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Biological Standards of Living in the Developing World

**Biological Standards of Living on the frontier of development:
the case of Spain**

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I. INTRODUCTION

This paper explores the evolution of the biological standard of living in Spain, a country that was on the frontier of the developed world throughout the 19th and 20th centuries. With stature data from conscripts between 19 and 21 years of age corresponding to the generations born between 1837 and 1948, a regional series is constructed which links with another, national series for the generations born from 1934 to 1980. Thus, the secular trend and height cycles are analysed over the long term. Various hypotheses on the determinant factors of biological well-being are hereby discussed, and the relationship with other standard of living indicators are verified, such as per capita income and infant and child mortality rates. Finally, territorial inequalities and the regional convergence process are analysed, and the biological standard of living of Spaniards is put in the international context.

II. SOURCES AND DATA

According to various research projects of historical anthropometry carried out in Spain, the most reliable physical height or stature series go back to the generations that were born after 1837, with the start-up of recruiting and draftee legislation of 1856. As from this date, we are therefore able to determine the secular trend of the stature of Spaniards, although relative to the stature of the individuals who were at recruiting ages at the end of their physical growth stage, and we are likewise able to explore the changes occurring in the biological standards of living.

As in most countries, the sources of military recruiting are our main basis for anthropometric data¹.

The regional series is constructed based on 186,387 records from almost 250,000 files of draftees between 19 and 21 years of age who were born between 1837 and 1948 and were measured between 1857 and 1969. The series, which will be called the Southeast (SE) series, is then compared with other height series available on Spain for certain, shorter periods of time, such as the one by Quiroga (2001, 2003a) based on a national sampling², and the series derived from the data published by the INE (National Institute of Statistics) starting in 1955³, which is prepared based on the Recruit Statistics of draftees born between 1934 and 1980. We will thus be able to determine the trend and the cycles to which the height of Spaniards was subject as from the mid 19th century to the end of the 20th century, a period marked by the process of modernisation and by profound social and economic changes.

The mean height is compared with other standard of living indicators, including per capita income (Prados de la Escosura, 1995, 2003), in order to check the degree of divergence existing between both indicators, which has been observed in other countries. The results discuss the implications of the height trend in a crucial period of Spanish economic development, and they advance some of the explanatory hypotheses

¹ For anthropometric sources in Spain, see the works by Borreguero-Beltrán (1989), Cámara-Hueso (2006), Feijoo (1996), Jiménez-Guerrero (2001), Martínez-Carrión and Pérez-Castejon (2000), Puell de la Villa (1996), and Quiroga (2001, 2003a).

² The Quiroga series (2001) is prepared using 46,385 records of recruits born between 1875 and 1933 and measured between 1893 and 1954, from a random sampling using Regimental Register Sheets from the General Military Archives, Troop Section. Given the criteria used for preparing this series, we used the data from 1891-1933.

³ Until then, only some statistics – those from 1858 and 1915-1929 – provide information about height, which furthermore is the information on “useful conscripts.” In any event, these data are used to calculate the evolution of stature between the mid 19th century and the start of the 20th century (Gómez-Mendoza and Pérez-Moreda, 1985, 1995).

for the height cycles throughout the analysed period. The mean height is furthermore compared with other series on well-being that measure health, such as those on infant and child mortality that were prepared by Sanz-Gimeno and Ramiro-Fariñas (2002) for the interior of Spain.

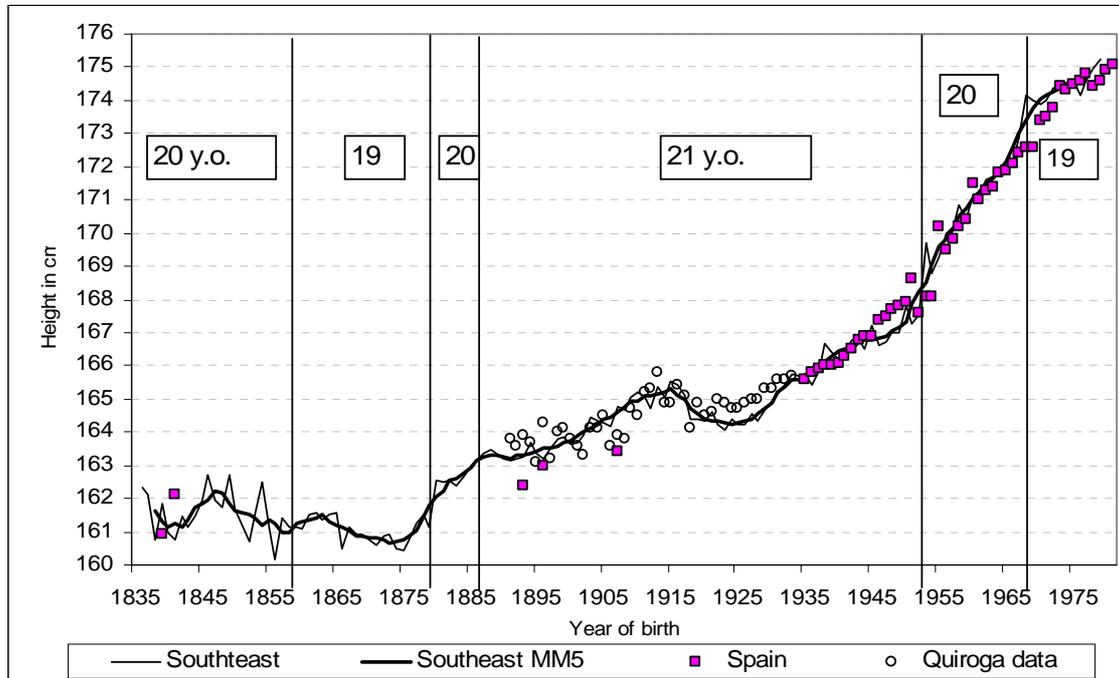
Finally, regional variability is analysed. It is thus endeavoured to verify if the height differences existing in Spain during the 19th century tended to decrease throughout the course of the 20th century and to verify at what time the convergence occurred. The data provide some keys to the process of stature convergence reached in the final decades of the nineteenth hundreds. The mean height of Spaniards is also compared with the mean heights of other countries in order to put the biological standard of living of Spaniards into an international context.

III. SECULAR TREND AND CYCLES

1. The trend of physical stature

The results of Figure 1 show a secular growth trend in the very long term for those born between 1837 and 1948. In accordance with the SE series, the mean height of 161.6 cm for those born in the five-year period from 1837-41 reaches 166.7 cm in the five-year period from 1944-48. Height increased 5.1 cm, thereby using the start and the end of the series as a reference. The increase was 0.5 cm per decade. Although significant, this increase is far below what is exhibited by subsequent draftees born in the second half of the 20th century, the period in which the largest increase in the physical stature of Spaniards occurs. The INE data for all Spain reveal a growth of 9.5 cm in those born between 1934 (1955 draftee) and 1980 (1999 draftee), going from 165.5 cm to 175.1 cm. The increase was 1.9 cm per decade. In almost 140 years, linking the SE series with the Spain-INE series (cohorts from 1837-1841 to 1980), the mean height increase was 13.5 cm.

FIGURE 1
 MEDIAN HEIGHT OF CONSCRIPTS (SOUTHEAST) AND RECRUITS IN SPAIN,
 BY YEAR OF BIRTH



Source: Own preparation based on *Recruit and Draftee Records*, INE, Quiroga (2003a), and Gómez-Mendoza and Pérez-Moreda (1995).

The results of the SE series do not significantly differ from other height estimates available for Spain. The first published statistic that we manage on Spanish draftees is the statistic on those born in 1838, and their estimated mean height is 160.9 cm (Gómez-Mendoza and Pérez-Moreda, 1995), 1.2 cm below the SE mean. Conversely, if we take the mean stature estimated by the anthropologists, Aranzadi and Hoyos (1893), for those born in the three-year, 1839-41 period – which they calculate at 162.1 cm – it is 0.9 cm higher than the SE, which records an average of 161.8 cm in those years. Obviously, the differences decrease if we use the averages of several years as a reference, instead of just one, given that the fluctuations are attenuated.

