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# Human capital in Spain: An estimate of educational attainment*

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Abstract

In this paper an alternative methodology is proposed for obtaining long time-series data for a human capital indicator based on the average number of years of education of the working-age population. In contrast to previous studies, we use Labour Force Survey microdata relating to the level of education actually completed, in order to construct temporal profiles of educational attainment and thus avoid the need to interpolate from censuses. To illustrate the method proposed, we evaluate the number of average years of education of the Spanish working-age population for the period 1910-2000.

Code JEL: O4, I2

Keywords: Human capital indicator, number of years studied

> "The key factor of all economic development comes out of the mind of man"
>
> Ernst F. Schumacher *Small is Beautiful*

## 1. Introduction

Human capital can be defined as the set of knowledge and qualifications possessed by workers in an economy. The accumulation of human capital through education increases labour productivity and is an important factor in economic growth capacity.

Economic growth is a complex, continuous process and sufficiently long time-series of potentially relevant variables are therefore needed for proper comparison of the relationships between them and to detect possible structural changes in the relationships. Various works conducted in this field provide researchers with the required data [see, for example, Summers and Heston (1991) and Maddison (1995)], although these often present shortcomings due to the quality of the information offered and the limited duration of the period covered. As De la Fuente and Domenech (2002) have shown, gradual improvements in inference technology have produced increasingly satisfactory indicators of human capital.

Measuring human capital is an extremely complex task. The most widely used method for estimating an economy's human capital centres on formal education, considered the main provider of training. Wößmann (2003) gives an interesting review of the different methods of measuring human capital used in the literature, which will be described briefly here.

One widely-used indicator is literacy rate [see, among others, Azariadis and Drazen (1990) or Romer (1990)]. However, it reflects only one part of human capital investment and does not include another very important part, such as technical and scientific knowledge. Another indicator is the enrolment rate for the different levels of education [see Barro (1991) or Mankiw *et al*. (1992)]. This measure too is unsatisfactory given that students' qualifications do not play a role in the economy until several years post-enrolment. Moreover, the rate depends on certain factors (failure at school or the desire to carry on to tertiary education, for instance), which are not taken

into account. Lastly, this indicator takes no account of the level of education attained by those who exit the labour market.

The most commonly accepted measure is the number of years of education completed by the working-age population. Notably, the World Bank's International Economics Department firmly supports the use of this indicator to measure human capital stock (Nehru, Swanson and Dubey, 1995). In line with this recommendation, authors such as Benhabib and Spiegel (1994), Gundlanch (1995) and Barro (1997; 2001) have used the measure, obtaining varying results. Different methods have been employed to construct the indicator: Lau *et al.* (1991) and Nehru *et al.* (1995), for example, use the perpetual inventory method, which in broad terms seeks to recreate the results of the education system using information on enrolments, school drop-out rate, etc. Such information is difficult to obtain and is often incomplete, and the assumptions that often need to be made can negatively affect accuracy in calculating human capital stock. An alternative method is to incorporate population census information. Proposed originally by Psacharopoulos and Arriagada (1986), this method has some disadvantages, among them the fact that a census usually covers relatively long time periods (usually 10 years) and the number of observations is therefore considerably lower. A further problem is that in many countries the information has only recently become available or fails to include data on educational attainment. A number of solutions have been put forward in an attempt to remedy these problems. Kyriacou (1991), for example, estimates econometrically the level of attainment using delayed enrolment variables. Using the results, the author projects the level of attainment by the population of subsequent years. A drawback to the method is that the parameters are presumed to be constant over time. As Wößmann shows (2003), however, the relationship varies over time and between countries, and hence this assumption is inadequate. Barro and Lee (1993), meanwhile, use census data as stock and carry out a perpetual inventory exercise to complete the information for the years and countries for which no direct census is available. The main problem here stems from the use of the perpetual inventory, given that in many countries the census data cover just one or two years and the bulk of the human capital data is therefore based on the imperfect calculation of the perpetual inventory method.

Given the current limitations of the usual indicators, and as stated by De la Fuente and Domenech (2002) and Wößmann (2003), there is a genuine need for improved ways of calculating human capital stock.

