Does Tallness Pay Off in the Long Run? Height and Life-Cycle Earnings

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Abstract

The existence of a height premium in earnings is well documented, but how it develops over the life cycle is largely unknown. By using data on approximately 43,500 dizygotic and monozygotic twins born in Sweden 1889-1958, we analyze how the height premium in earnings changes over the adult lifespan. OLS regression estimation of the height premium reveals that one decimeter additional height is associated with, on average, 6-10 percent greater earnings. Moreover, the height premium increases over the life cycle for men, but decreases for women. Within twin-pair fixed effects (WTP) estimates are on average about 40 percent lower than the OLS estimates for men, suggesting that genetic endowments and early life environmental conditions operating on a family level explain a significant part of the unconditional returns to tallness throughout adult life. Including education as an explanatory variable induces a similar reduction (about 40 percent) of the estimated OLS height premium, but has no effect whatsoever on the within twin pair estimates, implying that the OLS and WTP estimates tend to coincide. Hence, it seems as if schooling may mediate the association between height and earnings among unrelated male individuals but not among twins. For women, the differences between the OLS and WTP estimations are less precise.

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1 Introduction

The association between height and labor market outcomes such as earnings is well known. Scholars from various disciplines have explored this topic for at least 100 years, documenting a strong positive relationship between adult stature and earnings by employing a variety of data sources, reaching from historical data from the 18th and 19th centuries (e.g., Jacobs and Tassenaar, 2004; Komlos, 1990) to more recent data from developing countries (e.g., Steckel, 1995; Thomas and Strauss, 1997) as well as modern societies (e.g., Case and Paxson, 2008; Case et al., 2009; Lundborg et al., 2014; Persico et al., 2004).[1]

Recent research suggests that in the contemporary western world (e.g., USA, Great Britain and Sweden) the average increase in earnings resulting from being 10 centimeters taller is substantial, similar in magnitude to one additional year of schooling (i.e. about 10 percent in the United States and United Kingdom, and about 6 percent in Sweden, Card, 1999; Case and Paxson, 2008; Lundborg et al., 2014; Persico et al., 2005). The height premium has been attributed to stature being associated with productivity related characteristics in the form of non-cognitive (social) skills (Persico et al. 2005) and cognitive skill (Case and Paxson 2008), or both (Lundborg et al. 2014, Schick and Steckel 2010).

Previous studies on height and earnings are mainly based on cross-sectional analysis of fairly young people (aged 30-40) and it is still not known how the height premium develops over the life cycle. Moreover, in analysis on unrelated individuals it is uncertain to what extent unobserved individual or family environmental or genetic characteristics influence the estimated relationships. Lundborg et al. (2014) neutralizes some of this by studying variation between brothers who share family environment and, on average, 50 percent of their genes. Though two brothers share some genes and early-life environmental conditions, they differ in birth parity implying that one of them grew up with an older brother and the other with a younger brother. Furthermore, family conditions are generally not static, which means that siblings may face similar conditions at the same point in time but not necessarily at the same age. This may be important if family conditions change over time and environmental influences (or gene-environment interactions) are age sensitive.

The purpose of this paper is to analyze the development of the returns to tallness over the adult lifespan, for both men and women, and to investigate to what extent unobserved

[1] See also: Gowin (1915); Hamermesh and Biddle (1994); Persico, Postlewaite, and Silverman (2004); Steckel (2009).

early life environmental conditions and genetic endowments influence the *crude* (or *unconditional*) height premium from this respect. To analyze the association between height and earnings we utilize longitudinal annual register data on earnings 1968-2007 for 21,740 same sex twin pairs from the Swedish Twin Registry, born 1889-1958. We follow these twins from early adulthood (age 25) to old age (79) in order to establish how the return to tallness is developing over the entire labor market career and in retirement age.[2] By also studying the development of the height premium over the life cycle for consecutive birth cohorts, we address whether it has changed over time for different age groups. A twin differencing design is employed in order to provide new evidence on the association between height and earnings. Under the assumption that the height variation among MZ twins is environmentally induced (i.e. depends on, for example, accidents and diseases striking unevenly between the twins during childhood and youth), whereas the corresponding variation among DZ twins could be of either genetic or environmental (or both) origin, a comparison of the height premium in respective sample will indicate the relative importance of environmentally and genetically induced variations in height for earnings.

We find that taller people earn more: one decimeter additional height is associated with about 6-10 percent greater earnings, a magnitude similar to the findings of previous studies (see Section 2 for further discussion). Whereas the height premium increases with age for men, it decreases for women. Analysis on three consecutive birth cohorts reveals that the height premiums have declined somewhat over time. Within twin-pair fixed effects (WTP), analysis reveals that, for men, about 30-40 percent of the crude height premium is explained by unobserved factors shared by twins. There is just a slight and imprecisely measured difference between DZ and MZ twins from this respect, suggesting that the main origin of the height variation (i.e. whether of genetic or environmental character) does not seem to severely influence the magnitude of the height premium for men. For women, it seems as if the height premium generally is somewhat lower when restricting the sample to MZ twin pairs, though the resulting age patterns are less stable.

The rest of the article is organized as follows. In Section 2 we review literature that is related to our study and discuss determinants of height and the association between height and earnings. We present the empirical framework of our study, and descriptions of the variables

[2] Note that we obviously cannot follow the same individuals over the entire age span considered in the main analysis (25-79), since data on earnings are only available from 1968 (when the oldest individuals born 1889 were 79 years old) to 2007 (when the youngest individuals born 1958 were 49 years old).

used in the analyses in Section 3. Descriptive statistics, the main results of our study, and sensitivity analyses are presented in Section 4. Section 5 provides a concluding discussion.

2 Background and Previous Literature

Determinants of Height

Three broadly defined mechanisms explain disparities in height growth and subsequent variation of adult stature: heritability of height, environmental factors, and gene-environment interactions (Silventoinen, 2003). Adult height has therefore been widely utilized as a marker of secular trends and socioeconomic variations in childhood conditions (Silventoinen 2003; see also the literature discussion in Section 1). Although an adult individual's height has been denoted "probably the best single indicator of his or her dietary and infectious disease history during childhood" (Elo and Preston, 1992), studies have found that up to 80 percent of the variation in height can be explained by genetic factors in modern societies (e.g., Stunkard et al. 1986; Silventoinen et al., 2003). Apart from the aspect of genetics, environmental factors in utero, infancy and childhood are according to the early-life hypothesis bound to affect health, cognitive ability, human growth and stature in adulthood (e.g., Barker 2007). Silventoinen (2003) also emphasizes the importance of nutrition and presence of diseases during the early stages in life on adult stature.

Although a substantial fraction of the height variation in the western world could be attributed to genetics, this is obviously not the case for height differences between MZ twins. Since MZ twins share genetic predispositions, height variations between them are bound to be environmentally induced. From this perspective, such variations constitute a window of observation into environmental conditions striking unevenly between the twins. It does not seem farfetched to suggest that these are more likely to be a result of exogenous variation (i.e. placement in the womb, accidents and illnesses) than to any systematic discrimination by parents favoring one of the twins. However, parents may adapt to variation in inherent capabilities or random insults striking unevenly among their children by compensatory (or reinforcing) measures, i.e. investing more (or less) time and money in the less (more) fortunate child. In such case, the pure impact of these insults will be counteracted (or reinforced) by parental behavior. While some empirical twin-based studies, using various measures of parental inputs, do not suggest that parents systematically reinforce or compensate for early life insults (see for instance Royer, 2009; Almond and Currie, 2011), there are some evidence on the contrary presented on US data (compensatory, Lundborg, 2013) and China (reinforcing, Rosenzweig and Zhang, 2009).