At the end of the 19th century, there is considerable concordance between the available series and data. Thus, the mean height of Spaniards born in 1894-95 is 163.0 cm and 163.3 cm in the SE, thereby observing a difference of just 3 millimetres. At the beginning of the 20th century, the differences (in favour of the SE) are not very significant: the mean height of Spanish cohorts from 1905-1906 is 163.4 cm, while the mean height of the SE is 164.3 cm. The difference is just 9 millimetres. The estimates

by Quiroga (2003a) are also very close to a sampling made at a national level: for those periods, the author estimates heights of 163.1 and 163.6 cm, respectively, thereby straddling my estimates for the SE and those of Gómez-Mendoza and Pérez-Moreda for all of Spain. The published INE data, based on the cohorts from 1934 to 1980, give a slight, 0.27-cm average advantage to the SE series in said period, and a greater convergence between both series is observed at the end of the 20th century.

The results highlight that the stature increase is relatively less in the first phases of modern economic growth, a fact that concurs with the experience shown in other countries. Unlike the stagnation or deterioration of stature that is noted at some points of the 19th century, the greatest advances in stature are recorded in the 20th century, and they are almost spectacular after the Second World War (Figure 1). This fact is attributable to the secular stagnation and the improvements in well-being that occur starting in 1960. Nevertheless, the Spanish case shows some peculiarities, as we will see, associated with its economic-social history and also its political history, which is a conditioning factor.

The main conclusion is that the stature trend was not one-way, but rather it was subject to cycles and fluctuations. In general, several cycles can be pointed out: (a) a cycle of deterioration that affected those born during the reign of Isabel II and during the Six-year Revolutionary Period, mainly between 1850 and 1875; (b) another cycle of recovery and growth, which started in the second half of the 1870's, with significant advances during the Restoration, and it extends up to the cohorts of the First World War; (c) a new cycle of deterioration, more significant and pronounced than the first, which is situated between 1917 and 1930 and which corresponds to the draftees who experienced the Civil War and the post-war period in their adolescent growth spurt phase, when the mean height decreased by almost one and a half centimetres; and (d), a final cycle of recovery and growth, which starts with those born in the first part of the 1930's and extends to the 1960's and 1970's, a substantial period of progress in the biological standard of living and general well-being of Spaniards.

2. *Difficult times in the 19th century*

Figure I shows that the average male height deteriorated throughout the course of the 1800's, and it certainly showed stagnation during the second third of the 19th century, which affected the draftees of the last third of the century. How much did

stature decrease? At what moment did the biological standard of living deteriorate? Given that there were changes that occurred in the recruitment age due to military reasons, we must estimate the stature variations based on heights of the same age, as shown in Figure 1. Beginning with the 20-year-old series, those born between 1838 and 1865, stature deterioration is put at 0.8 cm. However, from 1848 to 1860, the decrease is greater: 1.6 cm. The biological standard of living showed a significant decrease during those years. Continuing with heights of the same age, at the age of 19 years, a drop of one cm was recorded for the height of conscripts born between 1865-66 and 1875-1876, going from 161.5 cm to 160.5 cm. We could therefore affirm that, between the generations born at the end of the 1830's and those born in the mid 1870's, height decreased almost two centimetres. However, specialised literature indicates that, in situations of malnutrition and nutritional stress, physical growth can be delayed and can extend past twenty years of age. With this information, we suspect that at the age of 19 years, not all conscripts would have concluded their growth cycle, wherefore it seems sensible to sustain that the decrease in height between 1850 and 1975 might not be so significant.

In any event, the SE data suggest a deterioration of stature in the generations born during the third quarter of the 19th century. What factors could have intervened? At what moment of growth could they have had an impact? We cannot clearly establish if the environmental factors that intervened had more weight in the first years of life or in the years of the adolescent growth spurt. Both age periods are decisive for growth. And it seems plausible that in view of the political, economic, and environmental conditions of the period – highlighted by subsistence crises, epidemics, poor diets, high infant and child sickness rates and mortality rates, and intensive and generalised child labour in the fields and in the cities between 11 and 15 years of age – the accumulated interaction of adverse circumstances would have negative effects on both the first years of life and on the final growth stage, prior to or during the draftee measurement years or both. Wherefore, the causes that deteriorated height, for which a decline is observed around the generations born from 1850 to 1875, could have extended until the beginning of the 1890's, when these generations reached the age of maturity and finalised their growth. This fact is especially important when documenting the deterioration of biological well-being in a crucial stage of the process of economic growth and modernisation of the country, as pointed out by the majority of historians (Carreras and Tafunell, 2004; Pascual and Sudrià, 2002; Prados de la Escosura, 2003; Tortella, 1994).

TABLE 1

STUNTING OR PERCENTAGES OF CONSCRIPTS CLASSIFIED AS “UNDERHEIGHT” BY REGIONS,
DRAFTEES FROM 1858 (< 159.6 CM) AND 1885 (< 154.5 CM)

<i>Autonomous Communities</i>	1858	1885
Andalusia	7.0	14.5
Aragón	6.7	28.3
Asturias	14.4	18.5
Balearic Islands	5.3	6.6
Cantabria	7.0	11.2
Castile-La Mancha	7.1	11.5
Castile-León	7.4	19.9
Catalonia	6.0	8.8
Extremadura	6.9	13.9
Galicia	8.6	20.5
Madrid	6.9	10.2
Murcia	4.5	25.6
Navarre	5.2	10.8
Valencia	4.2	10.4
Basque Country	--	12.2
Rioja	8.1	12.7
<i>SPAIN</i>	7.2	15.5

Source: Own preparation based on Feijóo (1996), pages 494-499.

Can this situation of deterioration be generalised to the rest of Spain? While waiting for the results from other regions and areas of the country⁴, one alternative, which is certainly rough but valid, is to resort to the percentages of conscripts declared to be underheight (stunting). This procedure served the illustrious Laureano Figuerola (1893) in order to show the increase in physical well-being in the years after the First Carlist War. With data on those declared unfit due to being underheight from among those who were born in 1837/1838 and 1847/48, the distinguished author provided evidence of a slight improvement in the nutritional state through a 7.5% decrease in the number of shorts during that period. Figuerola’s inquiries agree with the results of the SE series (Martínez-Carrión, 2002). On this occasion, we are using data provided by Feijóo (1996) for the 1858 and 1885 draftees – born in 1838 and 1865 – and they must be considered with caution, given that between both sets of draftees, the consideration of “underheight conscript” was modified: from the 159.6 cm in force in 1858, according

⁴ Historical anthropometry in Spain has advanced spectacularly in recent years, as evidenced by the works submitted to the *Scientific Journals on the Well-being and Standards of Living in Contemporary Spain* (Murcia, March 2005), Meeting A of the 8th Congress of the Spanish Association of Economic History (Santiago de Compostela-Vigo-A Coruña, September 2005), and the 14th International Congress of the Spanish Society of Biological Anthropology (Murcia, September 2005).

to the 1856 draftee law, it changed to 154.5 cm in 1885, in accordance with the articles revised with the law of 1882.

The results of Table 1 suggest that the deterioration could have been significant and that it had an unequal impact in the Spanish territory. In general, the number of conscripts declared to be underheight doubled between the cohorts of 1838 and 1865. This value is very high if it is furthermore taken into account that between both dates there was a revision of the minimum required height, which we know decreased by five centimetres. In the 1858 draft, 7.2% of the conscripts were underheight, not reaching the required 159.6 cm, while in 1885, the percentage of conscripts below the 154.5 cm was 15.5%. In spite of the fact that the recruiting requirements decreased in height, the increase in shorts was dreadful. The regions most affected were Aragón, Murcia Galicia, Asturias and Castile-León, which showed the highest percentages of those declared to be unfit from among those born in 1865 due to being underheight. The Balearic Islands and Catalonia are on the opposite end of the spectrum. The data reveal that times were hard and difficult for most regions and that between the 1850's and 1870's, protein-energy malnutrition could have extended throughout most of the country. It is inferred from the anthropometric evidence that the beginning of political and economic modernisation in the country took a high toll in biological terms, and the secondary effects on physical activity and work productivity have yet to be evaluated.