Our aim with this paper is to provide a methodology that seeks to address the need for sufficiently long time-series and at the same time to improve the human capital indicator considered as the average number of years of education of the working-age population. In contrast to previous studies, we propose to use the information contained in national *Labour Force Surveys* (called, in Spain, the 'Working Population Survey' and known by its Spanish acronym 'EPA') rather than use the population census. Such *Statistics* usually cover a broad sample spectrum and are commonplace in most countries. Another advantage is that surveys of this type are conducted annually, which eliminates the need for interpolation of any kind between census years. Moreover, they include information on the population with studies actually completed, again avoiding the need for interpolation. A final advantage is that the population series drawn up using these surveys cover groups that are directly related to the labour market.

The paper is organised as follows: Section 2 briefly outlines the methodology used. By way of illustration of the proposed procedure, Section 3 presents the results obtained for the period 1910-2000. Finally, Section 4 provides some concluding remarks.

## 2. Methodology

In this paper a methodology is proposed to help improve the estimation of the average number of years in education of the population ($I_{ANYE}$), expressed as follows:

$$I_{ANYE} = \frac{\left( \sum_{a=16}^{64} \left( \sum_{e=1}^{5} P_{a,t} \times Pe_{a,e,t} \times Ne_{a,e,t} \right) \right)}{\sum_{a=16}^{64} P_{a,t}} \qquad (1)$$

