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Generational Effects on Adult Height in Contemporary Spain: Exploring Gender and Individual Heterogeneity*

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Abstract: As adult height is a well-established retrospective measure of health and standard of living, it is important to understand the factors that determine it. Among them, the influence of socio-environmental factors has been subjected to empirical scrutiny. This paper explores the influence of generational (or environmental) effects and individual and gender-specific heterogeneity on adult height. Our data set is from contemporary Spain, a country governed by an authoritarian regime between 1939 and 1977. First, we use normal position and quantile regression analysis to identify the determinants of self-reported adult height and to measure the influence of individual heterogeneity. Second, we use a Blinder-Oaxaca decomposition approach to explain the 'gender height gap' and its distribution, so as to measure the influence on this gap of individual heterogeneity. Our findings suggest a significant increase in adult height in the generations that benefited from the country's economic liberalization in the 1950s, and especially those brought up after the transition to democracy in the 1970s. In contrast, distributional effects on height suggest that only in recent generations has "height increased more among the tallest". Although the mean gender height gap is 11 cm, generational effects and other controls such as individual capabilities explain on average roughly 5% of this difference, a figure that rises to 10% in the lowest 10% quantile.

Key words: Adult height, Generational effects, Individual heterogeneity, Gender gap, Quantile regression, Blinder-Oaxaca decomposition.

JEL classification: I19, N44, N84

Resum: La comprensió dels determinants de l'estatura dels adults és una qüestió important en tant que constitueix una mesura retrospectiva de l'estat de salut i del nivell de vida de les persones. Entre els diferents determinants de l'alçada l'impacte dels factors socio-ambientals, en particular, són un motiu principal de recerca entre els experts. Aquest article analitza empíricament la influència els efectes generacionals (ambientals) sobre l'alçada dels adults tenint present l'específica heterogeneïtat individual i de gènere. La base de dades utilitzada és l'Enquesta Nacional de Salut de 2003 (qüestionari d'adults) representativa de la població espanyola. Primer, mitjançant anàlisi de regressió per MCO i Regressió Quantílica es tracta d'estudiar els determinants de l'alçada declarada dels individus i de mesurar la influència de l'heterogeneïtat individual. Segon, s'utilitza el mètode de descomposició de Blinder-Oaxaca per explicar i descompondre el diferencial d'alçada per gènere i la seva distribució amb el propòsit de mesurar la influència de l'heterogeneïtat en aquest "gap". Els nostres resultats suggereixen una expansió significativa de l'estatura dels adults d'aquelles generacions que es varen beneficiar de la liberalització econòmica del país en la dècada dels anys 50 i, especialment, d'aquelles cohorts nascudes després de l'arribada de la democràcia. Per altra banda, els nostres resultats assenyalen que, pel cas de les generacions més joves, l'alçada ha crescut força més entre els més alts. Si bé el diferencial mitjà home/dona en alçada s'estima en 11 cm, els efectes generacionals i altres controls, com ara les capacitats dels individus, explicarien aproximadament un 5% d'aquest "gap"; si bé aquesta porció s'eleva fins el 10% en el percentil més baix de la distribució.

Paraules claus: alçada d'adults, efectes generacioanals, heterogeneitat individuals, diferències de gènere, regressió quantília i descompisició Blinder-Oaxaca.

1. Introduction

Height is a retrospective measure of an individual's health and is also an outstanding indicator of standard of living (Komlos and Baten, 1998; Persico *et al*, 2005). It is almost completely determined at an early age, typically before the 'early twenties', though the underlying factors are individually heterogeneous and country/culture-specific. In a genetically stable society, changes in adult height might be envisaged as physical returns to psycho-socially beneficial health environments (Steckel, 1995). If so, beneficial inputs such as nutritional improvements, reduction of barriers to comprehensive health care, health awareness and suitable housing conditions may all potentially translate into height improvements (Smith *et al*., 2003; WHO, 1983). The environmental and institutional influences on human height are well recognized. Indeed, some studies estimate that environmental factors are responsible for as much as 20% of adult height variability (Silventoinen, 2003).[1] However, Komlos and Baur (2004) provide stimulating evidence suggesting that the average height of the American population stagnated in the second half of the 20th century. One potential explanation might lie in the fragmentation of the welfare state and the impact of socio-environmental changes that have improved the access of minorities to healthy inputs and achieved greater gender equality. The development of a welfare state which reduced income inequality in Norway seems to have influenced individual height growth/caused a convergence in individual height (Sunder, 2003).

Environmental effects can be considered as generational or specific influences reflecting exposure to similar contemporary time/space limitations (e.g.,

[1] Environmental factors affect dimensions of health and well-being such as the quality of parental care, human safety, access to food and nourishment, social recognition and teenage autonomy as well as economic barriers to leisure activities – all factors that determine height.

social norms, restrictions on freedom, etc.) and budget constraints (e.g., lack of welfare support for health and social care) after controlling for individual heterogeneity (e.g., capacity, geography and other conditions). Other explanations see health-related preferences as being generation-specific (e.g., intensity of sport activity, consumption of vegetables and greens, attitudes towards safety and violence, etc.). Arguably, generational effects on adult height result from contemporary *environmental pathways*, including, among other factors, social norms[2], the quality of personal interactions, and favourable social and educational influences during childhood.[3] From a present-day viewpoint, extreme contexts such as autocratic regimes – in which essential liberties such as freedom of speech and education and the right of association and political affiliation are denied, and international economic exchange is restricted – would be expected to curtail health production through a variety of mechanisms that are still not fully understood. Accordingly, we speculate that if environmental factors influence health production, *generation-dependent environmental change resulting from the reform of institutional and political structures will exert a significant influence on adult height* (e.g., height will be expected to increase after an economic boom or the introduction of democracy).[4]

[2] See Bowles (1998) for a general discussion of the social environmental factors that determine production and consumption activities.
[3] For instance, some contemporary evidence suggests that shorter individuals are more likely to be discriminated against (Frieze *et al.*, 1990). However, Case and Paxson (2006) question this view, saying that height might reflect the influence of "omitted variable biases", most notably the influence of strength and intellectual capacity. Interestingly, when the empirical height specification accounts for differences in individuals' intellectual and physical capacity, the effect of height on wages disappears.
[4] In so far as it affects attitudes towards life, security, changes in social norms and freedom that could ultimately affect health production.

In the absence of natural experiments, the question of socio-environmental influences on adult height is especially relevant in settings where democracy has been introduced or restored. There are several reasons for this, including, in European countries, the establishment of welfare systems that address socio-economic inequalities in wealth and income and create environmentally beneficial conditions for health production. The introduction of structural reforms in the country's organization (e.g., the transition from planned to market economies) might be expected to change the health environment and access to health inputs, and ultimately have a positive affect on well-being. However, the effects of economic and political liberalization on height do not necessarily go hand in hand (Olsen, 1993). Whilst economic liberalization may bring reforms that improve access to food sources, introduction of new technologies and so on, some studies find that the chief effects on human capital come from political liberalization and the introduction of democratic decision-making systems (Tavares and Wacziarg, 2001).[5] With these new systems the effects of economic liberalization would be felt by the entire population, and socio-economic inequalities would shrink as a result.

Generational changes in adult height are likely to reflect a significant degree of individual heterogeneity. While some individuals suffer adverse environmental influence under authoritarian regimes, others may not experience this effect at all, or its effect may be less serious. We hypothesize that the effects of *economic liberalization, but not necessarily those of political liberalization*, will benefit the well-off in the society, and may therefore *"increase height more among the latter"*. On the other hand, the "democratization effect" would be expected to bring the effect of these changes to the entire population and therefore balance out this height

[5] Indeed, while political liberalization is assumed to involve those individuals who uphold democratic values in collective decision-making, economic liberalization refers solely to the

effect. As this effect is more intense at the lower scales of the height distribution, this may lead to a progressive “catching-up” process. Therefore, generation effects may well not be equal across height distribution, with the result that the effect must be examined not only in the “normal position” in the distribution but in the different height distribution quantiles as well.