3. *Improvement of biological well-being at the beginning of the 20th century*

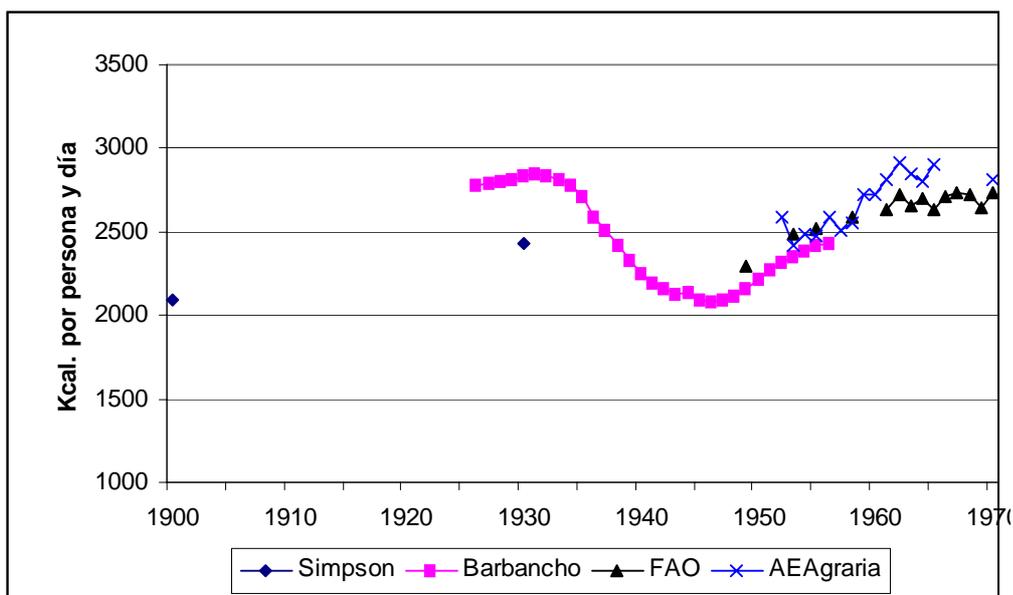
The generations born in the last two decades of the 19th century experienced an improvement of their nutritional state that extended to the cohorts of the First World War. Figure 1 shows that as from 1876 there is a trend marked by the sign of recovery and the growth of statures. The mean height of conscripts at 20 years of age increased by 1.2 cm between 1865 and 1885, and the height of conscripts at 21 years of age increased by 1.3 cm between 1886 and 1903. Those born at the end of the 1880's are at least one centimetre taller than those born in the middle of the century. There is an increase in a mean height from 161.2 cm in the 1858-62 period to 162.5 cm in the 1881-85 period among 20-year old conscripts. The losses occurring as from the mid 19th century are recovered throughout the 1880's. The generations born at the onset of the First World War reached a mean height of 165 cm, three centimetres more than the height reached at the time of the Second Carlist War. The evidence suggests a notable

improvement in the biological standards of living in the cohorts born starting at the end of the 19th century, who show their greatest growth potential in the first fifteen years of the 20th century. This fact had to have immediate effects on productivity in the first third of the nineteenth hundreds.

4. *The effects of the Civil War of 1936-39 and the post-war period*

Economic historians have sustained that the Civil War of 1936-39 and the economic policy of the first francoism period had perverse effects on income, wealth, production, and consumption, thus affecting the general well-being of Spaniards (Barciela, ed., 2003; Prados de la Escosura, 2003; Carreras and Tafunell, 2004; Maluquer de Motes, 2005). The forties were affirmed as the darkest era of material consumption in the Spanish population as a whole. Private consumption per inhabitant suffered a strong decrease from 1935 to 1945, and it did not recover until 1957. The situations of hunger and malnutrition were widely publicised, as revealed by dietary intake data (Cussó 2005, Figure 2).

FIGURE 2
APPARENT ENERGY CONSUMPTION PER INHABITANT IN SPAIN
(KILOCALORIES/DAY) 1900-1970, ACCORDING TO DIFFERENT SOURCES.



Source: Cussó (2005)

The advances reached in nutrient availability during the first third evaporated between 1936 and 1947. The apparent energy consumption per inhabitant was estimated to be 2717 kcal/day in 1935, and it decreased to 2249 and 2090 kcal/day in 1940 and 1947, respectively (García-Barbancho, 1960). The lowest estimates of energy and protein consumption were observed in 1947, reaching levels that took the food-energy supply back to 1900 values (Simpson, 1989). The 1930 dietary intake isn't recovered until 1960.

The deterioration of the nutritional state was on a par with the health state, which shows the appearance of chronic illnesses that had been almost buried or partially eliminated, and it was also due to the existence of ill-equipped health infrastructures and the lack of medicines.

The socio-economic context accentuated poverty and the situations of deprivation in broad social sectors, and therefore there was an increase in childhood diseases associated with infections in synergy with the nutritional state. Deficits were able to increase due to problems distributing basic foods, a true reflection of the autarchy and the inept interventionist policy of prices and fees that was implemented in the agricultural sector during the 1940s. During those years, the accumulation of political and economic factors propitiated the deterioration of living conditions and quality of life indicators at an accelerated pace, which was visible in many places as from the start of the war and, above all, during the first half of the 1940's (Nicolas, 2005).

As a mirror of the standard of living of a certain society, the mean height of Spaniards showed a significant drop between 1936 and 1945. The results of the SE conscripts put the decline around one and a half centimetres, going from 165.6 to 164 cm. The recruits of the Quiroga sampling likewise show signs of a decrease between 1934 and 1945, although somewhat less at almost one centimetre, going from 165.8 to 164.7 cm. The author observes the greatest drop in height between 1934 and 1939, and after the rise the following year, she indicates a subsequent stagnation of the same between 1940 and 1945. In accordance with the various series, the draftees from 1937 to 1951 showed mean heights below those reached in the years of the 2nd Republic. The lowest mean height is evidenced around 1945. In other words, the generations born in the 1920's suffered an involution in biological standards of living with the evaporation of the gains won among the cohorts of the first fifteen years of the 20th century (Figure 1). The deterioration in the quality of life among those born from 1916 to 1930 has been

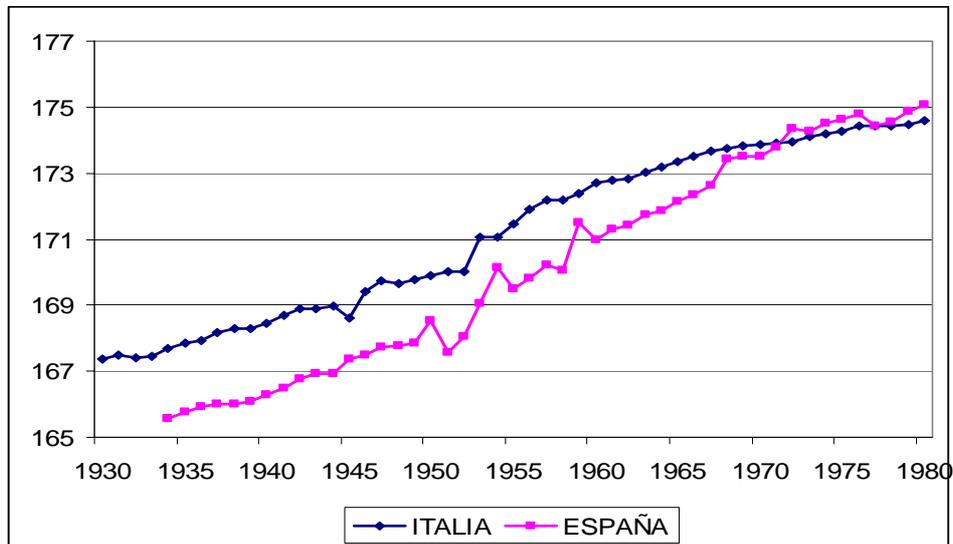
highlighted in various ecological contexts, according to residence (rural and urban) and economic activity: agriculture, mining, and industry (Martínez-Carrión, 1986, 1994a, 1994b, 2005a; Martínez-Carrión and Pérez-Castejón, 1998a and 1998b; Quiroga, 1998, 2001, 2002).