Height and Earnings

The empirical evidence on variations in adult height and its return in the labor market has revealed that being taller is associated with having higher earnings. How this premium arises is yet not fully understood, even less is known about how it develops over the life cycle and whether it has changed over time. One conjecture is that there is a general preference for tallness in the society, implying that tall people are positively discriminated, or vice versa, short people negatively discriminated against. This means that, regardless of their actual productivity capabilities, people are to some extent paid according to their height. A second proposition is that stature is associated with certain productivity related traits that are valued and rewarded on the labor market. Such associations may in turn arise from height affecting the development of such characteristics. This is a main feature in the argumentation of Persico et al. (2005), which, by studying the hourly wage rate at age 33 in the British National Child Development Study (NCDS) and for people aged 31-38 in the U.S. National Longitudinal Survey of Youth (NLSY), find that the height premium is reduced when non-cognitive skills is included as an explanatory variable. They put forth that height during youth promotes participation in sport and social college clubs facilitating the formation of non-cognitive (social) skills. If this argument is correct, there is a causal link from height to earnings via mediation of this type of skills.

It could, however, also be that there is some underlying third factor governing height as well as earnings. This would be the case if height growth and cognitive development, which is likely to be valued on the labor market, both are subject to common genetic or environmental developmental mechanisms in the form of e.g. insulin-like growth factors. Twin-based studies suggest that this is indeed the case (Silventoinen et al. 2003; Sundet et al. 2005). The overall association between height and cognition has mainly been attributed to genetic inheritance and shared environmental factors operating at a family level (the relative importance of the former being emphasized when assortative mating is taken into account, and plausibly also when there is less variation in income and nutritional conditions between families in society), and to a lesser extent to non-shared environmental effects (Beauchamp et al. 2011, Keller et al. 2013). Case and Paxson (2008), studying the US National Child Development Study (NCDS) data set and data from the British Cohort Study (BCS), find that a large portion of the crude height premium in earnings among unrelated individuals measured at age 30 (BCS) and 33 or

42 (NCDS) is explained by variation in cognitive skills.[3] Lundborg et al. (2014) analyzes 180,000 Swedish male brothers 28-38 years old in a sibling fixed-effects framework and find that cognitive and non-cognitive skills as well as unobserved factors operating at the family level explain the lion's share of the crude association between height and earnings. Notably, a statistically significant height premium still remains once these factors are controlled for. Closer inspection reveals that this remaining height premium is concentrated to the lower end of the height distribution, indicating that discrimination may occur among short (but not tall) people. In recent research, Böckerman and Vainiomäki (2013) analyze the height premium of average earnings 1990-2004 among 10,000 Finnish MZ twins born 1944-1958. Exploiting within twin differences in self-reported height, they find a statistically significant premium among female twins but not for male twins.[4]

3 Method and Data

3.1 A Simple Model of Height and Earnings

To form a basis for the analysis of the height premium in earnings we employ a simple conceptual, counterfactual framework:[5]

$$\xi_{i,A} \equiv \phi_{i,A}(h) \qquad [1]$$

where $\xi_{i,A}$ represents the potential earnings of individual I at age A, and h represents adult height. In this setting, the earnings of an individual depend on his or her stature, holding other characteristics constant. In other words, $\phi'_{i,A}(h)$ measures the height premium in earnings at a given age.

A statistical extension of the deterministic model [1] is:

$$y_{i,A} = \alpha_A + \beta_A h_i + X_i\gamma + Z_i\delta + \mu_i + \varepsilon_{i,A} \qquad [2]$$

where the subscript i refers to individual i, y is earnings, h is adult height, and X is a vector of individual control variables, Z is a vector of environmental and social family background

[3] Schick and Steckel (2010), also studying the NCDS, show that cognitive and noncognitive skills explain equal parts of the unconditional height- earnings association.

[4] In an attempt to avoid potential measurement error problems, they also estimate a model where self-reported height in one period is instrumented by self-reported height in another period (under the assumption that measurement errors in height are classical and non-correlated within the twin pair). This inflates the height premium so that the WTP estimates exceeds the crude OLS estimates by almost 300 and 700 percent for men and women, respectively.

[5] This framework is similar to the one formulated in Lundborg et al. (2014).

variables that are fixed in adult life, and μ represents heritable traits, all of which are affecting earnings.[6] If the entire vector X, Z, and μ are observable the estimate of β will measure the height premium in earnings of being one unit of length taller.

3.2 Empirical Framework

When estimating the height premium empirically, model [2] will ideally capture the causal effect on earnings of being taller. Estimating model [2] by using OLS regression methods is, however, likely to create problems of inference because of unobservable factors, resulting in omitted variable bias. If, for instance, unobserved background factors simultaneously governs height and cognition (which is also unobserved), creating a positive association between the two – and the latter also influence earning, OLS of height on earnings will result in biased estimates of the height premium. Insofar such background factors are shared between two study subjects (for example twins), differencing between them will neutralize such bias. Hence, the WTP specification is employed, cancelling out the effects of shared family environmental conditions and genetic inheritance.

Consider model [2] for twin i and j in a pair of (same gender) twins and take the first difference of these two equations:

$$y_{is,A} - y_{js,A} = \beta_A(h_{is} - h_{js}) + (X_{is} - X_{js})\gamma + (Z_{is} - Z_{js})\delta + (\mu_{is} - \mu_{js}) + (\varepsilon_{is} - \varepsilon_{js}) \quad [3]$$

where the subscript s refers to a given pair of twins (s=1,2,…,n). Assuming that two twins within a pair share the same family background, the Z vector cancels out. If genetic heritable traits are fully shared between two twins within a pair (as for MZ twins), μ cancels out as well. Hence the model becomes:

$$\Delta y_{s,A} = \beta_A \Delta h_s + \Delta X_s \gamma + v_s \quad [4]$$

where Δ represents the first difference between twin i and j for each given twin pair s and v_s represents the first difference in the error.

Albeit utilizing specification [4] will, at least partly, overcome the issue of omitted variable bias discussed in the text above, it will not tell us if the estimated effect is stationary or if the height premium in earnings changes over the life cycle. Therefore equation [4] will be estimated for eleven consecutive 5-year windows of age (*age waves*) ranging from 25-29 to 75-79. In our base case scenario we will assume that the entire X vector will be neutralized

[6]For ease of exposition, it is implicitly assumed that the effects of X, Z and μ are constant over age in this specification.

when applying the within twin-pair difference approach.[7] Differencing between twins, all unobserved factors common to the twins within a pair cancel out. This implies that identification of the regression coefficients in WTP models is obtained solely via within twin-pair variation in the covariates.[8]

To fully capture causal effects of interest, the variation in explanatory variables between twins has to be truly exogenous. In many twin based studies (on, for example, the effects of education on income), environmentally induced within twin pairs differences pose a threat as, ideally, the twins should be equal in all (unobserved) respects in order to establish a causal relationship. It is therefore often implicitly assumed that twins during their childhood fully share the same environmental conditions. Contrary to such studies, the fundaments of our study rely explicitly and ultimately on *exogenous variation* in the early life and childhood environment conditions, even within MZ twin pairs, resulting in height variations among them. Given that MZ twins share genetic predispositions, and height growth is a function of such predispositions, environmental conditions and their interaction, any variation in stature between them is bound to be a function of variation in their environment. Such variations occur from conception onwards and twins do differ in outcomes very early in life such as birth weight. In the case of MZ twins, the height premium could thus be traced back solely to non-shared environmental factors. Hence, comparing the results obtained in the DZ twin-pair and the MZ twin-pair cases will give indications of whether height differences induced solely through environmental variations (MZ twin-pair differences) and those also induced by genetic differences (DZ twin-pair differences) are associated with similar height premiums.