As far as environmental effects are concerned, it is accepted that certain institutional environments are more damaging to women than to men. Gender differences in height may be due to the existence of unfair social norms[6] (known as ‘environmental disadvantages’) and to disadvantages in the treatment of hazards at childbirth and in gaining access to food, for example (namely ‘disadvantaged access to healthy inputs’) which may combine to give rise to a height gap. The influence of some of these factors has already been pointed out in the feminist economics literature, namely the effects of individual ability (Iversen, 2003) and women’s self-respect compared to men (Nussbaum, 2003, 2004) on women’s power and economic outcomes, which could in turn be considered as determining a gender-dependent health production. However, to our knowledge, the evidence to explain patterns of adult height is limited. Men tend to be taller than women in all countries, though the height gap is most pronounced in Europe; women and men are closest in height in Africa.[7] However, very few studies have examined the potential socio-environmental or economic factors behind this gap.

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areas of economic activity and commerce.

[6] As a result, one might expect the “gender height gap” to be explained by generation-specific effects resulting from gender equality in the education system or at home.

[7] Some researchers suggest that the most pronounced differences occur in well-nourished populations because males are more vulnerable to nutritional deficiencies than females during early development; in poor countries, this phenomenon may stunt the growth of men.

Using data from the Spanish National Health Survey (2003), this paper provides an empirical examination of generational determinants of physical stature for adult men and women in contemporary Spain. The study explores the influence of generation-specific environmental effects on (i) self-reported adult height and distribution (individual heterogeneity) and (ii) the average 'gender height gap' and its distribution in different height quantiles, providing information on the effect of individual heterogeneity as an explanation of the gender height gap. The value of studies based on single country data is due to the assumption of population homogeneity with respect to external factors, which makes it possible to examine the influence of socio-environmental factors. In this regard the relevance of Spain, a country that has seen a set of wide-ranging economic and socio-political reforms in the last half century, is obvious.

The paper is structured as follows. Section 2 reports a self-contained discussion of the mechanisms through which socio-economic position may influence individuals' height. This section describes some historical and institutional contexts that will assist the interpretation of the empirical evidence from Spain. In Section 3 we describe the data and methods. Section 4 presents the results and Section 5 concludes by discussing the paper's results and implications.

2. Background

2.1 Adult Height and its Determinants

<u>a) Genetic endowments and ethnicity</u>

One of the main determinants of human height is genetics. However, the importance of other factors, especially environment and nutrition, is increasingly being recognized. The precise relationship between genetics and environment is complex, as is the exact role of genetics itself. The tendency for taller individuals to exhibit higher outcomes rests on an evolutionary explanation whereby body size provided a direct advantage in the competition for resources, and taller people may possess some favourable characteristics that lead them to reproduce more easily or to be preferred as sexual partners. The existence of gender differences in economic and social participation that constrain women's well-being is well known (Sen, 1999): women also suffer more limited access to literacy and education (Klasen, 2002), and are more vulnerable to forms of physical and psychological violence (National Organization for Women, 2005). This complex problem has social and cultural ramifications, which may stigmatize women or even lead to gender-driven assaults that often go unreported, or child abuse. Finally, the evidence suggests that, overall, Spain comes 27^{th} out of 58 countries rated in terms of gender gap rankings, performing well (reaching 5^{th} place in this classification) on the dimensions of health and well-being and relatively poorly in education (34^{th}) and economic participation (45^{th}) (Lopez-Claros and Zahidi, 2005).

Human height is known to be a highly heritable and multigenic trait. In biological families, the heights of parents and relatives represent a good predictor for the height of the children. The genetic profile (genotype) provides potentialities or proclivities which interact with environmental factors throughout the period of growth. Other than in the womb, humans grow fastest as infants and then during the pubertal growth spurt; if conditions are optimal then growth potential is maximized, but in a post-war situation, or if the government insists on an economy of autarky, malnutrition or neglect may be rife. Maternal health problems during pregnancy may also reduce child height. Adult height is highly dependent on child height at the age of 16 (Persico *et al.*, 2005) as well as on the individual ethnic group, which is especially important in countries receiving waves of immigrants from other culturally and geographically close countries.

b) Environmental effects: changes in the institutional environment

Although genes are key determinants of individual height, many studies suggest that differences in average height across populations are due largely to environmental factors (Steckel, 1995). Some authors state that environmental factors are responsible for about 20% of adult height variability (Silventoinen, 2003). Adults who are shorter due to a poor childhood environment display higher incidences of chronic conditions at adult age (Fogel, 1994). We argue that socio-environmental factors are reflected by generation effects. One theoretical explanation of a generation effect for adult height comes from classical findings that suggest that taller men are more attractive than those of average height (Gillis and Avis, 1980, Shepperd and Strathman, 1989). Even though an evolutionary explanation could predict an increase in adult height over time if taller adults are more successful in attracting partners, empirical evidence suggests a U-shape pattern, that is, a deficit at the extremes of height. Moreover, a pure generation height increase would be questioned because selection favours relatively taller men – above the mean height – and relatively shorter women – below their mean height (Nettle, 2002).

Height and socio-environmental effects have been studied by Komlos and Kriwy (2002) who used regression analysis to explore the existence of height differences according to social status and gender in East and West Germany . Interestingly, their findings indicate that in West Germany middle-class men (women) are 1.7 (1.4) cm taller and upper-class men (women) are 3.9 (3.2) cm taller, but social differences in height are smaller in East Germany. One explanation of these results is that societies where capacity is reimbursed highly tend to show higher height variability. Similarly, in a study in Sweden, Nyström-Peck and Lundberg (1995) found an association between short height and adverse economic status.

c) 'Capabilities': the ability to produce income and knowledge

One of the possible explanations for the differences in adult height is the difference in individual ability to produce health. For some authors, education is as a measure of an individual's efficiency of health production (Kenkel, 1991). Educational attainment in a meritocratic world would be seen as proxying the outcome that results from the application of individual capabilities to knowledge acquisition. A similar argument may well hold for individual final income (Keyes, 1980) so that adult height may be determined by current socio-economic status. However, there is evidence that the cause may lie elsewhere: an additional inch in adult height among males is associated with wage increases of 2.2% in the UK and 1.8% in the US (Persico *et al.*, 2005). Height at the age of seven has been argued to predict subsequent employment and social conditions (Marmot, 2002).

Nevertheless, the prevailing explanation of the significance of socio-economic position may not necessarily capture the effect of current income, since height tends to be determined retrospectively. Indeed, some research suggests that height is generally sensitive to socio-economic conditions (Persico *et al.,* 2005, Komlos and Baur, 2004). That is, height may reflect the influence of “omitted variable biases” (Case and Paxson, 2006), above all strength and intellectual capacity. Interestingly, when the empirical height specification accounts for differences in the individual’s intellectual and physical capacity, the effect of height on wages disappears. Indeed, socio-economic position is expected to capture underlying unobservable variables associated with a social gradient, such as differences in physical stress and urbanization (Greil, 1991). Height is argued to proxy other variables such as ability, strength and health (Steckel 1995, Strauss and Thomas 1998) in enhancing wages, since it is believed to reflect an individual’s perceived competence (Young and French, 1996). However, as we argue, the opposite may well hold true. Income and education attainment measure the efficiency of individuals in accessing material (monetary) returns and knowledge returns respectively to ability and capacity (capabilities). Indeed, some scholars find links between individuals’ cognitive and non-cognitive abilities and economic success (Hartog, 2001).

Another explanation could be that, in a society with limited social mobility, an individual’s socio-economic status is unlikely to change greatly over his or her lifetime. The influence of regional and educational background is reported in Silventoinen *et al.* (1999) for Finnish men and women. Case and Paxson (2006) find that an increase in US men’s heights from the 25th to the 75th percentile of the height distribution is associated with an average increase in earnings of 10%. This is interpreted as evidence of an association between greater ability and larger head size (Lynn, 1989) or the absence of discrimination at younger ages (Magnusson et al, 2006). Parental education has been found to determine individual height (Thomas, 1994, Heineck, 2006). However the causation can be easily reversed: higher capacity will be more likely to give rise to higher levels of education, or through the correlation between individual and parental education level. Similarly an influence of income on adult height is found in several studies (Silventoinen, 2003, Komlos and Kriwy, 2003, Boström and Diderichsen, 1997).

d) Geographical and regional controls

Cross-country data suggest that there are wide differences in adult height even within Western countries with similar institutional settings. Intuitive explanations for geographical controls are country-specific dietary and nutritional conditions. However, globalization may reduce transport costs, and thus help to overcome geographical barriers to access to health inputs and food. On the other hand urban/rural population characteristics may well capture the effects of exposure to pollution, exercise and fitness as well as climate. In the light of previous studies that suggest evidence of regional and urban differences, recent studies have included geographical controls (Heinerck, 2006). Evidence from Italy suggests significant regional differences in height (Arcaleni, 2006), a trend that was found in Italian immigrants to the US as well (Danubio *et al.*, 2005).