From the available evidence, it could be inferred that the Great Depression of the 30's hurt physical growth, which was further deteriorated by the combined effects of the Civil War and the long post-war period. It is sustained that the environmental context as from the 1930's to the end of the 1940's, characterised by nutrient deficits – above all calories and proteins – and deficiencies of micronutrients such as calcium, iron, and vitamins, had a decisive influence on the evolution of heights between 13 and 17 years of age (in the middle of the adolescent growth spurt), thereby delaying potential growth or possibly preventing it, which was thus reflected in the height when measurements were taken. This fact has huge relevance to the literature on nutritional anthropometry and economic history.

5. The golden years of growth

Height starts to recover with those born in 1930. The Spanish generations of 1934 (1955 draftees) show a mean height of 165.5 cm. The data are very similar to those from the Southeast data, which show 165.7 cm. With a lag of twenty years, the 1955 draftees reach the heights of the republican draftees. The generations born in the 1930's and 1940's thus resume the growth that had been occurring since the end of the 19th century. Since then, the height trend is clearly ascending. There is a strong increase recorded for the biological standard of living of Spaniards between the 1950's and the 1970's (Figure 3). The 1957 cohorts (1978 draftees) reached a mean of 170 cm, and in 1980 (1999 draftees) they reach 175 cm. The height of Spaniards grew 9.5 cm between the 1955 and 1999 draftees, an annual rate of 1.22 percent, which is above most European countries (Bodzsár and Susanne, 1998).

FIGURE 3
EVOLUTION OF THE HEIGHT OF RECRUITS IN ITALY AND SPAIN BY BIRTH COHORTS,
1930-1980



Source: Based on ISTAT, Arcaleni (2004) and Quiroga (2003a)

In the long term, the 20th century shows a clear growth trend, which is much more intense in the second half and is interrupted only by the tumultuous decades of the 1930's and 1940's. Out of the 12 centimetres that Spanish adults grow in the 20th century, 9.5 cm (meaning almost 4/5) occur as from the 1955 draftees. The evolution of stature in the draftees of the second half of the 20th century allows catching a glimpse of the gains that, in terms of biological well-being, were reached by the generations born after the Second World War. The progress of physical stature is unquestionable, and it coincides with the improvement in well-being and standards of living in general, as clearly shown by the physical quality of life index (PQLI) and the human development index (HDI) based on Dominguez and Guijarro (2001), Escudero and Simón (2003) and Prados de la Escosura (2003).

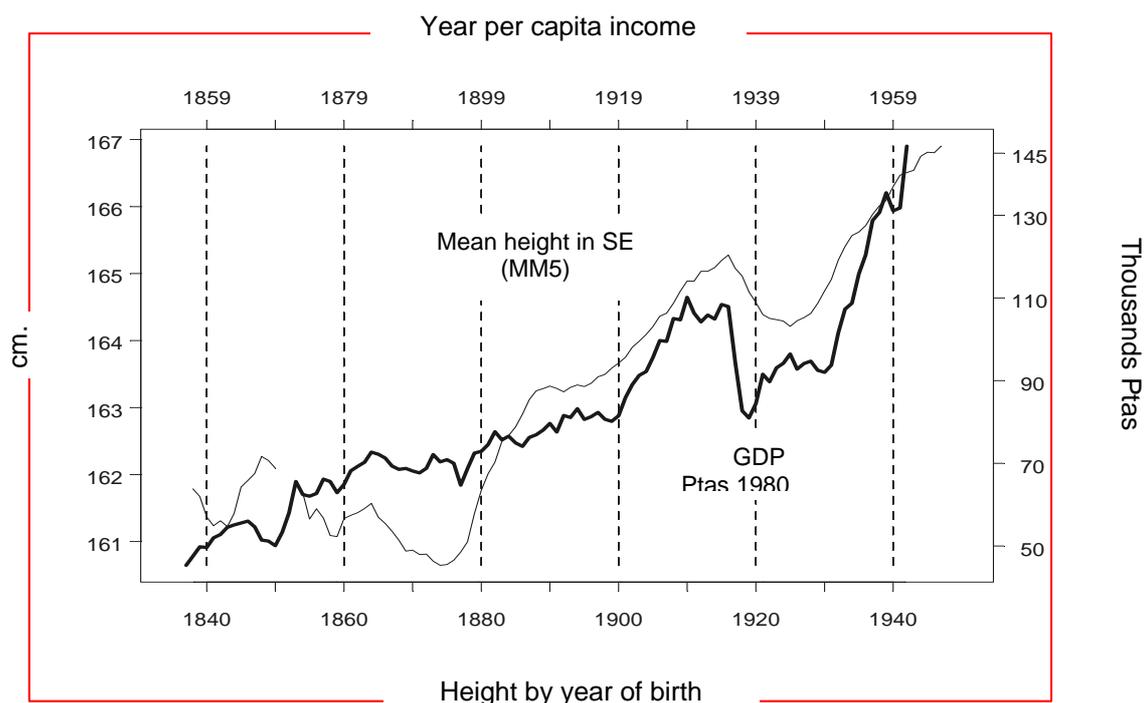
IV. STATURE, HEALTH AND WELL-BEING

This section relates biological well-being to the economic well-being and health of Spaniards. It is hereby endeavoured to explore the relationships that are established between stature and other standard of living indicators, which on the one hand include per capita income as the economic indicator most conventionally used to measure

development, and on the other, life expectancy and infant mortality as an expression of the state of health. It furthermore endeavours to investigate the changing function of stature throughout the course of the last 150 years.

1. Income and height

FIGURE 4
HEIGHT AND PER CAPITA INCOME AT THE AGE OF 19 YEARS, BY BIRTH COHORTS.



Source: Own preparation based on draftee records and Prados de la Escosura (1995)

Biological well-being and economic well-being were related between the SE series – centred moving averages on the order of five to smooth out height fluctuations – and the per capita income of Spain estimated by Prados de la Escosura, which is shifted to the year when the age of 19 years is reached (Figure 4). Although this exercise is risky due to the restricted nature of the height sample used (Southeast series), the analysis shows interesting results. It is deduced from the graph that there is no correspondence between both series until the draftees born at the end of the 19th century. As from then, the relationship between both series is greater, thereby maintaining a close association between income and height throughout the 20th century.

The contrast between both series suggests that the adolescent years are decisive in the evolution of stature and that stature is very sensitive to changing environmental circumstances. The greatest correspondence between income and height occurs throughout the 20th century, and in particular during the Civil War and the post-war years. The drop in height is parallel to the drop in income and earnings. The evolution of real wages, sketched some time ago by Fontana and Nadal (1980) and corroborated in subsequent studies (Catalán, 1994; Maluquer de Motes and Llonch, 2005), also shows the same pattern of behaviour. The coincidence between the drop in height, income, and real wages as from 1936 until the mid 1940's is quite strong, and it likewise coincides with the recovery that is reached towards the mid 1950's.

The lack of concordance between the income and height series between 1850 and 1880 could be related to the Kuznetsian hypothesis of increasing inequality of income in the first stages of Spanish economic growth. The drop in height coincides with the deterioration of the purchasing capacity in view of the price increases from 1850 to the 1870's (Martínez-Carrión, ed. 2002; Maluquer de Motes, 2005). The loss of real wages is well-documented at the start of the industrial era (Moreno, 2006), or in other words, during the difficult start of industrialisation and the first phase of economic modernisation: banking, railroads, foreign investment and disentanglements, among others (Pascual and Sudrià, 2002; Carreras and Tafunell, 2004; Prados de la Escosura, 2003; Tortella, 1994). Furthermore, these were times of political movement, of the construction of the liberal state, which were marked by the impact of the subsistence crises, exposure to epidemics, and the consequences of the economic and political crises in the final stage of the Isabel II period and during the six-year democratic period. The divergence between economic well-being and physical well-being at the start of modern economic growth would clearly show that income alone could not explain the height behaviour.

