mortality and child mortality rates did not begin to fall until the first decade of the 20th century, when a long process of decline began that lasted until 1950, except for the parenthesis of the Spanish Civil War, and determined the characteristics of the demographic transition in Spain (Nicolau, 2005). This in itself indicates that living conditions, nutrition, environmental factors and hygiene improved over the period. Average heights also began to increase, as seen in the size of military recruits, which rose from 163.8 centimetres in 1900 to 168.6 in 1950 to 175.1 in 1980 (Quiroga Valle, 2002; Nicolau, 2005). Although already visible in the first half of the century, this trend towards increased height grew more pronounced in the second half. Thus, quality of life improved in the 20th century, and the trend was even stronger in the second half. This statement can only be sustained over the long term, as there is abundant proof that real wages and economic growth actually fell during the years of autarky that marked the early Francoist period. However, with that caveat, we can say that the trend towards gains in quality of life is a phenomenon associated with the economic transformations of the 20th century (second and third technological revolutions).

Coupled with the aforementioned increase in quality of life, the educational offer also improved. While the gross stock of years of schooling of the generation born in 1901 was 4.6, it had grown to 7.1 for the generation of 1956, and 13 for the generation of 1980. In comparative terms, the achievements of the second half of the 20th century were not modest, as the ground lost in investment in education to date was regained. However, as seen in the previous sections, Spain began with a considerably smaller endowment of human capital. Even if education levels did not manage to converge, the number of students enrolled at secondary schools and university increased considerably, above all in the 1970s, with the start and consolidation of democracy. Nevertheless, as late as 1979, some 17.7% of the country's population still had no formal education (Nuñez, 2005).

2. METHODOLOGY AND SOURCES

To study the relationship between the accumulation of human capital and growth in Spain, we used a methodology based on treating these variables as time series. The historical evolution of most Spanish economic variables can be found, in the form of time series, in the different volumes of *Estadísticas Históricas de España* edited by Albert Carreras and Xavier Tafunell (2005). Specifically, we used the series available for GDP per capita by Prados de la Escosura, for years of schooling by Nuñez, for height by Nicolau, and for real wages by Reher and Ballesteros.

Conducting econometric exercises with time series to find causal relationships is a notoriously complex task. However, in our case the value of the statistics obtained shows the goodness of fit. First, we looked for the impact of height and years of schooling on real wages throughout the 19th century and up until 1930. Then, in a second section, we measured the impact of height and years of schooling on the growth of GDP per capita.

From some perspectives, it has been argued that the variable of the number of years of schooling is only an approximate measure of human capital, as it fails to take into account the evolution of the quality of the education. Sala i Martin has proposed to use the evolution of real wages as a measure of useful quality human capital instead. However, we rejected this option for the Spanish case. During the Franco years in the 20th century, real wages were determined by the government and, thus, were hardly indicative of productivity. Additionally, we used real wages as a measure of income in the 19th century and confirmed the little correlation they had with education levels at a time when, as already noted, the training of human capital in Spain was rare. Consequently, we accepted the estimate of the gross educational stock until the age of 29 reported by Nuñez (2005) to measure the evolution of education in Spain.

To gain a more precise understanding of the evolution of the educational offer and its impact on economic growth, we divided the series into 3 sub-periods: from 1850 to 1930, from 1930 to 1960, and from 1960 to 2000. The

first sub-period encompasses the second half of the long 19th century, which we extended to 1930, so as not to excessively split up the series. The years between 1930 and 1960 were years of economic crisis, followed by the Civil War and Francoism. They should thus be considered separately due to their distinct defining features, which set them apart, in terms of their evolution, from the other segments in the series. The years from 1960 to 2000 saw the start of strong economic growth in Spain and, from the 1970s onward, the modernization of the education system. Additionally, for the purpose of making international comparisons, we used data from the World Bank and Barro-Lee for the same years, which allowed us to measure the degree of Spain's exceptionality or similarity to other OECD countries.