2.2 The Institutional Setting: A brief overview of Spain 1920-2000

Spain is an interesting setting for the examination of changes in adult height because of the institutional and environmental reforms implemented in this country. While economic historians have traditionally shown that institutions influence economic performance (North, 1991), one might argue that they impact on other measures of well-being and health, such as adult height. Overall, in half a century Spain has evolved from underdevelopment and authoritarianism to prosperity and democracy . Hence, as we examine here, this transition may have had an impact on anthropometric measurements such as adult height. The country's economic and socio-political reforms included economic liberalization after two decades of autarky (1939-1959) – and the subsequent reforms that introduced economic rights – but especially the effects of the political transition from an authoritarian regime to a parliamentary democracy in the late 1970s and the development of the Welfare State, though the first attempts date back to the introduction of social health insurance for low-salaried workers during the era of the Second Republic (1931–1936).

After the upheavals of the early 20th century, with a dictatorship lasting most of the 1920s, Spain was proclaimed a Republic in 1931, for the second time in its history. The Republic was challenged by large-scale but unsuccessful uprisings in 1932 and 1934, and the Civil War (1936-39) ended in victory for the military insurgents and led to forty years of dictatorship. Under the new regime, the majority of the population lacked basic liberties, a fact which, we argue may well have influenced access to health production inputs. Indeed, the post-war period was marked by brutal repression, exile, and a shattered economy at a time when the rest of Europe was immersed in the 2nd World War. The dictatorship enforced a system of autarkic industrialization in an attempt to achieve self-sufficiency, but the system collapsed within a decade due to severe imbalances in the country's trade and finances and to divisions at the social level.[8] In 1959, as a result of changes in government, an economic reform was introduced known as the Stabilization Plan (designed in cooperation with the IMF) and which built on previous agreements undertaken with the US government from 1951 onwards. At the macroeconomic level, this change of direction resulted in the highest rates of growth in the Western world after Japan, and had a pronounced effect on the patterns of consumption in the Spanish economy (García Delgado and Jiménez, 1999). Reforms in welfare provision were introduced, primarily in health and income replacement insurance after the approval of the Social Security Act of 1967 which set up the basis of health and social security system, with the development of a publicly funded network of primary and specialized outpatient care (Duran *et al.*, 2006).

In the last years of the dictatorship, Spain obtained a preferential agreement with the European Community. After the approval of the Spanish Constitution in 1978, a set of political and economic reforms were put in place, including the recognition of the right of all Spaniards to a healthy environment and adequate public health services. This led to the creation of new institutions, in particular the progressive introduction of new values in schools and the development of the reforms that gave rise to a welfare state and decentralization of social policy (Lopez Casasnovas *et al.*, 2005), especially after the General Health Act of 1986. Furthermore, economic liberalization led to the set up of the social insurance system to cover health care during the late sixties, whereas the set up of a National Health System can be directly attributed to the democratization process of the mid-eighties. However, the prevailing institutional inertia slowed the implementation of

[8] The social repression took the form of the imposition of rigid social norms based on conservative Catholic values, especially in schools. At that time, Spain lagged behind most Western countries in terms of living standards, industrial expansion, and employment growth.

these plans, and consequently the changes took place progressively rather than once and for all.

3. Data and Methods

3.1 Database and Variables

The data used in this paper were taken from the 2003 edition of the Spanish National Health Survey (SNHS). This is a nationwide cross-section survey compiled every two years which gathers information on aspects such as the population's perceptions of their state of health, primary and specialized health care utilization, consumption of medicines, perceived mortality, lifestyles, conducts related to risk factors, anthropometrical characteristics, preventive practices and socioeconomic characteristics.[9] The SNHS-2003 follows a stratified multi-stage sampling procedure in which the primary strata are the Autonomous Communities, and sub-strata are then defined according to population size in particular areas. Within the sub-strata, municipalities and sections (primary and secondary sampling units respectively) are selected using a proportional random sampling scheme. Finally, individuals are randomly selected from the sections. The survey provides weighting factors to raise the estimations to the national level.

As is common practice, our measure of physical stature is obtained from respondents' responses to a question about their height (in centimetres) without shoes. Since the analysis uses self-reported data on height, reporting bias is obviously a problem. The literature acknowledges the existence of overestimations of height that vary with individuals' age and gender (e.g., individuals become shorter with age, though at different rates depending on gender) though this difference seems to disappear in older age groups (cf. Giles and Hutchinson, 1991; Hill and Roberts, 1998; Cavelaars *et al.*, 2000 and Ezzati *et al.* 2006). A recent study concludes that while men tend to overestimate their reported height, women report their height quite accurately (Cizmecioglu *et al.*, 2005). As our study focused on adult height, we restricted our sample to adult subjects, to avoid potential biases resulting from the fact that younger individuals have not yet reached their final height (Persico *et al.*, 2005). Though we were fully aware of the over-reporting problem, we decided not to correct our sample for two main reasons. First, we do not have information on the precise magnitude of the bias present in the data. Secondly, and perhaps more importantly, we do not actually need exact measurements, given that all we want is to stress the influences or effects of our variables of interest.[10]

Our original sample contained 21,650 adults aged 16-99 from all Spanish regions. Some 329 observations were deleted due to missing data and 5,320 observations were also dropped because no data were available on household income, a variable of interest in our investigation though no influence on potential sample selection was found. Finally, the estimated sample contained 16,001 adults (7,249 men and 8,752 women).

Table 1 reports the definition, mean and standard deviation of the variables used as determinants of height in the empirical analysis. Eight dichotomous birth

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[9] The SNHS-2003 contains separate adult (16+) and children samples in addition to a household questionnaire.

[10] Nonetheless, the findings are very similar after adjusting adults' self-reported height, taking into account the amount of height decline according to age and gender from the peak stature found by Chandler and Bock (1991). The estimates are available from the authors on request.

cohort variables were defined in order to reflect generational effects on individual height. Of course, we expected to find a positive, increasing cohort effect on height in younger generations (Komlos and Kriwy, 2002). To further explore the relationship between physical stature and individual abilities, two sets of variables were used. First, we used income to proxy individual abilities to generate returns on effort, in other words we assume income to reflect individuals endowments besides effort . Since earnings (i.e., total monthly net household income) in the SNHS-2003 are measured as a categorical variable with eight response categories, a (weighted) interval regression model was applied in order to obtain a continuous household income measurement. Once we had worked out net household income, we divided it by an equivalence factor (the number of household members powered to 0.5) to adjust for differences in household size and composition. Secondly, as another proxy of individual abilities, we used educational attainment, defining up to four categories of education: unschooled and/or illiterate, primary education, secondary education and university education. Survey data has been commonly used to study a social gradient in individual height (see Komlos and Kriwy, 2002). In view of previous studies – for example Komlos and Kriwy, 2002, who found that in both East and West Germany middle- and upper- class men and women were significantly taller than their lower-class counterparts – we expected a positive correlation between SES and physical stature for our Spanish dataset as well.

We also explored the role played by nationality and lifestyles as covariates to explain differences in physical stature. Since we do not have information on ethnic groups, we distinguished between nationalities, namely Spanish vs. overseas nationals, classified geographically. We are aware that our database underestimates the number of foreigners: indeed, 97% of interviewees were Spanish. For lifestyles, we constructed a set of dummy variables to measure alcohol consumption over the last 12 months, smoking habits, and the number of hours slept per day.