2. Mortality and height

Among the main quality of life indicators and the components of human development, life expectancy at birth and infant and child mortality shows the greatest relationship to the biological standard of living. There is no annual series available on life expectancy at birth, or on infant mortality in Spain, but the available data show a close relationship to the trajectory of height. We know that life expectancy was below

30 years of age until the 1880's and that, around 1900, it reached 35 years of age, placing it three points above Mexico and one below Brazil. On century later, it reached a mean of 78 years of age (Table 2). During the 19th century, the values are extremely low and are in accordance with those of an underdeveloped country. Conversely, throughout the course of the 20th century and above all during the second half of the same, there is a true jump, thereby reaching one of the highest values in the developed world in 1999. The poor results reached in the life expectancy of Spaniards until 1900 coincide with those of the stature values, some of the lowest in Europe (Floud, 1994). The strong increase in life expectancy highlighted in the 20th century likewise finds a comparison in the height increase, given that Spain is one of the countries for which the greatest increases in its secular trend has been recorded.

TABLE 2
LIFE EXPECTANCY AT BIRTH BY COUNTRY AND YEAR

Country	1820	1900	1950	1999
Germany	41	47	67	77
United Kingdom	40	50	69	77
Sweden	39	56	70	79
France	37	47	65	78
Netherlands	32	52	72	78
Italy	30	43	66	78
Spain	28	35	62	78
Russia	28	32	65	67
United States	39	47	68	77
Japan	34	44	61	81
Brazil	27	36	45	67
Mexico	-	33	50	72

Source: Maddison (2001), Table 1-5a.

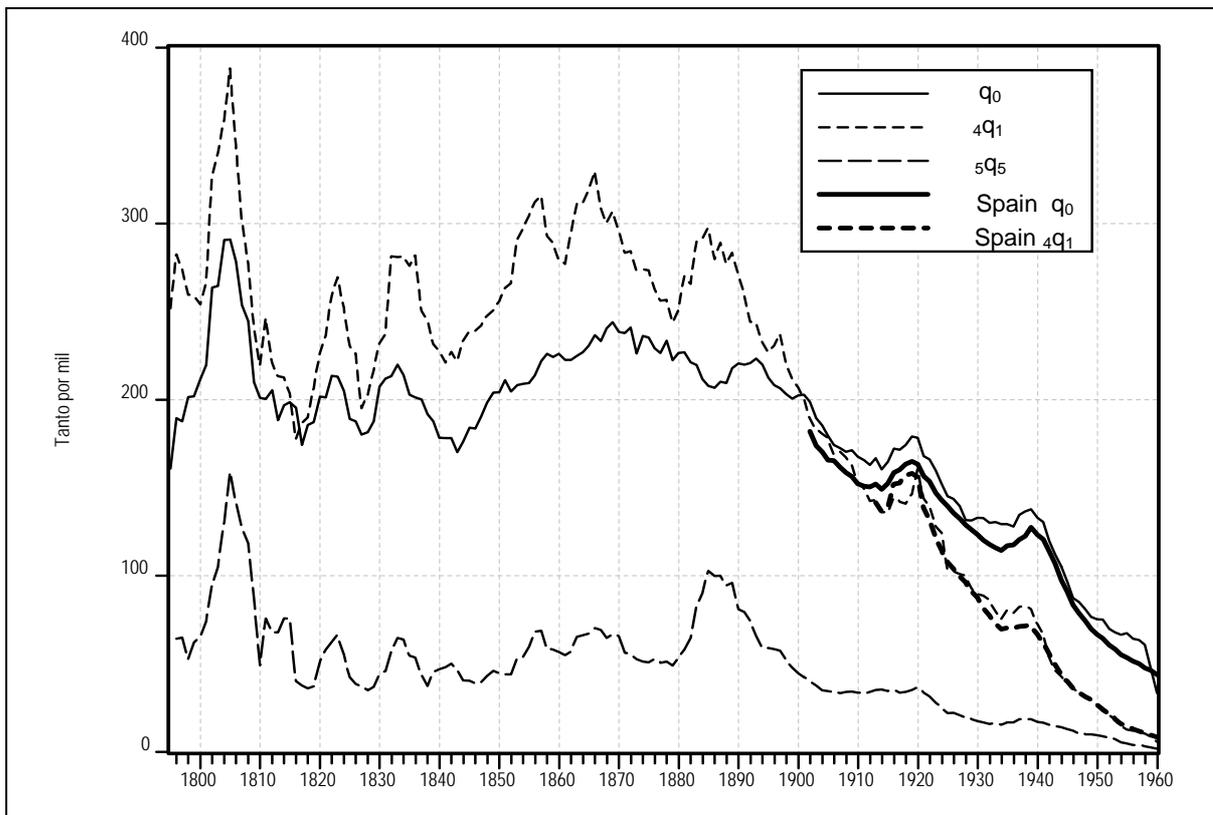
The availability of historical series on infant and child mortality in Spain has multiplied in recent years, and greater effort has been given to its behaviour in the 19th century (Reher, Pérez-Moreda and Bernabeu-Mestre, 1996; Ramiro-Fariñas and Sanz-Gimeno, 2000). The results from various regions reveal an increase in the q_0 , $4q_1$, and $5q_5$ values as from the start of 1840 until the 1870's. In the words of one expert, “*the reductions in the mortality rate that had characterised the 1780-1840 period (except for large mortality crises) were inverted during the middle decades of the century*” (Reher, 1996: 171). The probability of dying before ten years of age ($_{10}q_0$) increased to 25 and 30 percent, and reached values of around 480 per thousand. Even though in many places

of Europe a flare-up of various infant and childhood mortality quotients is recorded, the Spanish data reveal a more significant worsening of the factors associated with the evolution of the mortality rate that is more significant, if this is possible, than in other European populations (Sanz-Gimeno and Ramiro-Fariñas, 2002: 376).

FIGURE 5

EVOLUTION OF INFANT AND CHILD MORTALITY IN SPAIN.

NATIONAL RESULTS (1900-1960) AND RESULTS FROM INTERIOR SPAIN (1795-1960).

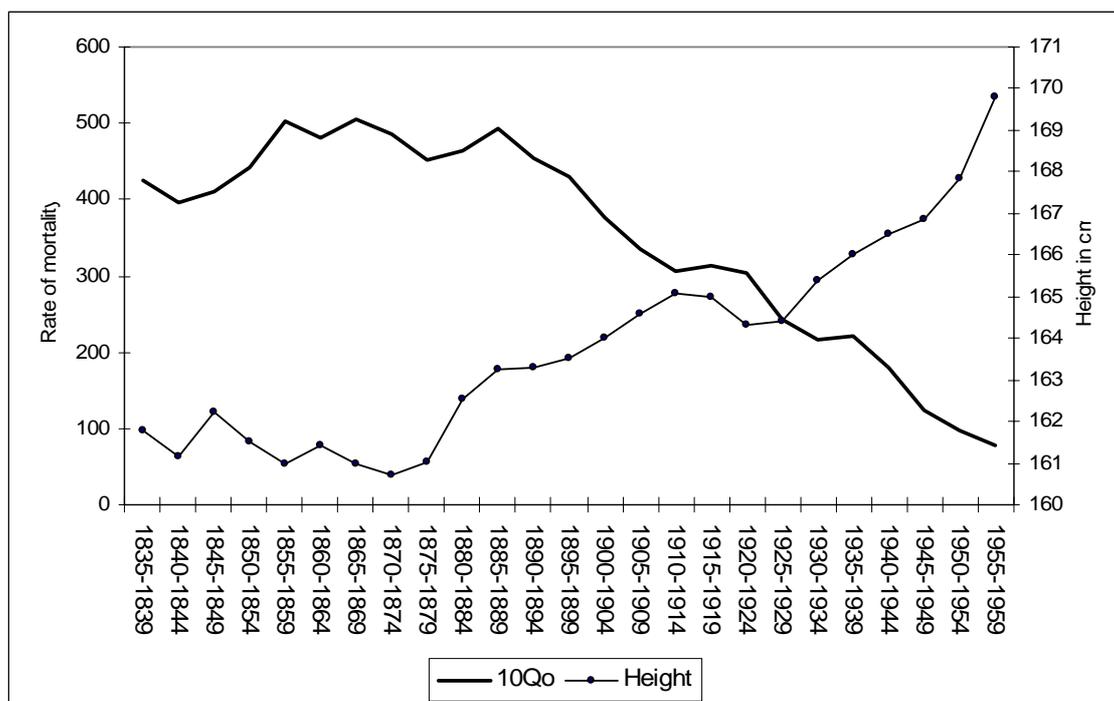


Note: All the series are five-year moving averages.
Source: Sanz-Gimeno and Ramiro-Fariñas (2002), p. 383