where $P_{a,t}$ is the population of age $a$ during period $t$, $Pe_{a,e,t}$ is the percentage of the population of age $a$ that has attained education level $e$ during period $t$, and $Ne_{a,e,t}$ represents the number of years studied by the population cohort aged $a$, according to the level of educational attainment $e$.

In order to infer the attainment of the working-age population (16 to 64 years) for the period 1910-2000, the level attained by all generations born between 1846 (64 years of age in 1910) and 1984 (16 years of age in 2000) must be determined. Obviously, this information is not systematised and certain assumptions are therefore required to estimate it..

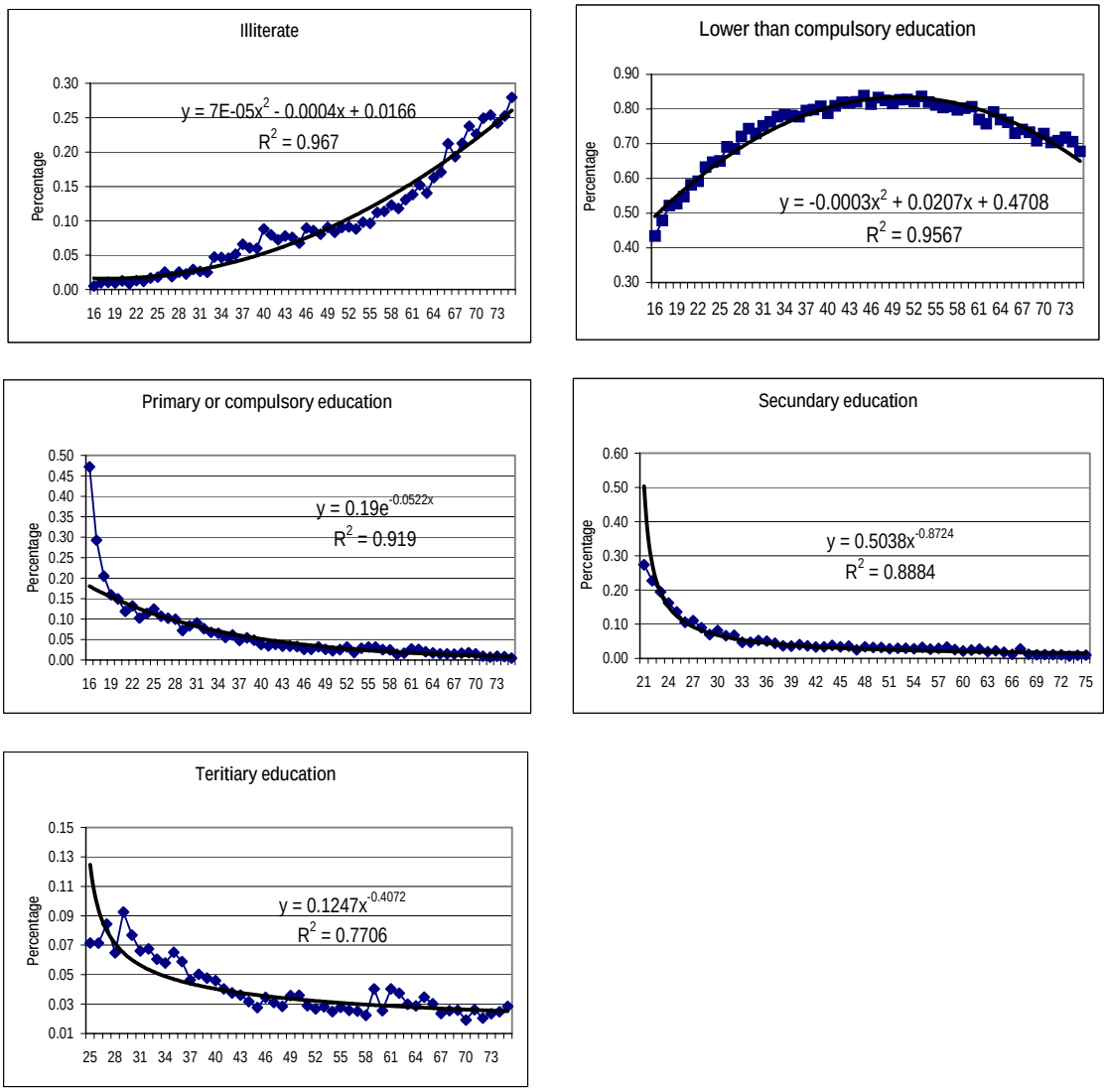
To calculate the working-age population $P_{a,t}$ we have used Hoyo and García's proposals (1988) for the period 1910-1980. In their publication, these two authors aggregate into one group the 'aged 60 and above' population cohorts, corresponding to the period 1910-1930. To estimate the population cohorts aged 60-64 we projected linearly back to 1846 (64 years old in 1910) the generation tables for Spain covering the years 1885 to 2000. These were obtained from the government's Directorate General for Insurance and the National Association of Insurers and Reinsurers (UNESPA). The survival probabilities obtained were applied to the different population cohorts according to year of birth until the generations not included in the aforementioned work by Hoyo and García (1988) were completed. For the period 1980-2000, Hoyo and García's series of population by specific ages was interlinked with series from Spain's National Institute for Statistics (1997, 1999, 2001) for 1977, and no further adjustments were required.