Finally, our empirical specification also contains other control variables.[11] In order to control for some rural/urban height differences resulting from better access to health inputs, we defined up to four dummy variables depending on the size of the interviewee's area of residence. Similarly, a dummy variable was included to capture the impact of insularity, that is, of living on an island (i.e. the Balearics or the Canaries) as opposed to living in the Iberian Peninsula. Two other regional variables were included in the model as controls: the percentage of kilometres of shore in each region, intended to proxy an (arguably) free access to fish, and the percentage of the region's immigrant population, to control for regional distribution of immigrants. To interpret the coefficients, we arbitrarily chose the reference category of the analysis to be the birth cohort of 1930-39, unschooled or illiterate, born in Spain, alcohol consumer and current smoker, living on an island and living in a village.

As Table 1 shows, overall birth cohorts are quite evenly distributed in the sample with the exception of the first and the second groups, clearly as a result of the high mortality of the Spanish Civil War (1936-1939). As mentioned above, the vast majority of individuals were Spanish nationals (97%), more than 60% live in

[11] To carry out meaningful empirical analysis there must be a sizeable "control group". This means that recent experience is difficult to analyse. Here we examine height changes compared to the generation born in 1930-39 who lived through the turbulent period of the Second Republic and the Spanish Civil War (1936-1939).

towns with fewer than 100,000 inhabitants, and most had completed primary (31%) or secondary (36%) education. Interestingly, a significant percentage had consumed alcohol in the last 12 months, but only 30% were smokers at the time of the interview. On average, each Spanish region shares almost 30% of the shore perimeter and the percentage of immigrant population residing in each region is roughly 10%.

3.2 Accounting for Individual Heterogeneity: The Normal Position Model and Quantile Regression

Traditionally, individuals' height has been assessed using the normal position model (ordinary least squares) to examine the determinants of the expected value or the conditional mean of the variable of interest. However, the method only provides information on the effects of variables that affect the total mean height, when in fact there may well be significant unobserved heterogeneity that must be controlled for. To obtain this information we could use the Quantile Regression (QR) framework (Kroenker and Hallock, 2001), as Kan and Tsai (2004) did in a study of obesity; the QR allows us to measure the determinants of an individual's physical stature at different points of the height distribution, and to obtain an estimate of the returns on health investment at different ages, specifically in adults. This information is important because it may identify otherwise unobserved effects that relate only to individuals at one or other extreme of the height distribution. The advantage of this method is that it takes into account the heterogeneity in individual height distribution, and thus controls for some of the unobserved heterogeneity: for example, it may well be that lifestyles explain an increase in the lower percentiles of the height distribution. QR provides substantial advantages over alternative estimation techniques that require splitting the sample into different measures.

The QR model specifies the conditional quantile as a linear function of covariates. Denoting individuals' height as H_i, the QR model to the θth (0<θ <1) quantile can be expressed as:

$$H_i = \beta'_\theta X_i + \mu_{\theta i} \tag{1}$$

where $\beta_{\theta i}$ is a vector of coefficients, X_i a vector of economic determinants and $\mu_{\theta i}$ a random term, so that :

$$Q_\theta(H_i \ / X_i) = \beta_\theta X_i \tag{2}$$

where Q_θ is the conditional quantile or the θ quantile of the height density conditional on X_i and $\beta_{\theta k}$ refers to the marginal change in the θth conditional quantile due to a change in X_{ik}. The standard errors from QR may be computed analytically and calculated using 'bootstrapping' methods (Koenker and Bassett, 1978, Rogers, 1993).

3.3 Gender Height Gap Decomposition

To quantify the factors that explain gender differences in mean height, we follow the standard Blinder-Oaxaca linear decomposition procedure. The technique is easy to apply and only requires coefficient estimates from linear regressions and sample means of the covariates used in the regressions. We depart from the following models:

$$H_i^m = X_i^m \beta^m + \mu^m$$

$$H_i^f = X_i^f \beta^f + \mu^f \qquad (3)$$

where the *m* and *f* subscripts refer to males and females respectively. Now, following the well-established Blinder-Oaxaca decomposition, the average male/female height gap can be expressed as:

$$\overline{H}_i^m - \overline{H}_i^f = \left(\overline{X}_i^m - \overline{X}_i^f\right)\hat{\beta}^m + \overline{X}_i^f\left(\hat{\beta}^m - \hat{\beta}^f\right) \qquad (4)$$

where $\overline{H}^j$ is the predicted mean value of height, $\overline{X}_i^j$ is a row vector of average values of the independent variables and $\hat{\beta}^j$ is a vector of coefficient estimates for gender *j*. This allows us to decompose the influence of each of the factors included in our regression model on the difference in the outcome variable of interest. The first term in brackets in equation (4) measures the portion of the gender gap that is due to group differences in the distribution of X or differences in observed endowments ("the explained part"), while the second term reflects the portion of the gender gap attributed to differences in unmeasurable or unobserved endowments or characteristics ("the unexplained part").

Furthermore, given that gender differences might well be subject to an individual heterogeneity that is unobservable to the researcher, we use QR to examine whether extending the approach captures additional heterogeneity, following Garcia *et al.* (2001). Accordingly, given a set of observable characteristics X_i, male and female height can be compared at different quantiles, as follows:

$$\hat{Q}_\theta(H_i^m / X_i) - \hat{Q}_\theta(H_i^f / X_i) \qquad (5)$$

So, assuming that the θth quantile of the error term is zero, it is possible to estimate the predicted gender gap, as follows:

$$\hat{Q}_\theta(H_i^m / X_i) - \hat{Q}_\theta(H_i^f / X_i) = X_i(\hat{\beta}_\theta^m - \hat{\beta}_\theta^f) \pm \varepsilon \qquad (6)$$

where the choice of X_i is arbitrary and so is the error term (ε).

4. Results

4.1 Preliminary Evidence

Figures 1a and 1b report the distribution of adult height by age groups for both men and women in 1993 and 2003 in Spain. The principal differences in adult height suggest the existence of a 'generation effect'. Indeed, with the exception of some smoothing out at ages 16-19 for men (when subjects are still growing)[12], in general we can conclude that younger generations are systematically taller. The

[12] Peak growth velocity is about 12 for females and 14 for males (Beard and Blaser, 2002, Case and Paxson, 2006).

cross-cohort difference peaks at the ages of 40-49 for men and 30-39 for women: these are the first generation of the democratic period in Spain, and the children of the first baby boom.

Table 2 provides empirical evidence of the age/gender distribution of adult height, using survey data from four different sources from 1993, 1997, 2001, and 2003. Generation changes seem to provide consistent height data that suggest that the data are reliable for our purposes. Interestingly, the result indicates that, as would be expected from an evolutionary standpoint, an individual's height increases with generation change regardless of gender, but the rate at which it changes varies markedly. Indeed, there is a significant height change across generations. While change in height from the age group over 60 (those that suffered the immediate consequences of the Spanish Civil War) – to the following generation is about 10%, from then on the height changes is no more than 1.5%. Indeed, some studies suggest that the period from birth to age three is generally identified as the postnatal period that is most critical to adult height, and the war or the immediate post-war period may well have impeded access to the treatment and prevention of respiratory and other conditions, and had a negative effect on the quality of parental care giving and on leading an autonomous life (Martorell *et al.*, 1994, Komlos *et al.*, 1992).

Descriptive evidence suggests that mean height has traditionally been low in Spain compared with rest of Europe. Spanish females are shorter than other European females (with mean heights of 161.5 cm and 164 cm respectively) though the mean height for males (175 cm) is the same as in other EU countries. Currently, one out of five men is taller than 179 cm and only 3.3% are shorter than 160 cm, whereas around 30% of females are below 160 cm Furthermore, the examination of gender effects in Spain is important because of the sexist values that prevailed in Spanish society in the late seventies. The extent of women's dependence on men at the time is reflected in the absence of full civil liberties (such as the right to sell property) until the reform of the Civil Code after the end of the dictatorship. The persistence of sexist stereotypes may partially explain the persistence of a high gender gap, since girls did not enjoy the same rights as boys at school, being unable to make free choices regarding their basic education, social life, behaviour and so forth.