The evolution of the mortality rate by infant and childhood ages between the 1840's and 1880's clearly shows a period of deteriorating health and standard of living. The epidemic onslaught period, prominent among which were cholera and typhus in 1833-35, 1853-56, 1859-60, 1863-66, 1868, and 1885-88 (Pérez Moreda, 1998; Sanz Gimeno y Ramiro Fariñas, 2002), the recurrence of the subsistence crises, which were well documented until the 1870's – such as those in 1847, 1856-57 and 1866-68 (Sánchez-Albornoz, 1963, Díaz Marín, 2003; Moreno, 2003) – and the increase of the

ordinary mortality rate explain the deterioration of health until the 1880's, the era when the final epidemic hits of cholera and the high mortality indices begin to decrease (Figure 5).

FIGURE 6
INFANT AND CHILD MORTALITY ($10Q_0$) AND STATURE IN SPAIN



Source: Height data, SE series.

Infant and child mortality data in Sanz-Gimeno and Ramiro-Fariñas (2002), p. 403

The increase in infant and child mortality could have been a determining factor of the biological standards of living until the 1880's, surpassing earnings and income. As observed in Figure 6, there is a close relationship between height and mortality under the age of ten. When the former decreases or becomes stagnant, the indices of infant and child mortality increase, and vice versa. This close relationship suggests that epidemics and exposure to infection must have had consequences on the height of the bodies of children and adolescents. A greater incidence of diseases transmitted by water and food has also been recorded, which could have increased the ordinary mortality and sickness rates (Cussó and Nicolau, 2000). Together with the "dwarfing" of conscripts, a phenomenon that has been shown through the increase of the stunting in almost all regions, all the indices point to a deterioration of the nutritional state as a consequence of deprivation and poverty, in addition to the lack of food hygiene. Protein-energy malnutrition and greater exposure of children to infectious diseases were responsible for

the low statures and the delayed physical growth of the children who survived the age of twenty years. The final years of the 19th century marked the dividing line of the epidemiological transition of Spain, and, similar to what occurs in the stature indices, the infant and general mortality indices improve as from the 1890's. It thereby created the conditions for height to increase and for income to play a more leading role in the dimension of physical growth. Having cleared the danger of the high sickness rate at the end of the 19th century, the positive relationship that is observed between height and income at the age of 13-15 years for those born from 1890 to 1910 thus seems to provide confirmation (Martínez-Carrión and Pérez-Castejón, 2000). This fact finds support in the numerous studies that indicate a relative improvement in hygiene and health, both private and public, in the initial decades of the 20th century and, above all, in the 1920's, due to the promotion of institutional programs on health protection (Pérez-Moreda, 1998). In view of the Spanish stagnation in health and nutrition matters, any improvement – no matter how small – would be noted rapidly in the final mean stature. If we take into account that Spaniards had reached a mean height of around 162-163 centimetres before deteriorating between 1850 and 1870, it is not difficult to foresee rapid recovery in the subsequent decades after a slight improvement in the environmental circumstances.

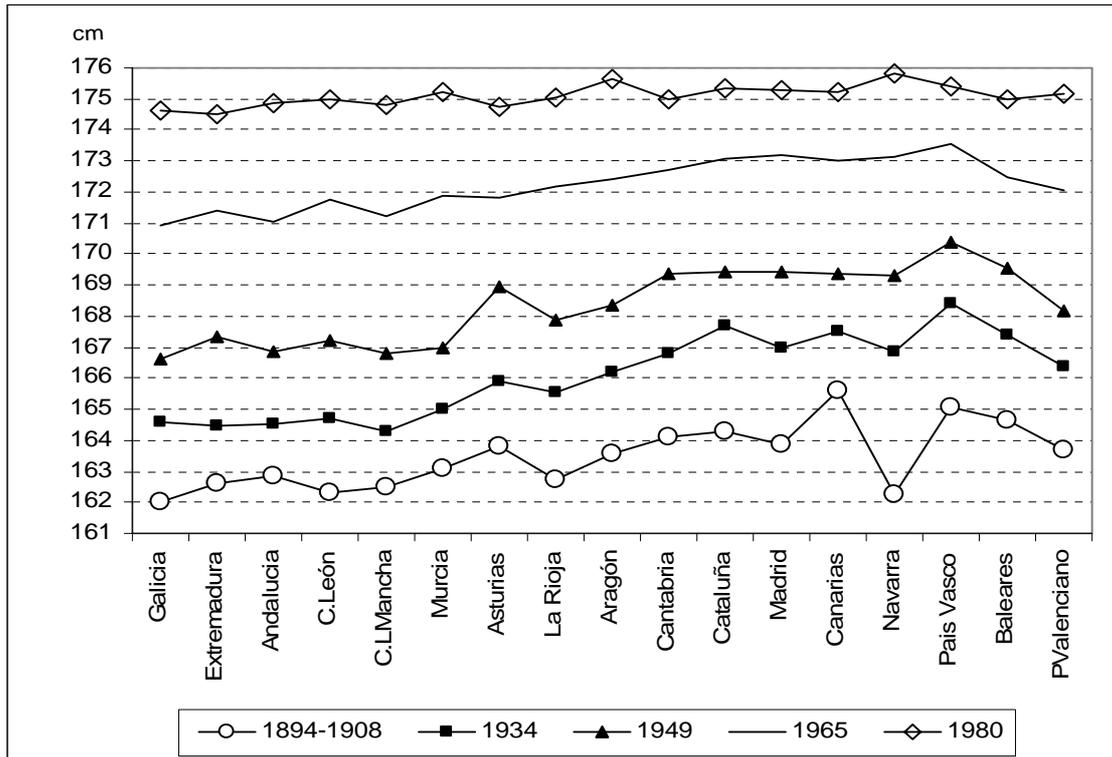
V. STATURE AND REGIONAL CONVERGENCE

Did statures converge as from the mid 19th century? The regional information available for said century is poor, unlike the 20th century, yet there are corrected estimates from Gómez-Mendoza and Pérez-Moreda (1985, 1995) based on statistical yearbooks from 1858 and 1915-1929. Between both dates, there is a prominent study made by the military doctor, Luis Sánchez-Fernández (1913), with data from the 1903-1906 draftees. For the rest of the 20th century, we have the Recruit Statistics of the Ministry of Defence and the data from the National Institute of Statistics (INE) published regularly since 1955.

In the middle decades of the 19th century, the highest mean heights were located in Catalonia, the Valencia region and the Balearic Islands. Although there are no data for the Canary Islands, various local studies put it at the head of the ranking of mean Spanish statures. There also is no data for the Basque Country, but it could probably be put among those at the top of the ranking. Aragón, La Rioja, Navarre and Madrid show

heights above the Spanish mean. Galicia and Asturias show the worst results, together with Castile-León. Western Andalusia and some provinces of the central regions show intermediate heights, even above the Spanish mean.

FIGURE 7
STATURE VARIATIONS BY AUTONOMOUS COMMUNITIES IN SPAIN,
COHORTS FROM 1894/1908 TO 1980



Source: Own preparation based on INE data, Recruit Statistics, and Gómez-Mendoza and Pérez-Moreda (1995).