The main assumption we will adopt to calculate $Pe_{a,e,t}$ is that someone who has reached the typical age for each stage of schooling and has attained a given level of attainment will maintain that level until the end of his/her life. We will assume also that the level attained is that proposed in the EPA classification. The first available EPA with microdata corresponds to 1977. Using this survey we can obtain the level of education attained by each cohort of the population, which has been grouped into 5 categories (illiterate, lower than compulsory education, primary or compulsory education, secondary education and tertiary education). Sampling problems with the EPA survey made it difficult to obtain data for elderly persons. If we discount those aged over 83, we have the levels of educational attainment for all generations from 1894 (people aged 16 in 1910 and 83 in 1977) to the present day (using successive EPAs). These can then be used to obtain the percentage occupied by each level of education within each cohort.

The problem arises when trying to determine the level of attainment of generations born between 1846 and 1893 (aged between 17 and 64 in 1910). For this purpose we estimated the trends observed for each level of education in the composition by ages, using the EPA77 data, as shown in Figure 1.

Figure 1:

Trend estimation of age curve by level of education



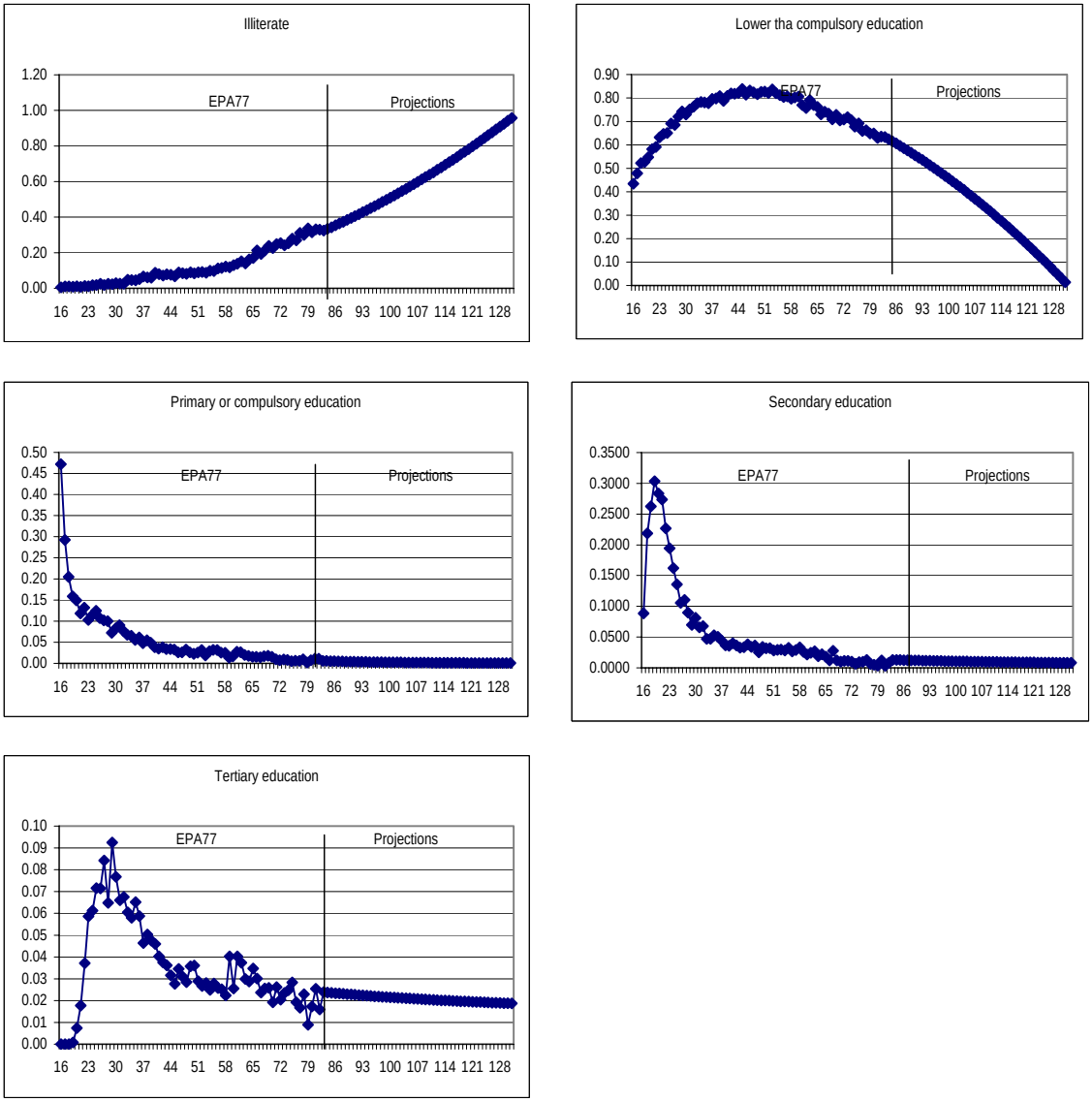

Source: Authors' calculation

The regression adjustments are reasonably good, as reflected by the high correlation coefficients obtained. A highly differentiated trend is seen according to age and level of studies, including for a relatively early year such as 1977.

To estimate the population cohorts born between 1846 and 1893 (aged between 17 and 64 in 1910), i.e. cohorts who were between 84 and 131 years old in 1977, the estimates shown in Figure 1 were projected to age 131. The results are illustrated in Figure 2. To complete the composition of the 1910 working-age population, we used the percentage composition of the projections given in Figure 2. In order to ensure that the sum of all the percentages of the levels of education total 100% of the population, one of the percentages had be left as a residue for adjustment purposes. We chose the 'lower than compulsory education' level for this since it was the only estimate for which projection served no useful purpose. It should be noted that when the 'lower than compulsory education' group estimate in Figure 1 is taken and the trend projected, negative values are reached long before the age of 131, which we need for our purposes here. The choice of the 'lower than compulsory education' group for the adjustment makes sense, given that -as Figure 2 shows- the projection closely matches the trend seen in EPA77 and adjusting the percentage represented by this group with the other levels of education gives 100%.

Figure 2:

Educational attainment by generations: projections




Source: Authors' calculations

We thus obtain, for each cohort of the working-age population, the probability of attainment of a given level of education.