The twin design brings certain distinct advantages to the analysis of the relation between height and earnings. It enables analysis of variables that are constant over time (such as height), which is unfeasible in traditional fixed effects panel data models based on repeated individual observations (see for example Wildman 2003; Islam et al 2010). Identification based on twin differencing is obtained via variation within twin pairs, and in the present case virtually all twins have different earnings (and adult height). It should also be noted that twin estimates are likely to reflect a population average of the considered effects, as differences

[7] In order account for plausible time effects, we also include birth year fixed effects in all OLS regression specifications.

[8] In the main specification we will only include height as an explanatory variable. Variables such as years of schooling and birth weight are not included as the effects of height on earnings may well be mediated through them. To analyze the extent to which the height premium is affected by inclusion of such variables in the specification, we also perform several sensitivity analyses in which we include different covariates (see Section 4.2).

within twin pairs in for example height are likely to be represented along the entire height distribution.

3.3 Data

Our main data on height is from the Swedish Twin Registry (STR), managed by the Karolinska Institute in Stockholm, Sweden. The STR was established in the 1960s and is the largest of its kind to this date. The registry holds information on about 85,000 pairs of twins born in Sweden since 1886. The STR defines zygosity status of pairs of twins based on questions of intrapair similarities in childhood, a method that studies using DNA validation have shown to have approximately 98 percent accuracy (see Lichtenstein et al., 2002, for a comprehensive description of STR). The sample used in this paper includes only twin pairs with known zygosity, DZ or MZ. By the use of personal identification numbers we merge the STR height data with information on earnings. Below follows a brief description of the main variables utilized in this study.

Adult Height

Height is self-reported in questionnaires from 1963, 1970, 1973 and 1998-2002. In order to obtain an appropriate measure of adult height we have followed a procedure where we, for each and every twin pair, use the information in the first available questionnaire where the twin couple is at least 18 years old and they both have answered it. Such a procedure will make sure that the reported height reflects adult height and that it is reported for the same age of both twins within a pair.[9]

Since height is self-reported, there is an issue of possible measurement errors in the explanatory variable. Under the classical errors in variables (CEV), OLS regression estimates will be biased and inconsistent; in within fixed effects models, such as sibling and twin models, the problem of CEV will be of even greater magnitude (Bound and Solon, 1999; Griliches, 1977; Grilches, 1979; Neumark, 1999). However, an analysis by Dahl et al. (2010), based on a subsample of the STR twins, some of which are followed under a period of 20 years, shows that misclassification in self-reported height is rather small. In their first investigation wave, when the twins already were rather old (mean age: 63.9, age range; 40-88) the mean error in reported height was +0.9 cm. The authors also show that the misclassification increases with age (0.038 cm per year, which is less than 0.8 cm over 20

[9] A handful of observations pertaining to reported height above 250 and below 100 cm were excluded.

years), probably due to peoples' self-perceived body image not fully adapting to the fact that, after the age of 40, they tend to shrink slightly, by about 0-5-1 cm per decade for men and about 1-2 cm for women, respectively. From this perspective it should be noted that we control for annual birth cohort in every OLS regression in order to found our height premium parameter estimates on intra-cohort height variations (rather than age variations due to trends in height growth or age related decreases in height). Especially Swedish males under the age of 40 in the birth cohorts who underwent mandatory enlistment (born before 1978) where height was measured, have a highly valid perception of their height. Moreover, it seems highly plausible that measurement errors in self-reported height within twin pairs are positively correlated since they ought to share several characteristics due to their common genetic and environmental inheritance; they are always in the same age, ought to shrink in similar pace and be similarly inclined to update their body image according to changes herein, et cetera. Taken together, this suggests that WTP differences in height should be less plagued by the problem of measurement errors than if such errors were randomly distributed between the twins in accordance with CEV. Unfortunately we do not have data on measurement errors in height and thus cannot make a direct and absolute assessment of the potential problem of CEV. Nevertheless, we will assess the potential importance of measurement error in height indirectly by using correlations and variances based on the self-reported height measure (see Appendix).

Earnings

Data on earnings is provided by Statistics Sweden and given by individual earned taxable income 1968-2007. The consumer price index has been used to deflate income across the years to the price level of 2010. Annual income is expected to carry small measurement errors, since the data is obtained from registers. Income was then aggregated into 5-year averages for every individual according to age ranging from 25-29 to 75-79, resulting in eleven consecutive measures. In our empirical specification we will use logarithm of earnings, implying that a portion of the sample will be dropped due to zero income. It should also be noted that earned taxable income includes income from employment, self-employment, parental-leave benefits, unemployment insurance, and sickness-leave benefits (these sources of income are also included in the earnings measure analyzed in the articles by Lundborg et al. 2014, and by Böhlmark and Lindqvist, 2006). Hence, our earnings measure captures consumption boundaries rather than pure labor market productivity. Including the last three of these income sources also serves the purpose of smoothing temporary earnings shifts. In a sensitivity analysis, Lundborg et al (2014) showed that the inclusion of such benefits does not affect the estimated height premiums for men in their thirties. Note that the effective age of retirement in Sweden, ranging from 63 to 66 years 1976-2007 (OECD, 2014) is much lower than the right end point of the studied age span. This implies that the estimated height premium in earnings for the last age groups (65-69, 70-74, 75-79) in essence will capture how height related labor market activity spills over on retirement via earned pension system benefits.

Since the data on earnings covers a time period of 40 years, it is inevitable that there have been some changes in the tax and social security system rules. The most extensive reform period from this respect occurred 1973-1974 during an expansion of the social security system when the reimbursement levels of unemployment, sickness and parental leave benefits, all based on current and/or previous work experience and income, were increased and became taxable. This implies that the more limited support given 1968-1972/1973 is not captured in our earnings data. However, the influence of this should be dampened in a twin difference setting, since income data on two twins are always taken simultaneously. Finally, the earnings are winsorized at the 1st and the 99th percentiles in all our specifications in order to neutralize the potential influence of extreme outliers.[10]

Birth Weight and Height

Data on birth weight and height is obtained from the STR BIRTH study, which is available for twins born between 1925 and 1958 and taken from the birth records. Due to the sampling scheme, the birth weight and height information is only available for twins that survived until 1972. For the full sample used in the main analysis, we have access to 22,762 observations on birth weight and 22,582 on birth height. The average within twin pair difference in birth height is about 1.5 cm, and the variation in birth weight ranges from about 300 grams (MZ twins) to about 350 grams (DZ twins), (see Table 1).

Educational Attainment

The education variable originates from several sources. For twins still alive in 1990, it is based on register data collected by Statistics Sweden from the educational institutions in Sweden 1990 and 2007. As for the earnings data, this implies that there should be only small or no measurement errors. Self-reported education is provided in several of the questionnaire waves, the first conducted in 1961, which means that we have access to information on

[10] We also employ winsorized earnings at the 5th and 95th percentiles in a sensitivity analysis, with no significant changes in the height premium estimates. Results available upon request.

education also for people in early cohorts. The data have also been linked to self-reported census information from 1960 and 1970, which contains a higher level of detail compared to the survey in 1961. The education measure used is years of schooling. Average years of schooling is about 9.5 years and the mean difference in schooling ranges from 1.3 (MZ females) to 1.9 (DZ males) (see Table 1). About half of the twin pairs have the same schooling, (not shown).