At the end of the 19th century, the situation changes slightly. The Balearic Islands, Canary Islands, Basque Country and Catalonia show higher heights for the cohorts of 1892 and 1894-1908, in accordance with the estimates made by Gómez-Mendoza and Pérez-Moreda (Figure 7). The latter two regions enjoy greater economic ranking in per capita income and level of industrialisation; the first two regions – given that they are islands – enjoy environmental advantages derived from a certain isolation that protects them from the epidemics and health problems (sickness rate) that show up in most of the stagnant regions of the peninsula. Not in vain, they are prominent – mainly the Balearic Islands – in anticipating the demographic transition, together with Catalonia and the Basque Country, and in this case they both show infant mortality rates

that are generally lower than the rest of Spain during the second half of the 19th century (Dopico, 1987). This behaviour would be motivated by ecological factors and, perhaps, by cultural and educational factors.

The Cantabrian regions (from Asturias to the Basque Country, the Levant [*East Coast*] (with Catalonia and the Valencia Region at the lead), and the island communities show the best results around 1900. In general, the largest heights are prominent in the peripheral provinces, except in the Galicia provinces and the Spanish Southeast, probably due to the considerable emigration (Sánchez-Alonso, 2000). Recent studies confirm that those who emigrate are normally taller and, at the same time, are those who have greater rates of human capital measured by educational levels (Quiroga, 2003b, 2005). Those who have information, those who know the state of relative deprivation, and those who want to get out of poverty are those who emigrate. At this time, the central regions of Castile show the lowest mean heights. These regions are traditionally agricultural, they have little diversification and they are linked to the interior market; this includes Madrid, which has the heavy weight of being the capital, where the incipient industrialisation and urbanisation penalise the biological standard of living at the time, or at least they do not favour it. This situation is observed, with considerable parallels, in the data provided by Sánchez-Fernández on the draftees born in 1883-1886.

Towards the mid 1930's, the short heights were in the found in the regions of southern Spain, the two Castilles and Galicia, with mean heights below 165 cm (Figure 7 and Table 3). Now, the tall heights are located in the regions with industry, such as the Basque Country, Catalonia, Cantabria, Madrid and the Valencia Region, with the Balearic and Canary Islands also prominent. The insular effects continued to be important. In addition to the environmental protection that any island generates, research shows favourable consumption indices, the importance of commercial exchange networks, and certain economic development.⁵

⁵ See the contributions by Antonio Macías on the Canary Islands and by Carles Manera on the Balearic Islands in the collective book published by Germán, Llopis, Maluquer de Motes and Zapata (2001).

TABLE 3
GROWTH OF HEIGHT BY REGIONS IN SPAIN BETWEEN THE GENERATIONS BORN IN 1934 AND
1980

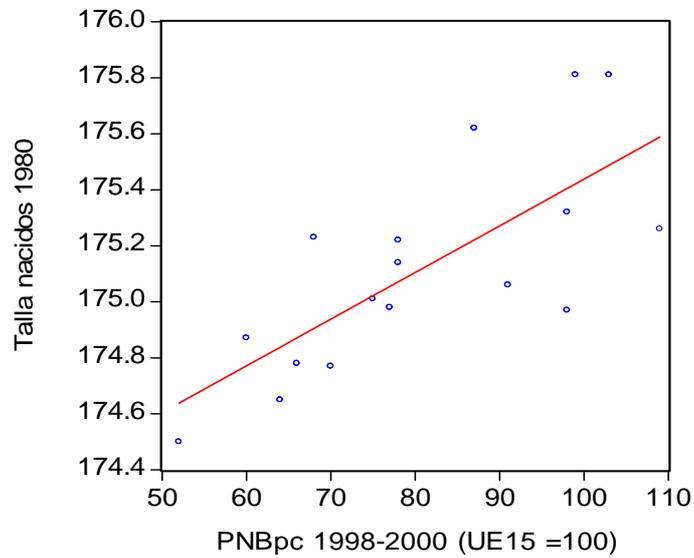
Region	Height in1934 cm	Height in1980 cm	Increment (1934-1980) cm	Increase of height (cm/year)	Rate of growth
Castile-La Mancha	164,29	174,78	10,49	0,23	1,35
Andalusia	164,50	174,87	10,37	0,23	1,33
Castile-León	164,69	175,01	10,32	0,22	1,32
Murcia	164,97	175,23	10,26	0,22	1,31
Extremadura	164,46	174,50	10,04	0,22	1,29
Galicia	164,61	174,65	10,04	0,22	1,29
La Rioja	165,52	175,06	9,54	0,21	1,22
Aragón	166,17	175,62	9,45	0,21	1,20
Navarre	166,87	175,81	8,94	0,19	1,14
Asturias	165,89	174,77	8,88	0,19	1,13
Valencia	166,35	175,14	8,79	0,19	1,12
Madrid	166,95	175,26	8,31	0,18	1,06
Cantabria	166,79	174,98	8,19	0,18	1,04
Canary Islands	167,52	175,22	7,70	0,17	0,98
Catalonia	167,68	175,32	7,64	0,17	0,97
Balearic Islands	167,40	174,97	7,57	0,16	0,96
Basque Country	168,40	175,81	7,41	0,16	0,94
ESPAÑA	165,55	175,08	9,53	0,21	1,22

Source: INE data, Recruit Statistics,

Between the cohorts from 1934 to 1980 (draftees from 1955 to 1999), the most noteworthy advances are shown in the regions with the smallest heights. The draftees of the lagging communities have grown much faster in the last decades of the 20th century, above all since 1970 (since the cohorts of 1949), as it can be seen in Graph 7. Increases exceeding 10 cm are recorded in Castile-La Mancha, Andalusia, Castile-León, Murcia, Extremadura and Galicia (Table 3). At the end of the 20th century, stature grows in all regions, but the tallest are found – like half a century before – in the autonomous communities that have the greatest economic development. If the mean height of the 1999 draftees is related to the GDP per inhabitant in the 1998-2000 period – base 100 indices on the mean of the EU-15 – the results are significant (Figure 8). The relationships that are established between statures and levels of regional economic development are positive, although not as much as observed in Italian regions (Martínez-Carrión, 2005b; Arcaleni, 2006).

FIGURE 8

RELATIONSHIP BETWEEN HEIGHT (1980 COHORTS) AND PER CAPITA INCOME IN SPANISH REGIONS (1998-2000, EU15=100)

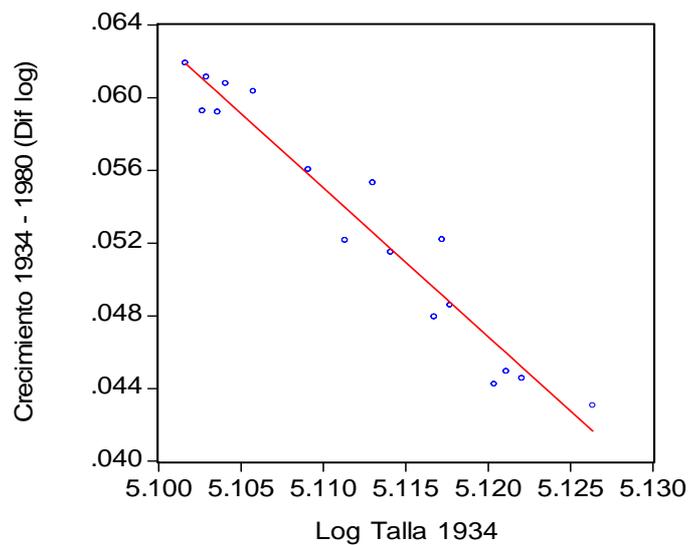


Coefficient: 0.016 t-Statistic: 4.293

Source: Martínez-Carrión (2005b)

FIGURE 9

INTER-REGIONAL CONVERGENCE OF STATURES IN SPAIN (1934-1980)



Source: Martínez Carrión (2005b)

Regional convergence occurs in statures, as it occurs with economic cohesion in the last third of the 20th century. Nevertheless, the regional inequality in biological standards of living widens in some stages of economic development. Let us take a look at the figures. The inter-regional differences were 3.4 cm in the 1894-1908 cohorts, they become notable – 4.1 cm – in the 1934 cohorts, and they still expand to about 5 cm around 1945. The times of greatest regional inequality occur, therefore, in the draftees of the 1960's, right in the middle of the country's industrialisation process when there are great migratory currents, which are mostly responsible for widening the gap of regional inequality (Dominguez, 2002). Since then, the differences tend to decrease, and the inter-regional variations are scarce. In the 1980 cohorts, the differences decrease to just 1.3 cm. The β -convergence analysis presents significant results (Figure 9), and it tells us that, for a group of regions, those regions that initially had a lower mean height than the group's mean do grow more throughout the period.