As expected, men (168.4 cm) are taller than females (153.9 cm), confirming the existence of a *gender gap*. For men in the last 10 years there has been an average height increase of 1.53 cm in the 16-19 year cohort, 1.77 cm in the 20-29 year group, 1.82 cm in the 30-39 year group and 2.89 cm in the 40-49 group (see Table 2). In women, height differences are more moderate: about 1 cm at early adult ages and a peak of 1.77 cm in the 30-39 age group, falling again to 1.06 cm in women aged 40-49 and disappearing thereafter. In fact, women aged 80 and over in 2003 have lower heights, which might be related to the fact that they were growing up during the Civil War. To put these differences into context, it should be borne in mind that over the period 1775-1995 average heights in the UK rose by 9.1 cm (Fogel, 1994). Comparing these results with those of the US, where the figures remained stable one might conclude that institutional and socio-environmental changes seems to affect adult height over time.

4.2 Normal position model (OLS) results

OLS parameter estimates of the determinants of (self-reported) adult height are displayed in Table 3. Robust standard errors and sampling weights were used in the estimation procedure. Estimates of the 'variance-inflation factors' for each variable included in our empirical specification allows us to rule out the presence of serious multicollinearity problems. R-squared values suggest that covariates included alone explain between 16-20% of the variability in height. The F-statistics suggest no evidence of joint insignificance of estimated parameters. Among all variables included, income could be argued to be endogenous. However, as Case and Paxson (2006) argue, the association between income, social position and height is quite likely to result from the existence of a third variable, such as individual ability. This is the interpretation that we apply to the significance of the variable income and education.[13] At the bottom of the table we report the Chi-squared statistics for Hausman's exogeneity test for the income variable, and conclude that income is exogenous and can estimate both equations by OLS.

As Table 3 shows, we find significant, increasing generational differences in height, especially from the 1950s onwards, suggesting that the impact of generation-specific effects due to a stable environment is a sound explanation. Men born before the 1920s do not differ in height from those born in the 1930s (our excluded **reference** group). Interestingly, along with cohorts born in the 1920s and 1940s these are the groups that suffered the immediate consequences of the post-civil war autarky. However, women born in the 1920s were significantly smaller, a fact that may indicate improvements in gender equality in the Second Republic. These specifications reflect the effects of generation, as well as the effects of abilities (income and education) measuring the impact of individuals' ability to

[13] Arguably, income here measures unobserved variables such as ability and innate skills which,

produce height. Some endowments linked to genetic and cultural factors may be associated with nationality and ethnicity in a setting such as Spain which has received immigration waves in the last decade

Following the literature, the specification also contains lifestyles and geographical controls. Interestingly, we find that after controlling for geography, lifestyles, nationality and ability, generational effects are highly significant and suggest that environmental factors – linked with changes in the institutional setting – underlie health production at growing ages. For instance, while men (women) born in the 1950s are 2.46 (1.12) cm taller than individuals born in the 1930s, men (women) born in the 1980s who grew up in a democratic environment with self-fulfilling institutions such as the welfare state (the right to health and social care) are 6.79 (5.06) cm taller than their counterparts born in the 1930s. Especially significant is the height changes experienced by the 1960s generation who benefited from the increasing economic liberalization and coincided with the Spanish "baby boom", by the 1970s generation, possibly due to the welfare reforms, and finally by the 1980s generation which could more clearly be linked to the political reforms that took place in Spain. Interestingly, adult height increase is generally more than one point greater in males than in females, possibly due to the adverse socio-environmental conditions experienced by women.

As expected, we found a modest but positive and statistically significant effect of ability, measured by income and education, on physical stature. Income elasticity of height is 0.004 for men and 0.003 for women, indicating that doubling an individual's income produces a 0.4 (0.3) per cent increase in height. Differences

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for similar investments in human capital, allow individuals to gather a larger pay off.

in height according to the ability to obtain income and/or knowledge are more notable when educational attainment is analysed. Our data show that physical stature increases sharply with level of education: men who have completed university education (secondary education) are 4.45 cm (3.35 cm) taller than their unschooled or illiterate counterparts. The same applies to women, although the impact of education on height is smaller: women with university education (secondary education) are 3.22 cm (2.44 cm) taller than unschooled or illiterate women. Overall, we conclude that the ability to produce health at younger ages – both due to existing endowments or as a result of parental influence (education) – is a positive and significant determinant of individual height. However, other unobserved factors may well underlie the results, such as parental educational attainment. Indeed, we find evidence of lifestyle choices for women which reflect some forms of anxiety, as well as geographical variables that could explain nutritional choices and access to food.[14]

4.3 Quantile regression results

Exploring the impact of the determinants of physical stature on individuals' height distribution, Tables 4 and 5 show the estimates for the conditional quantile functions on self-reported height for men and women, using the same specification as that of the conditional mean (the normal position model). The variance-covariance matrix of the QR estimates is obtained via bootstrapping methods with 100 replications. Interestingly, generational effects reveal significant differences across the height distribution both for men (Table 4) and for women (Table 5). By

[14] However, geography refers to current place of residence, which is not necessarily the place of growth for all the individuals included in the sample.

taking the male generation born in the turbulent period of the 1930s as a reference, we find no differences in height evaluated in the top quantiles (the tallest) between the reference group and the tallest born in the 1920s and before, but a negative effect for the height of the shortest. Interestingly, no differences were found in the shorter individuals between the reference generation group and the groups born in 1940s and even those born in 1950s when evaluated at the 10% quantile, whilst for the taller individuals there was a positive effect. Furthermore, the generational effect is systematically greater for taller men, the difference being roughly double for the tallest compared with the shortest. For women the generation effects point in the same direction. Whilst shorter women born in the 1920s or before exhibit below average height levels (compared with the reference generational group), women born in the 1940s and 1950s did not differ from the reference group. Generational effects reveal only small differences in height across the height distribution, which we will examine later.

These results seem to suggest that environmental effects are more significant for taller than for shorter men. Explanations for this are largely speculative, including selective mortality of the shortest in adverse environmental circumstances, a more suitable growing environment for taller individuals who have taller parents too, or discrimination against the shortest in the access to health inputs in adverse economic and environmental scenarios. Interestingly, gender differences suggest that shorter men and both short and tall women are exposed to similar environmental effects on adult height, and accordingly the main gender height differences patterns apply to relatively taller men, who seem to have taken advantage of the favourable circumstances of institutional reforms. The effects of the changes in the 1950s and 1960s – linked to economic liberalization and the relative openness of the country – seem to have increased height in relatively taller men and women, though the effects on men are twice as large. The reforms of the 1970s and 1980s seem to have led to another significant height increase: for shorter women the effects of the transition to democracy are greater (roughly 2.5 cm) than for relatively shorter men (roughly 1.5 cm) whilst for taller men and women the effect is similar (about 3 cm).

Besides generation effects, we find evidence of the effects of ability on adult height for both men and women. Yet, whilst income effects are relatively stable across the height distribution, the effects of education are greater among shorter individuals. Compared with the reference category, the increasing effects of education suggest that individuals more able to acquire knowledge tend to be more efficient in producing health, especially if they are relatively shorter. By comparing Tables 4 and 5 we find that educational ability is more important for women than for men. The effects of nationality and ethnicity are unstable across the height distribution, though Euro-North Americans are taller than South Americans. Differences in the effects for nationality are larger for men than for women. Lifestyle controls are mostly non-significant; only for taller men does alcohol consumption explain relatively lower height. Regarding geographical controls, significant effects are found for men and women for residence on an island, which explains access to certain types of food, namely fish, and other related health inputs, namely more sunlight, less stress and so forth.

4.4 Gender height differentials

In our dataset the mean gender height gap was 11.74 cm (table 6). After applying the standard Blinder-Oaxaca decomposition analysis on this mean differential and setting the male equation as a reference, we conclude that the explained portion or differences due to endowments or characteristics is very low – 4.7% – while the unexplained part or differences due to different coefficients (including the intercept) or “returns” is sizable, amounting to 95%. This result unambiguously shows that factors unobservable to the analyst may well explain the estimated gap. The results are roughly the same when the reference group is women (data not shown).