4 Results

4.1 Descriptive Statistics

The full sample used in the main analysis contains observations on 26,834 DZ twins and 16,646 MZ twins, of which 46 percent are males and 54 percent females. Descriptive statistics of height, within twin pair height differences, years of schooling, average annual earnings at age 30-39, and birth weight, and height are presented in Table 1.[11] Average height is similar across zygosity, men being 10 cm taller than women. Average earnings at age 30-39 follow a similar pattern across zygosity and men having higher earnings. The average height difference between twins is about 5 cm for DZ and slightly more than 2 cm for MZ twins. The distribution of height differences between twins within a pair is illustrated in Figure 1.[12]

The data set at hand is rich since it covers information on several birth cohorts reaching all the way back to the end of the 19th century, but these cohorts may differ in variables that have been shown to change over time (such as educational attainment). Therefore we also present descriptive statistics of height, within twin pair height differences, and years of schooling for the three different birth cohorts: those born 1900-1919, 1920-1939, and 1940-1958.[13] In Table 2 we see that height has increased over time, about 2.5-3 centimeters per cohort. The reported height of the male twins rather well matches the average stature registered by the enlistment authorities for the respective cohorts (Statistics Sweden, 1969). For the cohorts enlisting 1921-1925 to 1936-1940 the average height of Swedish conscripts

[11] We include descriptive statistics of average annual earnings at age 30-39 to enable comparison to previous literature, since many of these use data on people of this age. We also perform a brief analysis of earnings at age 30-39 in Section 4.2.

[12] In order to make sure that our main results are not driven by extreme outliers in height differences, we perform several sensitivity analyses in which we only include pairs of twins of which the height difference between the twins are restricted to various boundaries. These sensitivity analysis results do not differ significantly from our main results. Results available upon request.

[13] These birth cohorts will also be examined further in Section 4.2 in order to detect plausible time trends in the height premiums of males and females.

rose from 172.1 to 174.2, whereas in the twin sample the reported mean height for the first cohort is 173.3 and 173.1 for DZ and MZ twins respectively.[14] For the second cohort the reported height is 175.6 and 175.1 (DZ, MZ) whereas the conscript mean height records increases from 174.5 to 176.1 between 1941-1945 to 1956-1960. The corresponding figures for the third cohort is 178.8 and 178.4 while the conscript records increases from 177.4 to 179 cm between 1961-1965 to 1977. The within twin pair differences in height and the hereto-related standard deviations seem to be rather constant over the cohorts and thereby also with age as later cohorts have their height reported at a younger age. Educational attainment has increased from about 7 to more than 11 years over the cohorts under study.

Average annual earnings for the eleven age waves by zygosity and gender are shown in Figure 2. As can be seen, average earnings of men are 50-100 percent larger than the average earnings of women throughout the life cycle. Moreover, earnings are increasing at the beginning of the adult life, reaching its peak at around the age of 50, to finally decrease and level off at older ages for both genders. It is also clear that the DZ twin-pair sample and the MZ twin-pair sample have approximately the same earnings profiles and levels throughout the life cycle. Figure 3 and 4 illustrates the average earnings by height for different age groups for men and women respectively. Average earnings tend to be increasing with height for both genders, although the relationship is weak for males at the youngest age wave 25-29 years. Though this relationship may also capture possible time trend effects, there seems to be a positive correlation between average earnings and height.

4.2 Results

The Height Premium at Age 30-39

In order to make comparisons with previous literature possible, since most height premiums are estimated for individuals aged 30-40, and thus strengthen the external validity of our study, we start with examining the height premium at age 30-39. As illustrated by Figure 5, there is a positive relationship between average earnings at age 30-39 and tallness for both genders. This association is further examined by OLS regression and WTP regression analyses. As presented by Table 3, the OLS coefficients for males are 6.3 (MZ) and 7.4 (DZ) percent per decimeter in height. This is very similar to the estimates obtained by Lundborg et al. (2014) for Swedish males aged 28-38. By OLS regression estimation on 448,702 individuals they uncover that being 10 centimeters taller is associated with 6.2 percent higher

[14] Age of enlistment was 20 years 1915-1948. 1950-1953 it was 19 years and 1955-1967 it was 18 years.

earnings. By applying a within sibling specification they get a height premium of 4.2 percent, which is equivalent to our WTP height coefficient for the DZ twin-pair sample (see Table 3). Hence, the associations between height and earnings obtained via differencing between brothers (who are not MZ twins) are similar in the twin sample using self-reported height compared to the representative sample analyzed by Lundborg et al. (2014), where height was administratively recorded by military personnel. The similarity in results indicates that measurement errors in height are not heavily influencing the estimations of the present study.

WTP regression analysis of the MZ twin-pair sample reduces the height coefficient on earnings to 2.9 percent and also makes it insignificant. From this it appears that more than half of the crude height premium at age 30-39 for men can be explained by early life environmental conditions and genetic predispositions.

The unconditional height premium for women aged 30-39 is 8.8-10.2 percent and the conditional is about 7.8 percent, both of which are higher than the height coefficients for men. Restricting the sample to MZ twin pairs, the WTP estimates are just slightly reduced, but become statistically insignificant.

The Height Premium Over the Life Cycle

Having established a positive relationship between height and earnings at age 30-39, we now turn to the main focus of this paper: the analysis of the returns to tallness over the life cycle. The standard OLS regression and the WTP estimations of the height premium for the pooled sample (DZ and MZ twins) are illustrated in Figure 6 (see also table A.1).[15] [16] As shown, the unconditional height premium estimate is insignificant for earnings at age 25-29 for males. This is not surprising since this category may not yet have reached their earnings potential and some of them may well still undergo further education. From age 30-34 onward, the height premium is increasing over the life cycle for men, starting out with 5.5 percent higher earnings to reach a magnitude of 13.9 percent higher earnings at age 75-79. Differencing between twins lowers these height coefficients by around 30-40 percent. A significant part of the crude height premium for men can thus be explained by unobserved factors operating at the twin level. Moreover, the gap between the unconditional and the conditional height premiums increases as the men grow older.

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[15] Height coefficients with standard errors clustered by twin pair are also presented in Table A.1 in Appendix.

[16] Here we pool the sample and thus do not separate between DZ and MZ twins (as we do in later analyses). OLS regression estimations of the height premium for separate analyses on DZ and MZ twin pairs are performed, with very similar outcomes. Results available upon request.

Close to the opposite trend is found for women. Being 10 centimeter taller is associated with an 11.2 percent increase in earnings for women aged 25-29. As the women grow older, the height premium decreases and levels off to about 6 percent at age 70-79. Apart from the age waves 30-34 and 55-59, WTP estimation does not alter the height coefficients to any major extent, although the confidence intervals get significantly wider. The reason to why the height coefficient dips at age 30-34 and 55-59 may be explained by labor market participation choices among the women in our sample. This is investigated further in a sensitivity analysis presented below.

Taken together, apart from the dips in the WTP estimates at age 30-34 and 55-59, the male and female height premium patterns form a rather symmetric scissor like shape where the increase in the male premium is mirrored by a corresponding decrease in the female premium, as illustrated by Figure 7. It appears as that in the long run, tallness is of more importance for determining earnings for men than it is for women. Moreover, the extent of which family background and genetics determine the returns to tallness seem to be greater for men than for women throughout most of an individual's adult life.

The results are hitherto based on individuals covering several generations and capture the average height premiums in earnings for the considered age waves over a longer period of time. Hence the estimates may conceal a plausible time trend in the returns to tallness. In order to analyze whether the levels and development of these premiums have changed over time we have re-estimated the unconditional as well as the conditional height premiums in earnings for three different birth cohorts, born 1900-1919, 1920-1939, and 1940-1958 (see table A.2-5). As shown in Figure 8, both the male and female unconditional height premiums appear to have decreased over time for the three birth cohorts.[17] Differencing between twins gives a less clear picture; for men, it seems like the WTP height coefficients have decreased over the cohorts studied whereas, for women, there is no apparent trend. The overall results from cohort analysis imply that tallness has become a less important determinant of earnings.