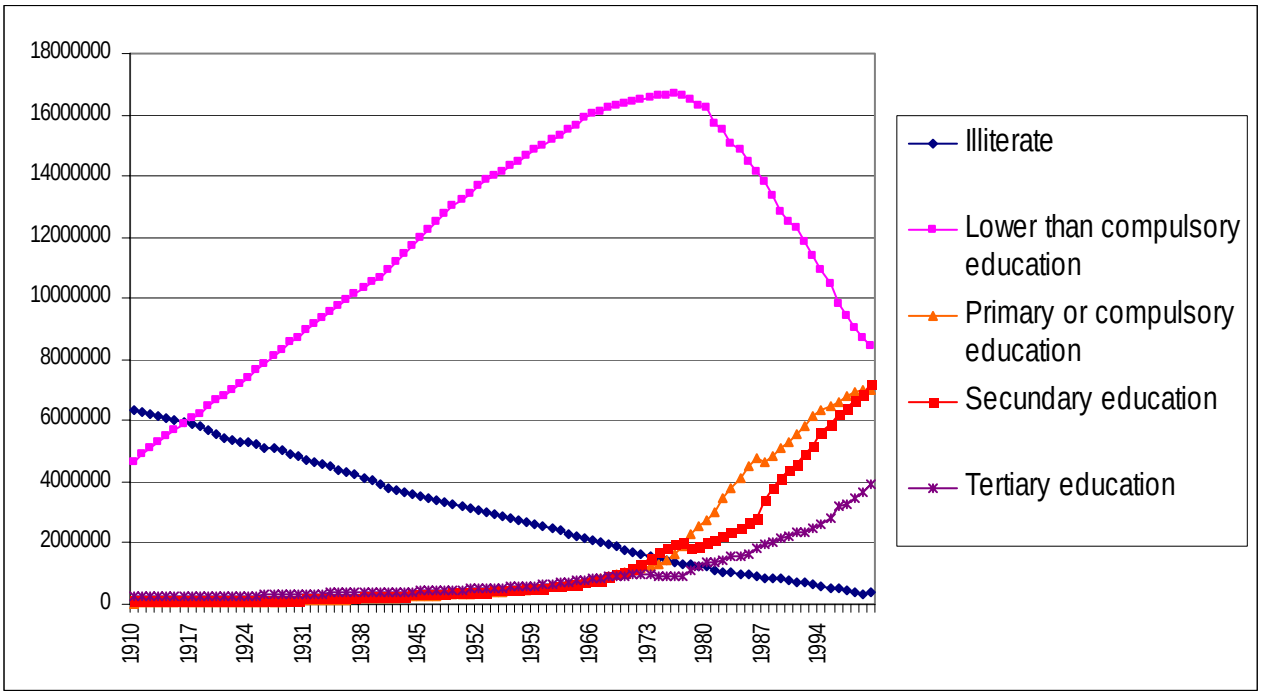
The number of years actually studied for each level of education $Ne_{a,e,t}$ in equation (1) is hard to ascertain, given the rather turbulent history of the Spanish education system[1]. Following the Moyano Law of 1856 the system was organised into the current levels of primary, secondary and tertiary education. However, education was a constant political battleground between the Church-backed conservatives and the liberals, and the political instability that characterised the second half of the 19th century and first half of the 20th meant that a new programme was put in place virtually every 4 years between 1836 and 1936. In an attempt to homogenise matters, we have estimated the average duration of studies per level of education as follows: 'illiterate'[2] = 1 year, 'lower than compulsory education' = 4 years, 'primary or compulsory education' = 8 years, 'secondary education' = 12 years and 'tertiary education' = 17 years.

## 3. Empirical results

The aggregated results given in Figure 3 show the evolution of the population of working age according to the level of academic attainment. The corresponding annual data can be consulted in the Appendix. The period up to 1976 saw a parallel process featuring a dramatic increase in the size of the working-age population with lower than compulsory education and a gradual fall in the number of illiterate people. The passing of the General Education Law, which introduced compulsory primary education, marked the beginning of sustained growth in the working-age population with schooling - initially primary, then secondary and, lastly, tertiary education.

[1] A comprehensive review of the history of Spain's education system can be found in Delgado (1994).
[2] In line with Delgado (1994), the reason for including 1 year for illiteracy is that there is broad evidence suggesting that a substantial number of people stated they were illiterate when entering military service or in the population census, despite the fact that they had attended school, albeit not regularly, and had learned to read and write, skills they had then forgotten through lack of daily use.

Figure 3:
Evolution of working-age population by level of academic attainment.