However, this picture is somehow limited in the sense that it considers only the information provided by conditional means, which may lead us to conclude that the size of the height gap and the weights of the covariates that make it up are constant over the height distribution. As additional evidence, we use QR and decompose gender height differentials to model the marginal height distribution as a function of individual characteristics. Table 7 presents the predicted height at the 10th, 25th, 50th, 75th and 90th quantiles of the height distribution conditioned on the vector of mean characteristics in the sample (García *et al.*, 2001). The table also includes the gender gap computed from the QR estimates and the portion of the latter that can be explained by differences in average characteristics between men and women.

Note that height in all the predicted quantiles is always higher for men than for women, and that this height gap that the model predicts for individuals with the mean sample characteristics is greater at taller heights. The greatest difference is found at the ninth quartile (12.89 cm). However, note also that the “explained” height difference is lower for these taller individuals: 10% in the case of the 10th quantile and 5.5% for the 90th quantile. As hypothesized, individual heterogeneity appears as a key component in explaining the gender height gap. Our results suggest that the *explained gender gap roughly doubles at the lower quantiles of the height distribution*, meaning that generational effects are particularly marked for shorter individuals. This result indicates that gender discrimination is most prevalent in shorter women, which can be explained by the barriers to access of health inputs that continue to affect women more than men.

5. Discussion

This paper examines generational effects on human height, taking into account gender and individual heterogeneity. We find significant evidence of generation effects on adult height in Spain. These results are consistent with the hypothesis of an existing return to institutional reforms not only in economic performance (North, 1989, 1990), but in the adoption of suitable environmental conditions for health production. Interestingly, these effects explain on average 5% of the gender height gap. However, both the overall effect of generational influences and its explanatory power in decomposing the height gap is greatly influenced by individual heterogeneity.

The main contribution of this paper is its presentation of significant evidence of the influence of generation-specific institutional reforms as an explanatory determinant of human height (a retrospective view of human health) which differs across genders. The Spanish experience suggests two specific processes of height expansion resulting from the economic liberalization and the inception of democracy and its institutions. Furthermore, the convulsive decade of the 1930s with three years of Civil War and the post-war period seems to have exerted a brake on height increase. However, the effects of generational dependence reforms are different across the height distribution; "generational effects are larger among the tallest", and especially among taller men compared to women. Capabilities, measured by the specific ability to produce (self-reported) income and knowledge (educational attainment) seem to produce taller height.

Nationality and geographical controls have a certain effect, but are heterogeneous across the height distribution.

Interestingly, whereas generational effects and other controls explain only about 5% of the mean gender height gap when evaluated at the lowest 10% quantile, the explain roughly 10% of such gap. Overall these results suggest that there are still gender-specific brakes that limit improvement in females' height resulting from a sexist environment or genetic influences. These results might well be due to gender-specific conditions at growing ages and the pre-existence of evolutionary effects and environmental discrimination that is not captured with a cross-section of human height. The influence of income and education on human height is interpreted as evidence of individual's capabilities (Paxson and Case, 2006). On the other hand, the predicted gender height gap increases along the height scale although the explained part of height differences is lower for taller individuals. Our results therefore confirm that the conditional mean estimates of height fail to represent accurately the pattern of differences encountered throughout the height distribution. Finally, it is important to stress that our study looks exclusively at evidence from a single country, and the institutional and environmental effects which well be country-specific. Future research may provide further insights into these questions.

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Table 1. Variables and Definitions (N=16,001)

Variables	Definition	Mean	Std. Dev.
Generational Effects (Socio-environmental and Institutional Factors)			
Generation <1920	Dichotomous variable: 1 if the adult was born before 1920	0.0219	0.1466
Generation 1920-29	Dichotomous variable: 1 if the adult was born between 1920 and 1929	0.0803	0.2718
Generation 1930-39	Dichotomous variable: 1 if the adult was born between 1930 and 1939	0.1139	0.3177
Generation 1940-49	Dichotomous variable: 1 if the adult was born between 19040 and 1949	0.1214	0.3266
Generation 1950-59	Dichotomous variable: 1 if the adult was born between 1950 and 1959	0.1531	0.3600
Generation 1960-69	Dichotomous variable: 1 if the adult was born between 1960 and 1969	0.1953	0.3964
Generation 1970-79	Dichotomous variable: 1 if the adult was born between 1970 and 1979	0.1989	0.3992
Generation 1980-89	Dichotomous variable: 1 if the adult was born since 1980 and 1989	0.1152	0.3193
Capabilities (Strength Intellectual capacity, etc)			
Equivalent Income	Equivalent net monthly household income (in Euros)	785.06	461.347
Unschooled	Dichotomous variable: 1 if the adult is unschooled or illiterate	0.1376	0.3445
Primary education	Dichotomous variable: 1 if the adult completed primary education	0.3096	0.4623
Secondary education	Dichotomous variable: 1 if the adult completed secondary education	0.3557	0.4787
University education	Dichotomous variable: 1 if the adult completed university education	0.1971	0.3978
Ethnicity & Nationality controls			
Spanish	Dichotomous variable: 1 if the adult is of Spanish nationality	0.9690	0.1733
Euro-North American	Dich. variable: 1 if the adult is of European or North American nationality	0.0088	0.0936
South-American	Dichotomous variable: 1 if the adult is of Latin American nationality	0.0160	0.1256
Asian-Oceanian	Dichotomous variable: 1 if the adult is of Asian or Oceanian nationality	0.0018	0.0427
African	Dichotomous variable: 1 if the adult is of African nationality	0.0043	0.0653
Life Styles controls (Anxiety, Personality, etc)			
Alcohol consumption	Dichot. variable: 1 if the adult has consumed alcohol in the last 12 months	0.5629	0.4960
Current smoker	Dichotomous variable: 1 if the adult smokes on daily or almost daily basis	0.3031	0.4596
Past smoker	Dichotomous variable: 1 if the adult does not currently smoke but smoked in the past	0.1716	0.3770
Never smoked	Dichotomous variable: 1 if the adult never smoked	0.5253	0.4994
Hours of sleep	Number of the hours usually slept by individuals per day	7.431	1.4853
Geographical controls			
Coast	Percentage of Kilometres of coast in each Spanish region	0.2910	0.2284
Residence on an island	Dichotomous variable: 1 if the adult lives in Balearic I. or in Canary I.	0.0929	0.2765
Regional Immigration	Percentage of immigrant population in each Spanish region	0.0935	0.0753
Village	Dichotomous variable: 1 if the adult lives in a town with less than 10 thousand	0.2537	0.4351

	inhabitants		
Town	Dichotomous variable: 1 if the adult lives in a town with between 10-100 thousand inhabitants	0.3574	0.4793
City	Dichotomous variable: 1 if the adult lives in a town with between 100-400 thousand inhabitants	0.2400	0.4271
Big City	Dichotomous variable: 1 if the adult lives in a town with more than 400 thousand inhabitants	0.1489	0.3560

Note: Mean and Standard Deviation computed using sampling weights.

Table 2. Mean Height by Gender and Age Groups in Spain: 1993-2003

		2003 (N=21321)		2001 (N=19303)		1997 (N=)		1993 (N=17944)	
Gender	**Age Group**	**Mean (cm)**	**s.e**	**Mean (cm)**	**s.e**	**Mean (cm)**	**s.e**	**Mean (cm)**	**s.e**
Men	16-19	175.69	0.38	176.15	0.27	175.47	0.65	174.16	0.229
	20-29	176.40	0.21	176.36	0.17	175.59	0.32	174.63	0.165
	30-39	174.52	0.17	174.37	0.16	174.06	1.11	172.70	0.167
	40-49	173.13	0.16	172.06	0.19	170.69	0.51	170.34	0.175
	50-59	170.17	0.20	170.00	0.18	168.30	0.45	168.89	0.185
	60-69	168.37	0.19	167.96	0.22	168.40	0.33	167.98	0.198
	70-79	167.01	0.21	167.69	0.26	166.67	0.71	167.13	0.295
	80+	166.03	0.36	165.96	0.48	167.11	0.82	165.76	0.663
Women	16-19	164.66	0.32	164.37	0.25	164.56	0.39	163.66	0.223
	20-29	163.85	0.18	163.92	0.16	163.45	0.33	162.97	0.138
	30-39	162.73	0.14	162.08	0.17	160.76	0.37	160.96	0.148
	40-49	160.84	0.15	160.04	0.17	159.62	0.47	159.78	0.171
	50-59	159.59	0.16	159.54	0.18	159.40	0.33	159.62	0.173
	60-69	158.58	0.15	158.56	0.20	157.62	0.51	158.94	0.182
	70-79	157.26	0.15	157.48	0.26	157.77	0.48	157.15	0.273
	80+	155.28	0.23	156.12	0.47	157.90	1.09	156.84	0.561

Note: Self-reported height in response to the following question: "What is your height without shoes in cms?" *Source*: Encuesta Nacional de Salud, 2003, 2001, 1997, 1993 editions.