Comparison of MZ and DZ twin pairs

Comparing OLS regression estimates with the height coefficients resulting from differencing out endowments of early life conditions and family genetics, as we have done so far, does not give the full picture on how important genes are for explaining the returns to tallness. In order to separate the influences on the height premium that originates from factors operating at the family (or DZ twin) level from those that originates fully from environmental

[17] Height coefficients with standard errors clustered by twin pair are also presented in Tables A.2-5 in Appendix.

conditions, we compare WTP estimates for a sample restricted to DZ twin pairs with those for a sample restricted to MZ twin pairs. WTP analysis of the MZ-twin sample will difference out all determinants of the height premium that stem from pure genetic endowment. Moreover, comparing OLS regression height coefficients with WTP height coefficients of the MZ-twin sample yields insight on to what extent the crude height premium is solely initiated by variations in other environmental factors than those shared by MZ twins.

Figure 9 (see also table A.6) demonstrates the OLS regression height coefficients for the pooled sample and the WTP height coefficients obtained from separate analyses on DZ twin pairs and MZ twin pairs.[18] For men, there is no general difference between the two samples from this respect. The line representing the MZ twins is more unstable curving below and above the less volatile DZ line indicating that there are no systematic variation in the height premium depending on whether its origin is solely environmentally (MZ twins) induced or also a function of genetic inheritance (DZ twins).[19]

As for men, moving from OLS regression analysis to estimates obtained from WTP analysis on MZ twins for the female sample, the height coefficients reduce, by on average 50 percent. In contrast to the male sample, however, there is a noticeable difference between the WTP height coefficient for the DZ and MZ twin-pair samples; on average the conditional height premium is 40 percent lower for the MZ twins than for the DZ twins. This, along with the results presented above, implies that genetics have about the same importance for the returns to tallness over the life cycle for both genders, but that early life environmental conditions, which most twins share, may have less influence on women's earnings than it has on men's. As can be observed in Figure 9, this pattern seems to hold over most of the life cycle.[20]

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[18] Height coefficients with standard errors clustered by twin pair are also presented in Tables A.1 and A.6 in Appendix.

[19] Results for the pooled sample is almost identical to those for a sample including only DZ twins. Comparing OLS regression estimates with WTP estimates for a sample only including MZ twins also give almost identical results to those presented here. Results available upon request.

[20] Notably the WTP estimate for the MZ twin sample is fairly inconsistent over the life cycle for both genders. It would be reasonably to suspect that the reason for this is that the height difference between MZ twins is less profound than it is for DZ twins. This possibility was tested with several specifications, by running the analyses only on twin pairs that (1) differ in height, (2) differ by at least 3 centimeters in height, (3) differ at least 1 centimeter but no more than 10 centimeter in height, (4) differ at most 10 centimeters in height, and (5) differ at most 5 centimeters in height. In most model specifications, the results did not change significantly. Hence, we cannot claim that the volatile life-cycle conditional height premium for MZ twin pairs arise because of (a lack of) height differences between these twins. Results available upon request.

Labor Market Participation

The path of height premium profile over the female adult lifespan is quite unstable and no obvious trend can be seen. The underlying cause of this may be that the returns to tallness are highly dependent on labor market participation.

The sample utilized in this paper constitutes of people born 1889-1958. The majority of the men of these cohorts did work during most of their adult life, whereas women born during this period did not participate in the labor market to the same extent. Therefore, many of the women in the sample very low (or zero) earnings at one or more of the 11 age waves, 25-79. In order to investigate how strong the association between stature and earnings is over the life cycle, given labor market participation, we re-estimated the main analyses on twins that had annual earnings of at least two *price base amounts* (PBAs, thus used as proxy for labor market participation),[21]

Table 4 (see also table A.7) reports the size and difference in size of the original (full) sample and the sample in which only twin pairs in which both twins earn at least SEK 84,800 (restricted sample). The number of individuals (and thus twin pairs) that have average annual earnings of less then base amount is significantly greater for women than for men, supporting the hypothesis of that men participate in the labor market to a larger extent than women (of this time period) do. The unconditional and the conditional height premiums for the full and the restricted samples are shown in Figure 10.[22] Imposing the earnings restriction described above leaves the estimates for the male sample almost unchanged. In contrast, the same restriction decreases the height coefficients for the female sample for most of the considered age waves. This implies that parts of the unrestricted female height premium could be attributed to a positive association between height and labor market participation. In this setting, the return to tallness for women is shown to be relatively constant throughout the life cycle amounting to about 5 percent in the OLS setting and 3-4 percent in the WTP setting.

[21] The PBA is a measure commonly used in Swedish law to define benefits and public insurance terms. It strictly follows the consumer price index over time and amounted to SEK 44,400 (or about USD 6,000) in 2010. Two PBAs is a very low income in Sweden. A study of seven major labor market negotiation sectors in 2004 (there are no legislated minimum wages in Sweden, but wages are set by negotiations between unions and employer organizations) showed that the very lowest monthly full-time salary was 12,790 SEK (Skedinger, 2006). On an annual basis, two PBAs were equivalent to 51 percent of this. Hence, the income restriction excludes individuals whose total earnings do not exceed the revenue from working half-time at the lowest wage.

[22] Height coefficients with standard errors clustered by twin pair are also presented in Table A.7 in Appendix.

Birth Weight and Height as Proxies for In Utero Environmental Conditions

The relationship between height and earnings could be a function of in utero and infancy conditions, which in turn should be mirrored by birth weight and birth height.[23] If the association between height and earnings could be traced back to such environmental conditions, including birth indicators in the model would lower the estimates of the height premium.[24]

Introducing birth weight or birth height into our model leaves the estimated height premium coefficients nearly identical to the main specification, which can be seen in Figure 11a and 11b (see also table A.8).[25] Hence, we conclude that within twin-pair differences of in utero and infancy conditions, do not explain differences in the height premium.

Educational Attainment as a Mediating Variable

Several studies have shown that height and cognitive ability is positively correlated over the life span, also among twins (Beauchamp et al., 2011; Case and Paxson, 2008a; Case and Paxson, 2008b; Keller et al., 2013; Richards et al., 2002; Tanner, 1979). If cognitive ability, and thereby also height, also is related to length of education it seems reasonable to believe that educational attainment could function as a mediating variable for the height-earnings relationship over the life cycle.[26]

Figure 12 (see also table A.9) illustrates the height coefficients for the main specification and specifications in which we include years of schooling.[27] Variations in educational attainment between individuals as captured in the main unconditional OLS model decreases the height premium estimates by approximately 40 percent for the male sample and more than 50 percent for the female sample. However, the conditional WTP height premiums remain almost unchanged for both genders when introducing years of schooling. Hence, intra-familial variation in education does not seem to affect the associated estimated height

[23] It has been shown that birth weight is correlated with both adult height and labor market outcomes such as earnings (e.g., Black et al., 2007). For the (pooled) sample used in this study, the correlation between adult height and birth weight is 0.19 and statistically significant.

[24] The average difference in birth weight for DZ twins is approximately 360 grams for males and about 340 grams for females. The average difference in birth weight for MZ twins is close to 300 grams for both men and women. Close to 91 percent of sample have a birth weight difference of at least 50 grams.

[25] Height and birth weight coefficients with standard errors clustered by twin pair are also presented in Table A.8 in Appendix.

[26] The average difference in years of schooling for DZ twins is 1.9 years for males and 1.6 years for females. The average difference in schooling for MZ twins is 1.3 years for both men and women. 53 percent of the full sample have nonzero within twin-pair differences in years of schooling.

[27] Height and years-of-schooling coefficients with standard errors clustered by twin pair are also presented in Table A.9 in Appendix.

premium at all. Moreover, and as shown by Figure 13, introducing years of schooling into the model specification for men yields almost identical OLS and WTP height coefficients. Overall, this suggests that the mechanisms behind the height premium that can be traced back to family background and genetics (that are differenced out in the WTP specifications) are mediated through variations in educational attainment between families. For women, the results of including schooling are less transparent (the WTP estimates are mostly larger for younger ages, but close to the OLS estimates for older ages).