3. REAL WAGES AND HUMAN CAPITAL IN THE LONG 19TH CENTURY

As noted, there is no single series to measure real wages in Spain in the 19th century. We thus chose to use the nominal wages and retail prices series by Reher and Ballesteros (2005) for Madrid. It is one of the most complete series with regard to the construction of the consumer price index, as well as one of the longest, covering the period up to 1930. Table 2 shows the regression results.

TABLE 2. THE IMPACT OF HEIGHT AND SCHOOLING ON REAL WAGES (1860-1930): TIME SERIES REGRESSION

Dependent variable: real wages (1913=1)

Years of schooling	0.06537 (0.03331)*
Height	0.104203 (0.017753)***
Constant	-16.56883 (2.86978)***

N=57

R-squared= 0.4720

Sources: For wages, Reher and Ballesteros (2005); for years of schooling, Nuñez (2005); for height, Nicolau (2005).

The coefficient values in Table 2 show how height and years of schooling had a statistically significant impact on the evolution of real wages, with height being the more influential of the two. A one-centimetre increase in height was associated with a 10.4% increase in real wages, whereas an additional year of schooling was associated with a 6.5% increase in real wages. That is certainly indicative of the impact of the main components of human capital (health and education) on real wages. In an agricultural economy, with little development in industry and services, the primary factor responsible for increasing productivity and, thus, wages was physical strength and health. As noted earlier, the educational system was not very developed and was less necessary to carry out the manual tasks required for an underdeveloped economy like Spain's. We can therefore conclude that, over the course of the 19th century, education was less decisive than height for the increase of labor productivity and real wages. Instead, children took on paid work at young ages and, in the case of industry, were incorporated at the age of 14 into a training system whereby more senior workers taught them how to handle the tools and the factory regulations. The recorded increases in real wages were the result of the

skills that labour acquired through experience and access to training (Camps, 1995). Beginning in the early 20th century, when production processes grew more sophisticated as a result of the introduction of electricity and the rise of big business, some major industrial hubs began to set up technical and vocational schools. Nonetheless, it is clear that in that stage of economic development, the key factor for increasing labour productivity was physical strength rather than education.

4. HUMAN CAPITAL AND ECONOMIC GROWTH

4.1 From 1860 to 1930

Table 3 shows the results for the impact of years of schooling and height on economic growth or the evolution of per capita GDP. As can be seen, the results are quite similar to those shown in Table 2, taking into consideration the fact that the GDP per capita logarithm was multiplied by 100 to obtain the results in terms of percentage increases. In the second half of the 19th century and early 20th century (1860-1930), a one-year increase in schooling was associated with a 5.4% increase in GDP per capita, while an additional centimetre of height was associated with a 12.63% increase in GDP per capita. These magnitudes of increase, like those obtained for real wages, are quite notable and suggest that the Spanish economy could have grown quite a bit in this period. If it failed to do so, it was because of the very modest advances in both height and schooling and, therefore, the unlikelihood that they would act as multipliers of economic growth. As noted earlier, in Spain's industrial and mining regions, average heights even fell as industrialization became more pronounced. Also as previously noted, in 1900, school enrolment stood at less than 50% (specifically, 47%).

Therefore, the stagnation of both factors associated with human capital helps to explain the sluggish evolution of economic growth in this period. Nevertheless, it should likewise be noted that, in terms of economic growth, height and, therefore, physical strength had a higher impact than education.

TABLE 3. IMPACT OF HEIGHT AND SCHOOLING ON GDP PER CAPITA (1860-1930) IN PERCENTAGE TERMS: TIME SERIES REGRESSION

Dependent variable: log GDP per capita * 100 (1913=100)

Years of schooling	5.4902 (2.6999)**
Height	12.6320 (1.4386)***
Constant	-1552.6 (232.5562)***

N=57

R-squared=0.6458

Sources: The data on GDP per capita were taken from Prados de la Escosura (2005); the data on years of schooling, from Nuñez (2005); and the data on height, from Nicolau (2005).