Figure 1a. Distribution of Adult Men's Height by Age Groups in Spain: 1993-2003

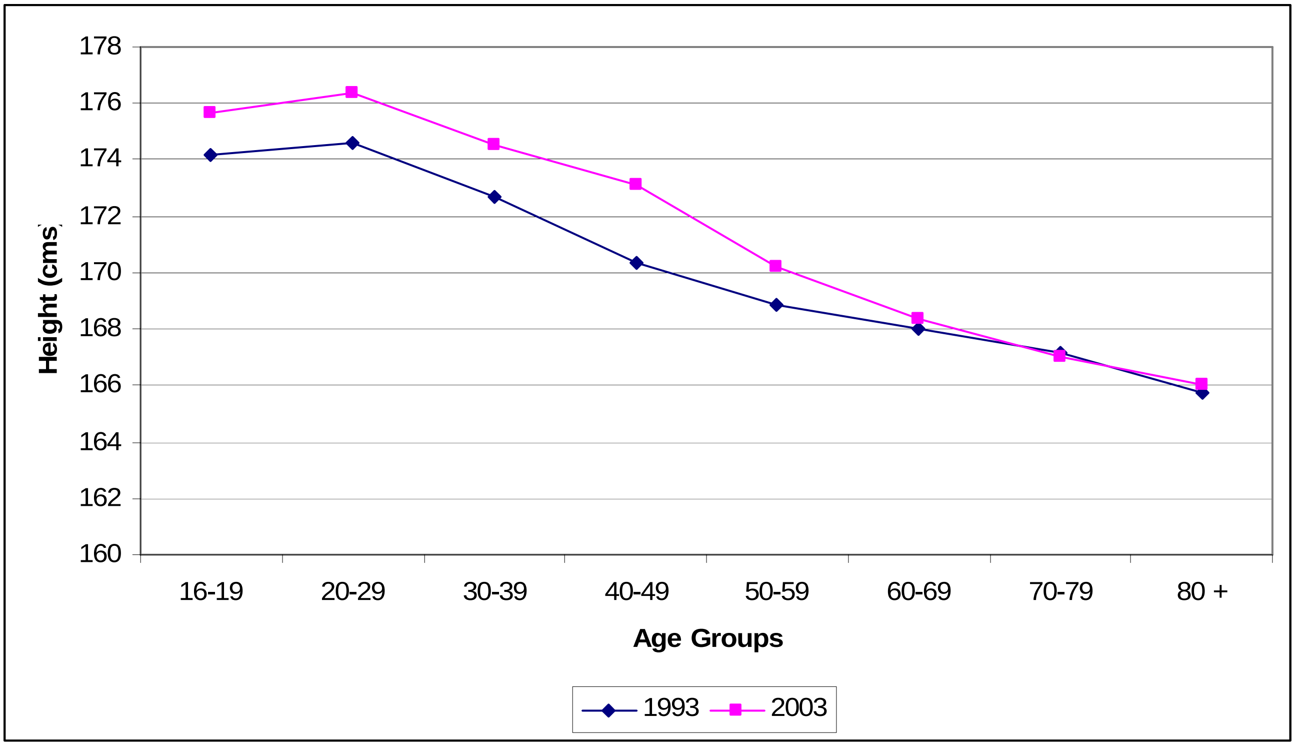

Figure 1b. Distribution of Adult Women's Height by Age Groups in Spain: 1993-2003

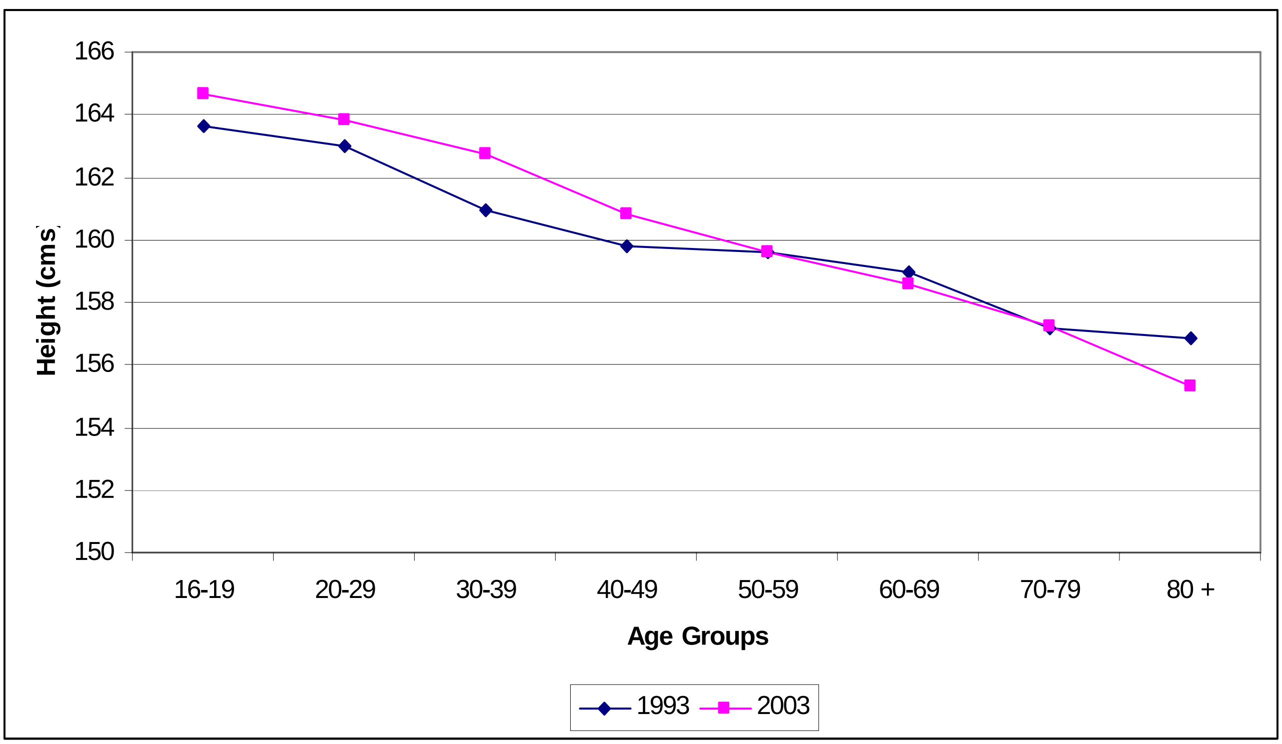

Table 3. OLS Estimation of Self-Reported Adult Height

	Dependent variable: Height (cm)	
	Men	**Women**
Constant	165.16**	155.71**
Generational Effects		
Generation <1920	-0.366	-2.333**
Generation 1920-29	-0.958*	-0.901**
Generation 1940-49	1.523**	0.819**
Generation 1950-59	2.461**	1.119**
Generation 1960-69	4.508**	2.588**
Generation 1970-79	5.392**	3.499**
Generation 1980-89	6.788**	5.062**
Capabilities		
Equivalent Income	0.0009**	0.0007**
Primary education	1.311**	1.684**
Secondary education	3.351**	2.443**
University education	4.454**	3.220**
Nationality & Ethnicity		
Euro-North American	4.114**	0.858
South-American	-1.871*	-3.245**
Asian-Oceania	-5.523	-2.126
African	1.647	4.220**
Life Style controls		
Alcohol consumption	0.096	0.565**
Past smoker	0.142	-0.511
Never smoked	-0.076	-0.084
Hours of sleep	-0.016	0.069
Geographical controls		
Town	0.315	-0.041
City	0.463	0.241
Big City	0.224	0.263
Coast	0.588	-0.029
Island Residence	0.263	1.353**
Regional Immigration	4.666**	0.340
No. of obs.	7,249	8,752
F-statistic	47.06	43.80
R^2 (Adjusted)	19.99	16.67
χ^2_{24}	0.20	3.13

Note: OLS regression with robust standard errors and using sampling weights. Omitted categories are: generation born in 1930-39, Spanish nationality, unschooled or illiterate, consumes alcohol, current smoker, lives on an Island and lives in a village. (*) Significant at 5% level, (**) significant at 1% level.