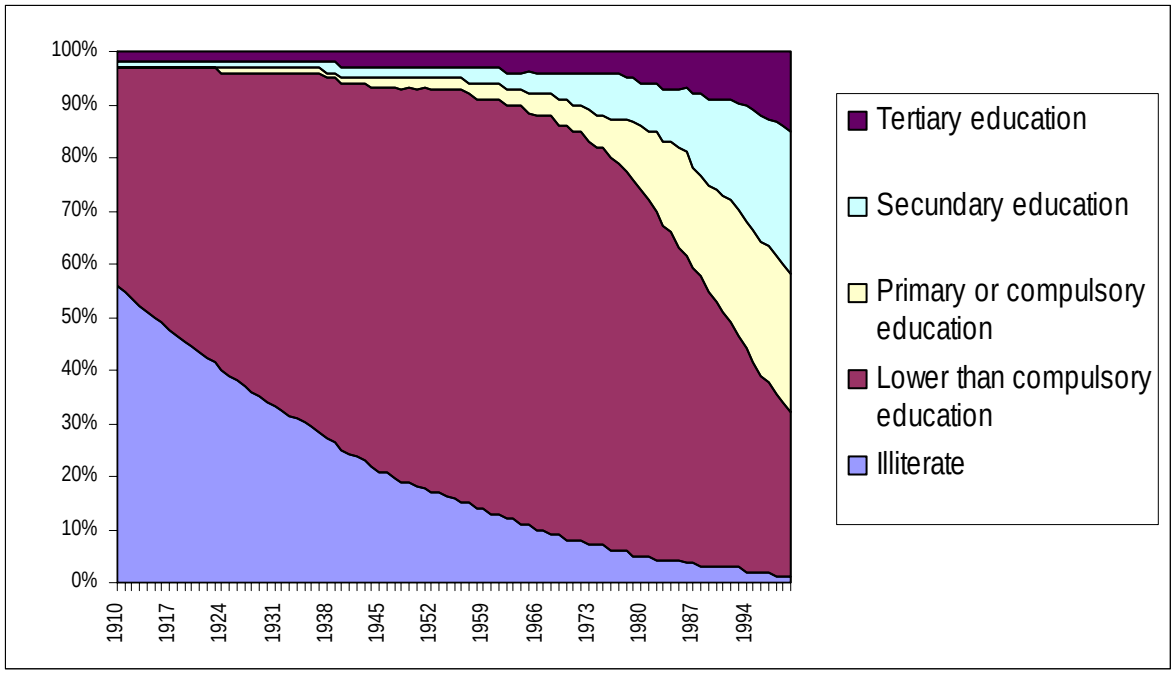



Source: Authors' calculation

Figure 4 shows the percentage composition of the level of attainment of the Spanish population during the period studied. As can be seen, there are two clearly distinct phases. From 1910 until 1970, there is a continued fall in the number and percentage of illiterates, in favour both of literates and of people who have completed at least some years of schooling. This process is directly related to the gradual improvements introduced in the education system and, above all, the progressive migration from rural to urban areas. In the second phase, which begins with the General Education Law of 1970, we see that the different population cohorts increasingly access secondary and tertiary education.

Figure 4:

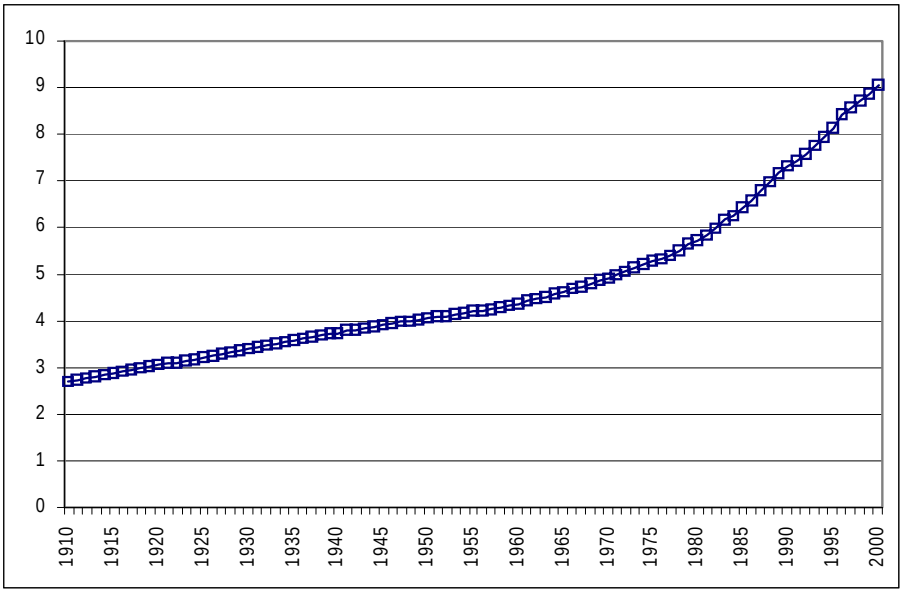
Percentages of educational attainment by the Spanish population