5 Concluding Discussion

It is widely known that tall people earn more than people of limited stature. This study primarily explores how the height premium in earnings develops with age, whether this pattern has changed over time, and to which extent the crude height premium can be traced back to early life conditions (family background) and genetic predispositions. Our estimations show that the profiles of the returns to tallness over the life cycle vary between men and women. For men, the height premium increases with age, a pattern that qualitatively remains, tough less pronounced, when differencing between twins. Moreover, the height premium at a given age tends to fall across cohorts. A positive development of the height premium for men is not consistent with discriminatory models in which employers erroneously accredit capabilities to (young) people according to their height and such misperceptions eventually unfold. Increasing height premiums with age are consistent with a scenario in which productivity-related individual characteristics such as cognition and non-cognitive skills (and skill development) are associated with height, and such characteristics promote career building and earnings growth. But it would also be consistent with a situation in which taller individuals throughout their careers are, regardless of their skills, positively discriminated when it comes to promotions to higher, better paid occupations or positions. The data material at hand does not allow us to discriminate between these hypotheses. Further, the height premium in earnings is not limited to active labor market participation but spills over on retirement via pension reimbursements.

The height premium in earnings tends to decrease with age for women, but the estimated pattern is more volatile. However, taking labor market participation into account, the estimated height premiums are rather constant with age. Again, the data at hand does not allow us to discern whether this may be a function of age independent height related discrimination or a result of height being associated with productivity related traits. Generally, it appears as that tallness matter more for the earnings of men than of women.

For both males and females, the association between height and earnings has become somewhat weaker over time. The childhood and youth of the studied birth cohorts, ranging from 1900-1958, cover a period in which Sweden was transformed into a more modern welfare state. It seems plausible that this also meant that the total variation in height within the population became relatively more attributable to genetic and less to environmental factors. If there is an association between environmentally induced height and cognitive capability, which is stronger than the corresponding association between genetically induced height and cognition, it follows that the association between height and earnings should be expected to decrease when environmentally insults becomes more limited in a developing society. However, a decrease in the height premium over time would also be consistent with structural changes of the labor market in which, for example, height-based discrimination is decreasing.

Within twin-pair fixed effects estimates are on average 40 percent lower than the OLS estimates for men, suggesting that early life environmental conditions and genetic endowments explain a significant part of the unconditional returns to tallness throughout most of an individual's adult life. Including education as an explanatory variable has no effect on the within twin pair estimates, whereas it induces a similar reduction (about 40 percent) of the estimated OLS height premium, implying that the OLS and WTP height premium patterns now tend to coincide. Hence, it seems as if schooling may mediate the association between height and earnings among unrelated male individuals, but not twins.

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Figures

Figure 1
Distribution of within twin-pair height differences

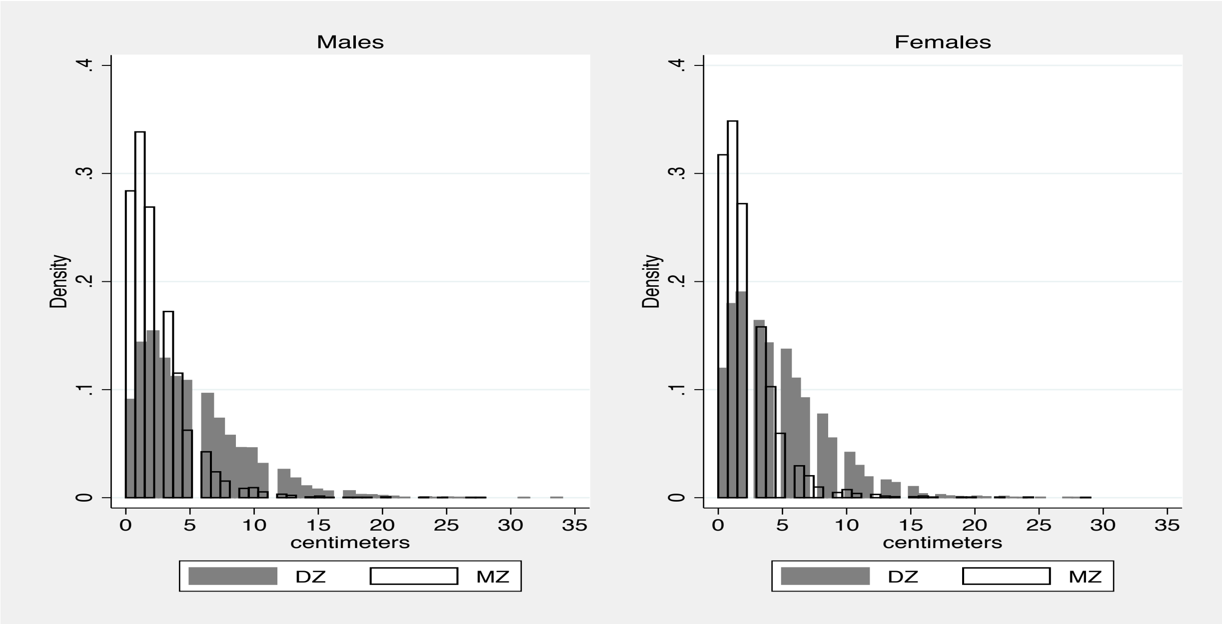


Figure 2
Average annual earnings by age

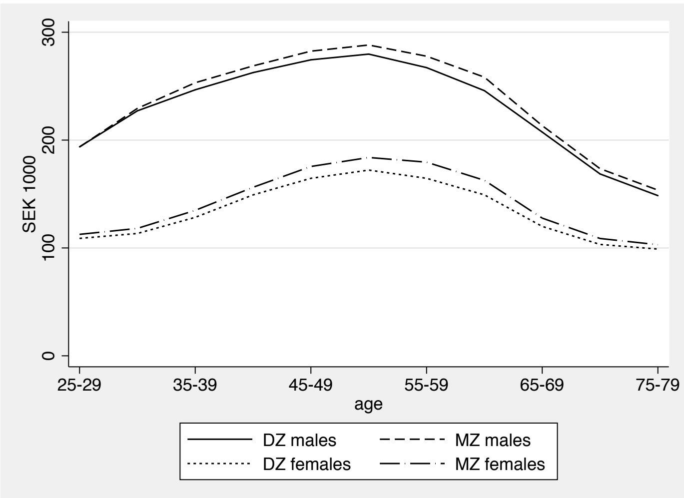


Figure 3
Average annual earnings (SEK 1000) by height for different age groups, males