Table 4. Quantile Regression Estimates of Self-Reported Adult Men Height (Bootstrapped standard errors)

	Dependent variable: Height (cm)			
	10%	**25%**	**75%**	**90%**
Constant	156.78**	160.07**	169.32**	173.85**
Generational Effects				
Generation <1920	-2.289	-1.265*	0.095	0.817
Generation 1920-29	-2.715**	-1.174*	-0.233	-0.286
Generation 1940-49	0.586	0.873	1.613**	1.256
Generation 1950-59	1.003	2.268**	3.741**	3.532**
Generation 1960-69	3.418**	4.243**	5.880**	5.715**
Generation 1970-79	3.977**	4.750**	7.130**	7.123**
Generation 1980-89	4.990**	5.764**	8.730**	8.722**
Capabilities				
Equivalent Income	0.001**	0.001**	0.001**	0.001
Primary education	1.612**	2.236**	0.616*	1.252
Secondary education	3.907**	4.042**	2.740**	2.713**
University education	4.856**	4.667**	3.929**	4.169**
Nationality & Ethnicity				
Euro-North American	-0.581	3.906*	4.003*	5.436**
South-American	-3.023	-1.770	-3.746**	-5.563**
Asian-Oceanian	-1.118	-4.142	1.622	-2.881
African	-1.272	0.435	-2.173	-3.989
Life Style controls				
Alcohol consumption	0.257	0.218	-0.157	-0.729*
Past smoker	0.232	0.254	0.157	-0.206
Never smoked	-0.505	0.087	0.004	-0.387
Hours of sleep	-0.033	-0.048	-0.039	0.023
Geographical controls				
Town	0.771*	0.236	0.365	0.849
City	0.836*	0.324	0.374	0.402
Big City	0.049	-0.072	0.821	1.085
Coast	1.781**	0.628	0.127	0.881
Insularity	0.470	0.086	0.762*	1.781**
Regional Immigration	3.884	6.188**	1.984	2.844
No. of obs.	7,249	7,249	7,249	7,249
Pseudo R^2	13.52	13.10	13.97	11.58

Note: Bootstrapping methods have been applied to derive standard errors. The number of replications has been set to 100. Omitted categories are: generation born in 1930-39, Spanish nationality, unschooled or illiterate, consumes alcohol, current smoker, lives on an Island and lives in a village. (*) Significant at 5% level, (**) significant at 1% level.

Table 5. Quantile Regression Estimates of Self-Reported Adult Women Height (Bootstrapped standard errors)

	Dependent variable: Height (cm)			
	10%	**25%**	**75%**	**90%**
Constant	149.30**	152.64**	159.79**	163.10**
Generational Effects				
Generation <1920	-2.213*	-3.721**	-1.753**	-1.269
Generation 1920-29	-0.200	-2.775**	-0.835**	-0.533
Generation 1940-49	0.416	0.683	1.139**	0.922*
Generation 1950-59	0.554	0.657	1.802**	1.460*
Generation 1960-69	3.134**	2.463**	3.037**	3.095**
Generation 1970-79	3.823**	3.396**	4.222**	4.383**
Generation 1980-89	5.655*	4.647**	5.829**	5.891**
Capabilities				
Equivalent Income	0.001*	0.001**	0.001**	0.001*
Primary education	0.201	1.203**	1.125**	1.455**
Secondary education	0.974*	2.139**	1.862**	1.908**
University education	2.366**	3.006**	2.293**	2.488**
Nationality & Ethnicity				
Euro-North American	0.769	1.616*	1.055	0.722
South-American	-2.366	-3.406**	-2.386**	-2.445**
Asian-Oceania	-3.361	-6.332*	-3.712	8.628
African	4.803	3.242*	5.411	6.056*
Life Style controls				
Alcohol consumption	0.226	0.213	0.305	0.357
Past smoker	-0.323	-0.259	-0.338	-0.295
Never smoked	-0.131	-0.233	-0.429	-0.311
Hours of sleep	0.001	-0.002	0.039	0.069
Geographical controls				
Town	-0.210	0.099	0.360	0.417
City	-0.072	-0.156	0.592*	0.723*
Big City	-0.246	-0.285	0.309	-0.086
Coast	0.926	0.821*	-0.067	0.069
Insularity	0.920	1.799**	1.192**	0.994*
Regional Immigration	-0.288	0.876	2.255	2.453
No. of obs.	8,752	8,752	8,752	8,752
Pseudo R^2	8.16	10.43	8.56	9.41

Note: Bootstrapping methods have been applied to derive standard errors. The number of replications has been set to 100. Omitted categories are: generation born in 1930-39, Spanish nationality, unschooled or illiterate, consumes alcohol, current smoker, lives on an Island and lives in a village. (*) Significant at 5% level, (**) significant at 1% level.

Table 6. Blinder-Oaxaca Decomposition of Male and Female Differentials on Self-Reported Adult's Height

Mean Gender Gap on Height = 11.739 cm		
	Differences in mean characteristics (Explained part)	**Unexplained (Residual part)**
Generational Effects	**0.2723 (2.3%)**	
Generation <1920	0.0042	0.0542*
Generation 1920-29	0.0175	-0.0051
Generation 1940-49	-0.0016	0.0859
Generation 1950-59	0.0347	0.1963*
Generation 1960-69	0.0761*	0.3591**
Generation 1970-79	0.0408	0.3696**
Generation 1980-89	0.1007*	0.1865*
Capabilities	**0.2255 (1.9%)**	
Equiv. Income	0.0274*	0.11629
Primary education	0.0089	-0.11432
Secondary education	0.1151*	0.30790
University education	0.0741	0.23326
Alcohol consumption	0.0242	-0.20493
Nationality and Ethnicity	**-0.003(-0.03%)**	
Euro-North American	-0.00581	0.0310
South-American	0.00332	0.0232
Asian-Oceanian	-0.00161	-0.0057
African	0.00054	-0.0106
Lifestyle controls	**0.0641 (0.5%)**	
Alcohol consumption	0.0242	0.2049
Past smoker	0.0215	0.0640
Never smoked	0.0213	0.0053
Hours of sleep	-0.0029	-0.6212
Geographical controls	**-0.0026 (-0.2%)**	
Coast	-0.0019	0.1808
Insularity	0.0014	-0.0985*
Regional Immigration	-0.0043	0.4069
Town	0.0041	0.1250
City	0.0012	0.0529
Big City	-0.0030	-0.0061
Constant		9.4511**
Total Gap on Height (in %)	**0.5559** (4.74%)**	**11.1829** (95.26%)**

Note: (*) Significant at 5% level, (**) significant at 1% level.

Table 7. Predicted Gender Height Gap and Decomposition

Quantile	Men Height	Women Height	Total Height Gap	Explained Part	Explained Part/ Total Height Gap
10th	163.163	152.170	10.992	1.0953	**9.96%**
25th	167.101	155.815	11.286	0.899	**7.97%**
50th	171.442	160.131	11.311	0.807	**7.14%**
75th	176.059	164.150	11.909	0.842	**7.07%**
90th	180.709	167.823	12.886	0.710	**5.51%**
Mean	172.651	160.912	11.739	0.556	**4.74%**

Note: All these measures are statistically significant at 1%.