Source: Authors' calculations

The average number of years in education for the population of Spain, according to equation (1), is given in Figure 5. As can be seen, as of 1965 there is a spectacular accumulation of human capital in a relatively short period, as of the threshold of 4.6 years of average schooling for the working-age population.

Figure 5:
Average number of years in education by Spain's working-age population




Source: Authors´ calculations

At this point it would be appropriate to compare our indicator with other historical data on the educational attainment of the Spanish population. However, the fact that this information is virtually nonexistent makes it difficult for us to compare the results obtained using our methodology and those from other independent measurements. The only information available is the degree of illiteracy given for every census year. Table 1 shows the net illiteracy according to the census and the results of our estimates. Although the results are very similar, the figure estimated using our method is somewhat higher than in the census, due to the different population groups studied. The 10-15 age-group included in the net illiteracy is very numerous but presents a lower illiteracy rate. Conversely, the over-64 group is small (particularly at the beginning of the century) but has a higher rate of illiteracy. Together with the fact that the data have been taken from the EPA - a survey -, this may explain the slight discrepancies. Since the methodology has been reasonably successful in calculating the degree of illiteracy, one may assume the other levels of education to be correct also.

| Table 1: Evolution of illiteracy | | |
|---|---|---|
| | Net illiteracy (age 10 and above) | (Result of estimation: population 16-64) |
| 1910 | 50.6 | 55.7 |
| 1920 | 43.3 | 44.0 |
| 1930 | 32.4 | 34.0 |
| 1940 | 23.1 | 25.3 |
| 1950 | 14.2 | 18.2 |
| 1960 | 11.2 | 13.3 |
| 1970 | 8.5 | 8.5 |
| 1981 | 6.3 | 4.8 |
| Sources: Delgado (1994) and own figures. | | |

## 4. Final considerations

This paper puts forward an alternative methodology for obtaining long time-series of a human capital indicator based on the average number of years' schooling of the population of working age. The procedure is based on the use of national *Labour Force Surveys* instead of the customary population census. Specifically, we use microdata relating to the level of studies actually completed in order to build temporal profiles of educational attainment, thus avoiding the need for interpolation of census data.

To illustrate the method, we have estimated the average number of years' schooling of the Spanish population of working age over a long historical period that covers most of the twentieth century.

In our opinion, the methodology proposed here could be applicable to other countries also, to give a broad cross-section of countries covering long time-periods, which could then be used for appropriate empirical evaluation of the different economic growth models found in the literature.

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# Appendix: Working-age population by level of academic attainment