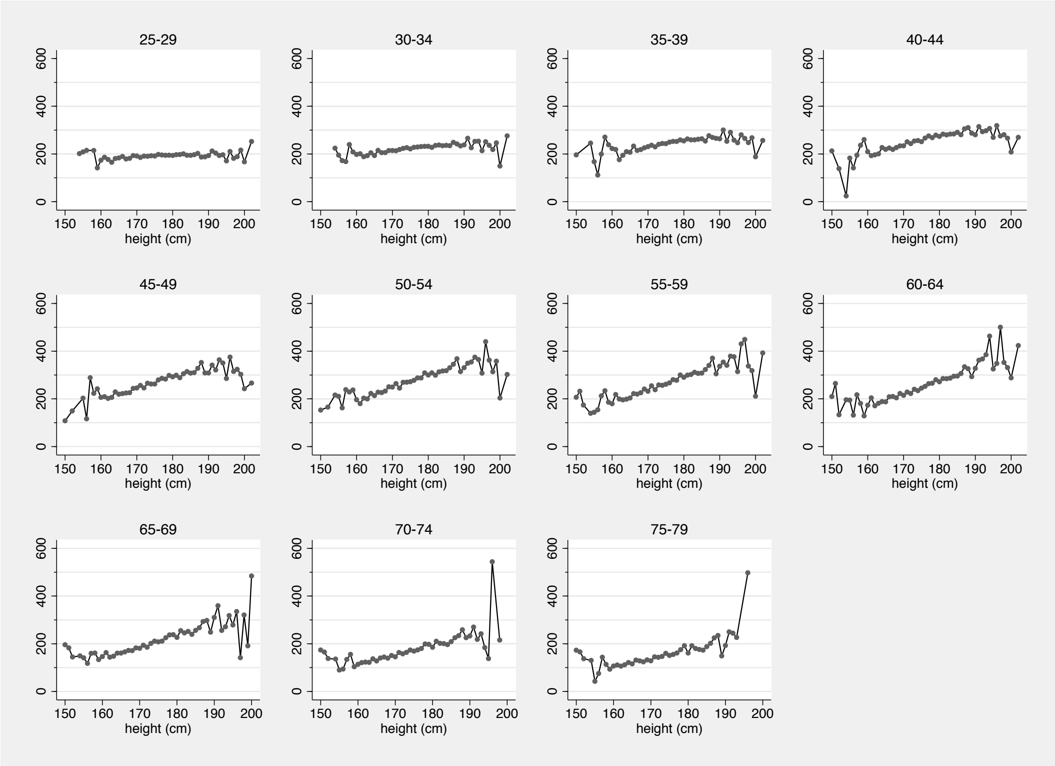


Figure 4
Average annual earnings (SEK 1000) by height for different age groups, females