4.2 From 1930 to 1960

The period from 1930 to 1960 was one of major political upheaval. It began with an international economic crisis, albeit one that had less of an impact on Spain due to the relatively low degree of openness of the Spanish economy. Moreover, although Spain was neutral in both World Wars, it

experienced civil war between 1936 and 1939, followed by Francoist autarky and isolation from the competitive forces of the international market. Several authors have underscored how the lack of competition, the closing off from the international market, the lack of foreign exchange to purchase imports, and administrative pricing distorted the market, leading to a period of economic depression during the 1940s and 1950s. With regard to our model, what is important to note are the distortions in the area of human capital formation and their impact on economic growth. As can be seen in Figure 2 of the appendix, the duration of schooling declined in these years. Democratically minded intellectuals, professors and teachers forged in the educational institutions of the Spanish Second Republic were forced to emigrate, leading to a considerable loss of human capital. Public resources, including those addressed to schools and universities, were allocated to regions that shared the dictator's ideology, which were often also the most depressed. This context of administrative allocation of resources noticeably affected the impact of human capital formation on growth.

TABLE 4. IMPACT OF HEIGHT AND SCHOOLING ON GDP GROWTH (1930-1960) IN PERCENTAGE TERMS: TIME SERIES REGRESSION

Dependent variable: log GDP per capita*100

Years of schooling	-10.7164 (2.2842)***
Height	14.7429 (2.1102)***
Constant	-1,811.284 (337.0928)***

N=31

R-squared= 0.6830

Sources: The data on GDP per capita were taken from Prados de la Escosura (2005); the data on years of schooling, from Nuñez (2005); and the data on height, from Nicolau (2005).

The value of the coefficients clearly shows the redistributive effects that took place during the period. The coefficient of the years of schooling variable becomes strongly negative, while that of the height variable becomes strongly positive. As already noted, during the period, the human capital resulting from education during the second Republic was forced to emigrate or go into exile. The decrease of the education acquired at the new Francoist schools and the poor quality thereof had a negative effect on the evolution of GDP per capita. Each additional year of schooling resulted in a 10.7% decrease in GDP per capita. The economies of the most prosperous industrial hubs became depressed, and Spain became more rural and less industrialized. Furthermore, not only the quantity but also the quality of the education changed. Teaching became doctrinaire in order to bind the people ideologically with the regime, while liberal content, based on liberal economics and favouring growth, was eliminated from textbooks and school and university teaching. In light of the data shown in Table 4, it seems clear that the transformations in the Francoist education system also help to explain why the period was one of economic stagnation: education, one of the mainstays of economic growth everywhere, became a force negatively correlated with it.

In contrast, the role of physical strength, measured here through height, was strongly positive, the most positive achieved in the long term throughout the entire period studied. Each additional centimetre of height was associated with a 14.7% increase in GDP per capita. For as the country was deindustrialized, the main economic activities came to focus on the primary sector. In fact, the gains in height over the period were not very noticeable, and that also explains why the final multiplier effect was modest. However, this factor offers a clear glimpse of the new foundations of the Francoist economy. The new planned economy depended on physical strength rather than education for its development. Economic activity shifted to subsistence agriculture and mining, activities for which physical strength is essential. Due to the losses of human capital, export and industrial activities were depressed, all of which helps to explain the sharp decline in economic growth registered during this period.

4.3 From 1960 to 2000

With the beginning of the golden age of capitalism, the Spanish economy rebounded from the strong stagnation of the previous decades. Following the stabilization plans of 1957-1959, the 1960s were marked by growth. Despite the relative lack of export activity, tourism and remittances from emigrants provided the necessary foreign exchange to finance imports. With minor fluctuations, this growth trend lasted throughout the 1970s (which saw the death of the dictator in 1976 and the start of the democratic transition) and 1980s (which saw Spain's entry into the European Economic Community in 1985) up to the year 2000, at the height of the second wave of globalization. Once the transition to democracy had been made, Spain became a more open country, subject to the competitive forces of the global international market.

In this context of economic and political modernization, the impact of the forces that define human capital was also affected. Table 5 shows how the impact of years of schooling on economic growth reached its highest value since 1860 and how, for the first time ever, the coefficients obtained in the time series regression for education are much higher than those obtained for height. The magnitude of the investment in human capital increased (see Figure 2 in the appendix) and, with it, the income and yields resulting from it. Moreover, in this period, the education system was once more transformed, and new universities were founded. In fact, based on the number of university enrolments (Nuñez, 2005), it was not until these decades that higher education became widespread. Furthermore, although average height also grew as a result of the leaps and bounds made by the healthcare system and improved nutrition, it came to play a secondary role in economic growth. As can be seen in Table 5, each additional year of education was associated with a 19.7% increase in GDP per capita, while each additional centimetre of height was associated with a 4.1% increase.