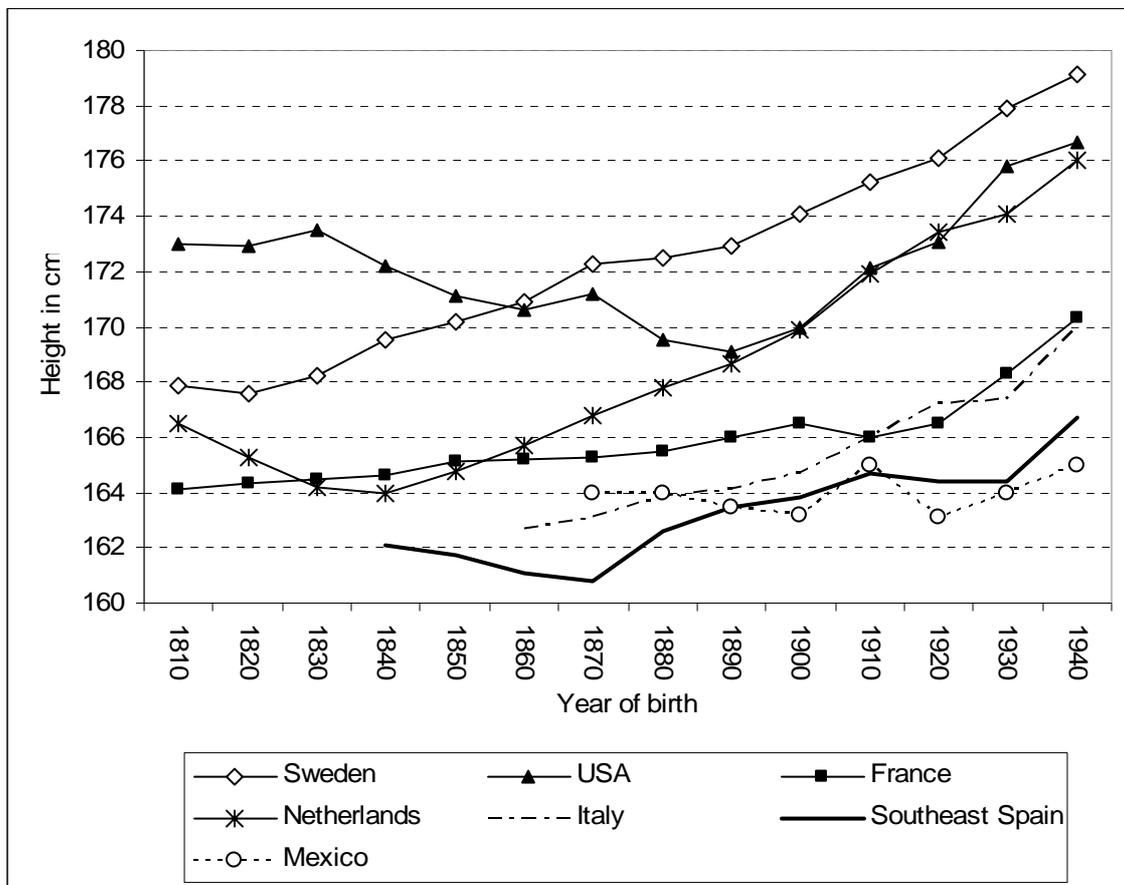
VI. THE INTERNATIONAL CONTEXT

Finally, the mean height of Spaniards is compared with the mean height of some industrialised countries and some developing countries, such as Mexico. In the Spanish case, the evolution of height based on the trend of the SE series is presented for the 19th century, thereby extrapolating it to the national case, something that is normally used in the historiography of other places where there are no statistics, such as the United States. For European countries, we have series available on Sweden, France, Holland and Italy. The results contained in Figure 10 reveal that the mean height of Spaniards was the lowest of European heights, and it was below the height of Mexican recruits until approximately the 1910 cohorts.

The differences are notable when compared with the heights of Swedes and North Americans in the mid 19th century, and they still widen at the beginning of the 20th century, with differences of almost ten centimetres. Conversely, they are lower when compared with the mean heights of French and Dutch recruits. The evolution with respect to the Dutch case is notable, in which the differences were only about two centimetres in 1840, and they increased to ten centimetres in 1940. With respect to Italians, Spaniards were one centimetre shorter in 1890, but the differences increase in favour of the former by three centimetres around 1940. Between 1910 and 1930, Spanish cohorts lose the growth opportunities that are observed in the developed world.

As from 1930, Spaniards grow, but the differences widened tremendously due to the losses caused by the draftees who experienced the Civil War and the post-war period. The data suggest that the biological standard of living of Spaniards was one of the lowest in European countries until the mid 20th century; it was even somewhat lower than the physical well-being of Mexicans during the Porfiriato.

FIGURE 10
INTERNATIONAL COMPARISON OF STATURES
(GENERATIONS BORN BETWEEN 1810 AND 1940)



Source: Sweden in Sanberg and Steckel (1997), p. 129; USA in Costa and Steckel (1997), p.72, and Steckel (2006); France in Weir (1997), p. 191; Holland in Drukker and Tassenaar (1997), pp. 357-59; Italy in Arcaleni (2006); data on France, Holland and Italy since 1910 in Floud (1994), pp. 16-19; Spain, Recruit Statistics, INE, Ministry of Defence, and Quiroga (2003a). Mexico in López-Alonso (2000).

The height of Spaniards converges with the height of Europeans in the final decades of the 20th century in a process similar to the convergence between the Spanish regions. Between 1930 and 1970, Spanish cohorts grew somewhat more than 8 centimetres, with an annual mean growth far above what was recorded in most European countries. This strong increase was due to the pull on well-being exercised by

economic growth starting in 1960, and it was also due to the “recovery” of the physical potential achieved in the pre-war times.

VII. CONCLUSIONS

The biological standard of living of Spaniards has improved notably throughout the 20th century. The mean height grew twelve centimetres during the 20th century after suffering various periods of deterioration: the first among the generations born in 1850-1870 and the second between 1915 and 1930. Between those born in 1838 and 1980, Spaniards increased in height by almost fourteen centimetres. Together with a clearly rising secular trend throughout the course of the 20th century, the existence of cycles in the trajectory of the biological well-being of Spaniards is one of the main conclusions. The first cycle of height deterioration coincides with the increase in prices and the decline of real wages. Considered by historiography as an age of relative “economic prosperity”, what is true is that the worst period for infancy in all the 19th century is recorded between 1840 and 1870, approximately. This fact is corroborated by the high levels of ordinary mortality reached, the increase in infant and child mortality, and the adverse results of the biological standard of living. The recovery of stature in the final decades of the 19th century and the subsequent growth until the generations of the First World War reveal a substantial improvement in the biological standards of living and of well-being of Spaniards, thereby coinciding with the demographic transition.

The second cycle of height deterioration, between the cohorts of 1915 and 1930, is a consequence of the economic climate that is experienced during the 2nd Republic, and above all it is due to the more direct effects on the nutritional state caused by the Civil War of 1936-1939 and the post-war period. In addition to the drop in purchasing power – a decrease in income per inhabitant, a drop in real wages – Spaniards lose several centimetres in height and become one of the shortest populations in Europe, with the respective secondary effects on health and work productivity. The cost of the Civil War and the “long” post-war period were very high from a *biological* point of view. Subsequent history is well known.

Starting from the very low biological standards of living in the middle decades of the 19th century, the most important achievements are reached starting with the generations born in 1930. The largest growth rates in stature are recorded for the draftees of the second half of the 20th century, and they point to a process of inter-

regional convergence starting in 1970. Parallel to this, the increase in stature makes it possible to reach the mean heights shown by the developed world, thereby likewise generating greater conquests of the biological standard of living. In the early days of the 21st century, the mean height of Spanish adult males is around 176 centimetres, one centimetre above the mean height of Europeans.

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