| | Illiterate | Lower than compulsory education | Primary or compulsory education | Secundary education | Tertiary education |
|---|---|---|---|---|---|
| 1910 | 6368 | 4669 | 29 | 120 | 245 |
| 1911 | 6273 | 4883 | 33 | 121 | 246 |
| 1912 | 6236 | 5086 | 37 | 120 | 251 |
| 1913 | 6167 | 5281 | 39 | 122 | 253 |
| 1914 | 6119 | 5495 | 40 | 121 | 252 |
| 1915 | 6053 | 5704 | 43 | 121 | 256 |
| 1916 | 5981 | 5889 | 45 | 121 | 257 |
| 1917 | 5910 | 6103 | 47 | 124 | 260 |
| 1918 | 5795 | 6246 | 48 | 124 | 264 |
| 1919 | 5708 | 6474 | 51 | 126 | 269 |
| 1920 | 5585 | 6654 | 54 | 125 | 271 |
| 1921 | 5446 | 6778 | 55 | 125 | 271 |
| 1922 | 5393 | 6982 | 59 | 128 | 277 |
| 1923 | 5325 | 7199 | 64 | 130 | 279 |
| 1924 | 5273 | 7424 | 71 | 132 | 286 |
| 1925 | 5211 | 7652 | 78 | 135 | 291 |
| 1926 | 5137 | 7878 | 84 | 144 | 296 |
| 1927 | 5077 | 8089 | 89 | 147 | 304 |
| 1928 | 5020 | 8334 | 95 | 152 | 314 |
| 1929 | 4939 | 8552 | 102 | 159 | 321 |
| 1930 | 4816 | 8732 | 109 | 164 | 326 |
| 1931 | 4738 | 8938 | 119 | 172 | 336 |
| 1932 | 4667 | 9142 | 130 | 180 | 347 |
| 1933 | 4585 | 9345 | 135 | 185 | 352 |
| 1934 | 4497 | 9542 | 139 | 193 | 362 |
| 1935 | 4412 | 9731 | 148 | 203 | 365 |
| 1936 | 4321 | 9926 | 157 | 212 | 369 |
| 1937 | 4227 | 10130 | 170 | 220 | 373 |
| 1938 | 4143 | 10352 | 183 | 232 | 379 |
| 1939 | 4036 | 10554 | 195 | 241 | 383 |
| 1940 | 3910 | 10681 | 200 | 248 | 386 |
| 1941 | 3804 | 10912 | 214 | 259 | 392 |
| 1942 | 3738 | 11190 | 225 | 271 | 401 |
| 1943 | 3664 | 11455 | 235 | 283 | 412 |
| 1944 | 3597 | 11708 | 246 | 296 | 424 |
| 1945 | 3529 | 11973 | 261 | 309 | 432 |
| 1946 | 3465 | 12239 | 273 | 319 | 441 |
| 1947 | 3403 | 12486 | 284 | 333 | 452 |
| 1948 | 3345 | 12778 | 300 | 348 | 461 |
| 1949 | 3281 | 13040 | 315 | 364 | 471 |
| 1950 | 3200 | 13229 | 329 | 376 | 480 |
| 1951 | 3130 | 13446 | 346 | 388 | 492 |
| 1952 | 3082 | 13688 | 361 | 403 | 506 |
| 1953 | 3029 | 13908 | 378 | 419 | 522 |
| 1954 | 2958 | 14022 | 394 | 427 | 532 |
| 1955 | 2888 | 14113 | 410 | 436 | 542 |
| 1956 | 2832 | 14345 | 432 | 455 | 559 |
| 1957 | 2761 | 14469 | 455 | 471 | 576 |
| 1958 | 2701 | 14642 | 477 | 491 | 598 |
| 1959 | 2638 | 14852 | 508 | 511 | 621 |
| 1960 | 2572 | 15009 | 539 | 532 | 645 |
| 1961 | 2479 | 15173 | 575 | 565 | 672 |
| 1962 | 2403 | 15346 | 618 | 595 | 699 |
| 1963 | 2317 | 15507 | 660 | 635 | 735 |
| 1964 | 2238 | 15663 | 693 | 668 | 775 |
| 1965 | 2164 | 15879 | 748 | 717 | 808 |
| 1966 | 2097 | 16066 | 806 | 778 | 852 |
| 1967 | 2020 | 16097 | 846 | 816 | 869 |
| 1968 | 1942 | 16207 | 912 | 887 | 901 |
| 1969 | 1874 | 16306 | 969 | 972 | 925 |
| 1970 | 1793 | 16361 | 1020 | 1070 | 947 |
| 1971 | 1720 | 16433 | 1088 | 1190 | 958 |
| 1972 | 1650 | 16497 | 1148 | 1339 | 960 |
| 1973 | 1578 | 16555 | 1229 | 1502 | 954 |
| 1974 | 1511 | 16600 | 1318 | 1680 | 945 |
| 1975 | 1450 | 16635 | 1437 | 1829 | 935 |
| 1976 | 1387 | 16664 | 1612 | 1958 | 924 |
| 1977 | 1320 | 16597 | 1894 | 2003 | 909 |
| 1978 | 1294 | 16474 | 2264 | 1845 | 1098 |
| 1979 | 1233 | 16322 | 2520 | 1906 | 1253 |
| 1980 | 1212 | 16252 | 2747 | 1997 | 1345 |
| 1981 | 1129 | 15740 | 3004 | 2112 | 1348 |
| 1982 | 1059 | 15495 | 3437 | 2205 | 1409 |
| 1983 | 1049 | 15041 | 3825 | 2367 | 1580 |

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