TABLE 5
 THE IMPACT OF SCHOOLING AND HEIGHT ON GDP PER CAPITA (1960-2000)
 IN PERCENTAGE TERMS: TIME SERIES REGRESSION.

Dependent variable: log GDP per capita*100.

Years of schooling	19.47 (6.969)**
Height	4.144 (7.181)
Constant	-301.4532 (1157.148)

N=20

R-squared= 0.9719

Sources: The data on GDP per capita were taken from Prados de la Escosura (2005); the data on years of schooling, from Nuñez (2005); and the data on height, from Nicolau (2005).

Table 5 shows how, in the new stage, the only variable that has statistically significant results is years of schooling. The new globalized economy was no longer associated with primary sector activities requiring physical strength but rather had become oriented towards services and, to a lesser extent, industrial activities. As noted in the introduction, with these activities, education plays a vital role. . Therefore, as can be seen in Table 5, during the second era of globalization, education became the engine of growth. It stimulated the creation of new economic activities that enabled Spain's integration in Europe and the world and served as an additional spur to economic growth.

In order to enable a comparative analysis of the impact that education had on growth in Spain with its impact in other OECD countries during the same period, Table 6 shows the international results. In this case, data on height were not available. We thus used the evolution of life expectancy to measure the degree of health.

TABLE 6. THE IMPACT OF EDUCATION AND LIFE EXPECTANCY ON GROWTH OF GDP PER CAPITA (1960-2000) IN PERCENTAGE TERMS IN OECD COUNTRIES: PANEL DATA REGRESSION

Dependent variable: log GDP per capita*100

Years of education	11.54 (1.268)***
Life expectancy	5.49 (0.350)***
Constant	-457.416 (16.550)***

N=679

R-squared= 0.7767

Sources: Data from Barro-Lee and the World Bank.

A comparison of the data in Tables 5 and 6 shows the high degree of similarity between the results achieved in Spain and those of the other OECD countries. In the period from 1960 to 2000, in OECD countries, each additional year of schooling was associated with an 11.54% increase in GDP per capita (in Spain, this figure was 19.47%), and a one-year increase in life expectancy entailed a 5.49% increase in GDP per capita (in Spain, a one-centimetre increase in height entailed a 4.14% increase in GDP). Although the data on height and life expectancies are not strictly comparable, they are both good indicators of the degree of health resulting from childhood and adolescent nutrition and medical care. The impact of education was even higher in Spain, since, as noted, it started at very low levels. The

quantitative and qualitative changes were quite noticeable and paved the way for economic growth. Growth was also higher because the magnitude of the investment in human capital was quite high from a historical perspective. Furthermore, the considerable similarity between the results seen in Tables 5 and 6 is a good indicator of the high degree of economic integration achieved by Spain in relation to the other OECD countries. Thus, during this period, the Spanish economy came to depend on economic activities involving levels of investment in human capital similar to those registered in other developed economies.

CONCLUSIONS

In the preceding pages, we have shown that the Spanish economy was not modernized until the decades ranging from 1960 to 2000, when investments in education increased and had a high impact on economic growth. This period coincides with the second wave of globalization, and the similarity of the results for Spain and those of the other OECD countries is proof of the high degree of economic integration achieved.

However, we also saw that this has not always been the case. In the long term, in the period from 1860 to 1960, we saw how education levels in Spain were always considerably lower than in neighbouring European countries. Because Spain had an agrarian economy, physical strength, measured here through height, had a greater impact on economic growth than education levels did. We even saw how the education provided in the early years of Francoism may have effected growth negatively. All these factors are characteristic of an underdeveloped economy in which the values arising from education and the Enlightenment did not take root in society until well into the 20th century, thereby contributing to Spain's relative lag with regard to other European countries.

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