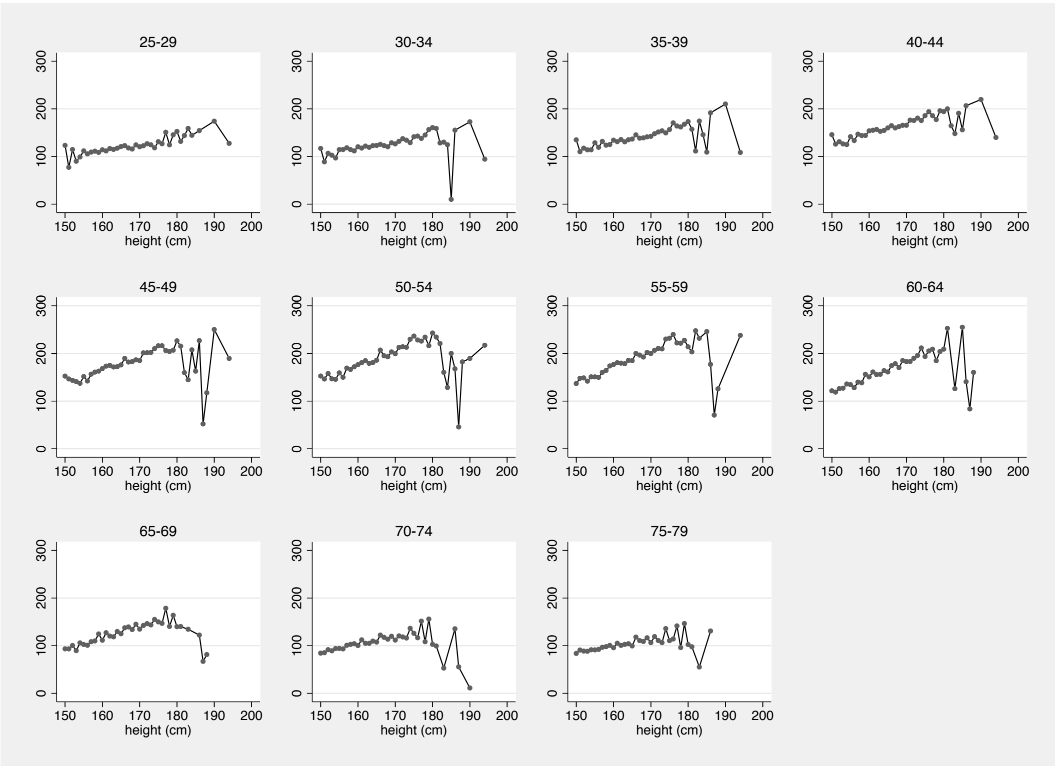


Figure 5
Average annual earnings at age 30-39 by height

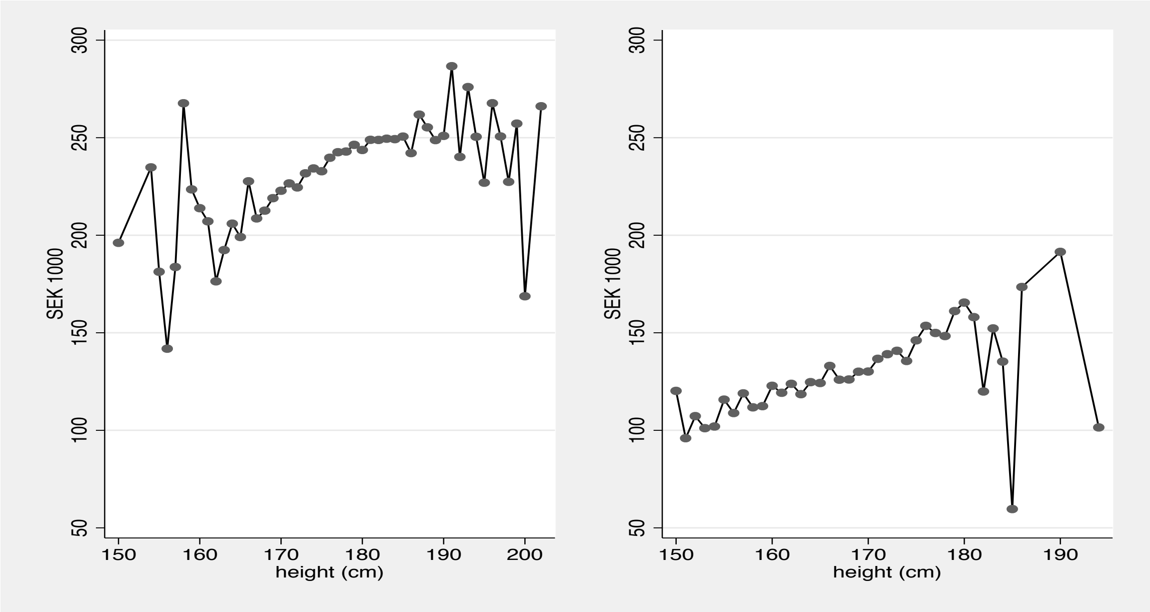


Figure 6
The unconditional and conditional height premiums in earning

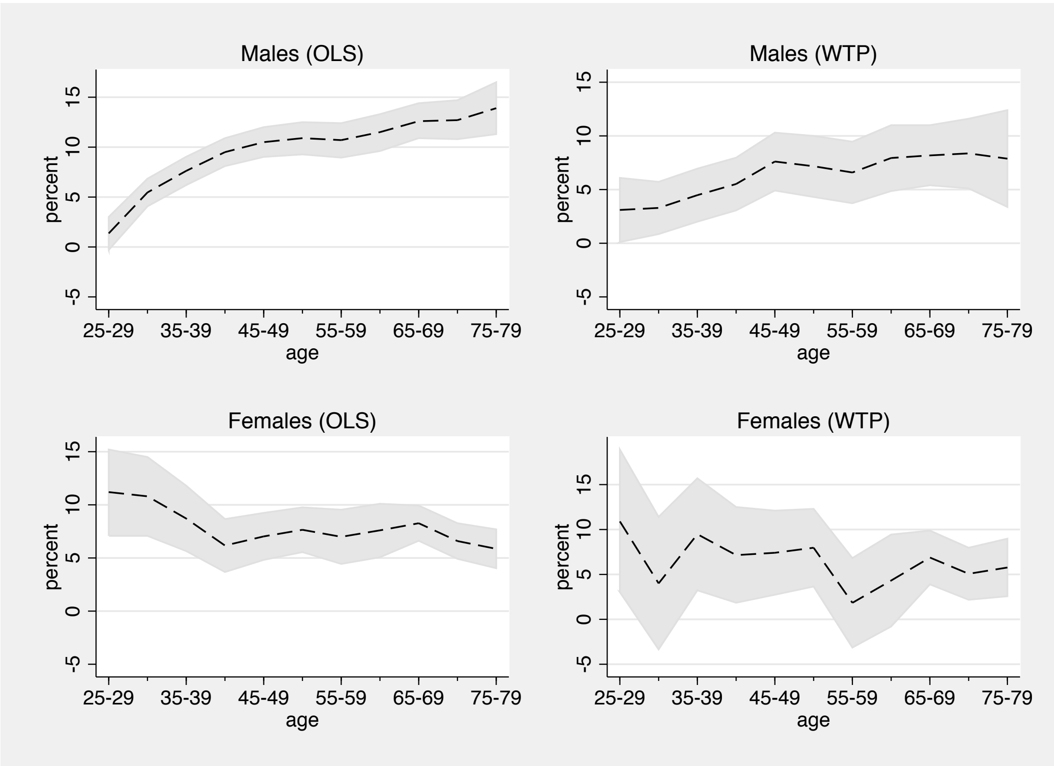


Figure 7
The height premium in earnings: gender differences

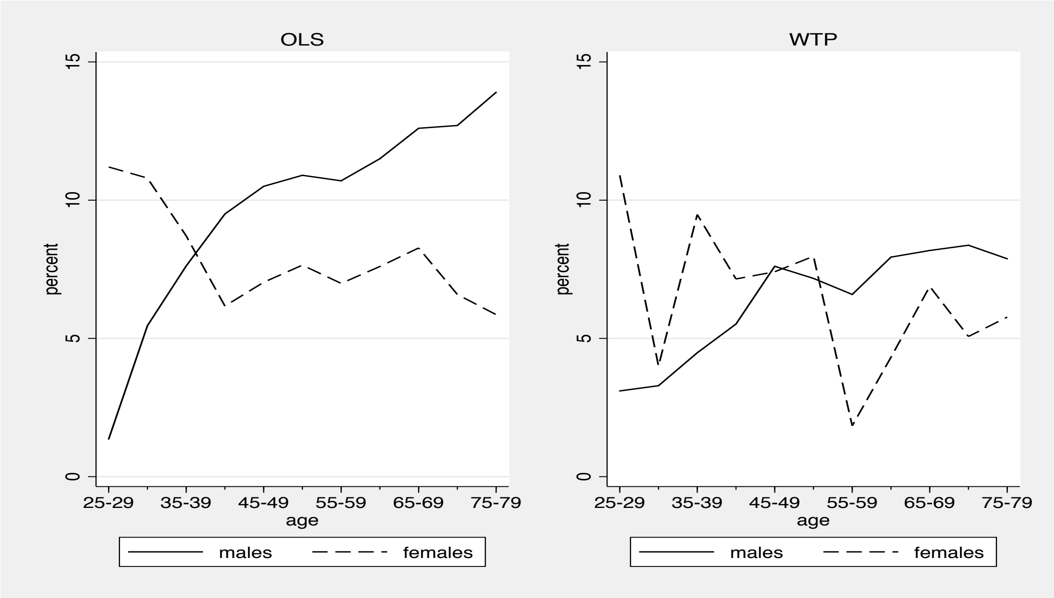


Figure 8
The height premium in earnings: birth cohorts born 1900-1919, 1920-1939, 1940-1958

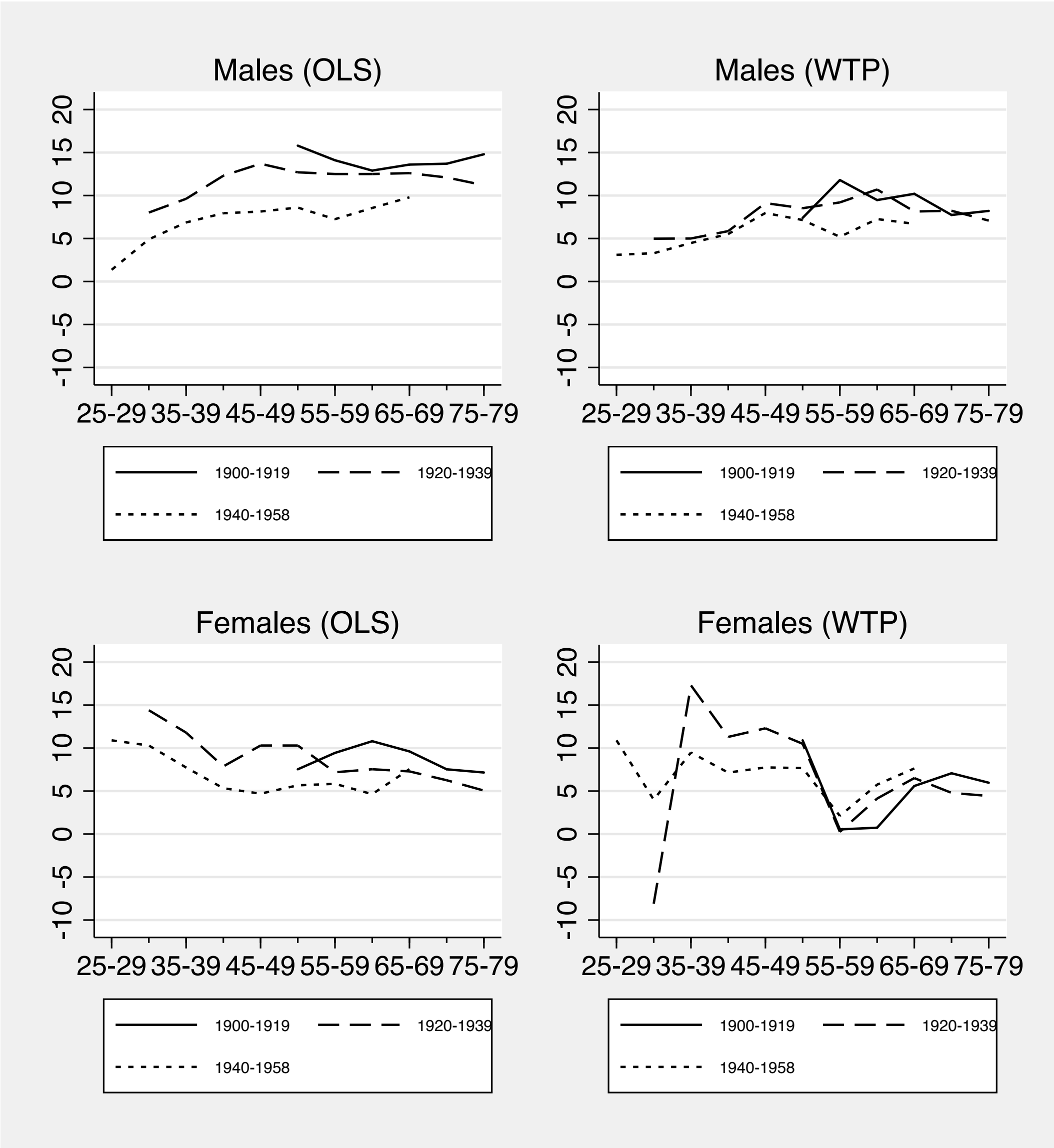


Figure 9
The height premium in earnings: improtance of early life environmental conditions and genes

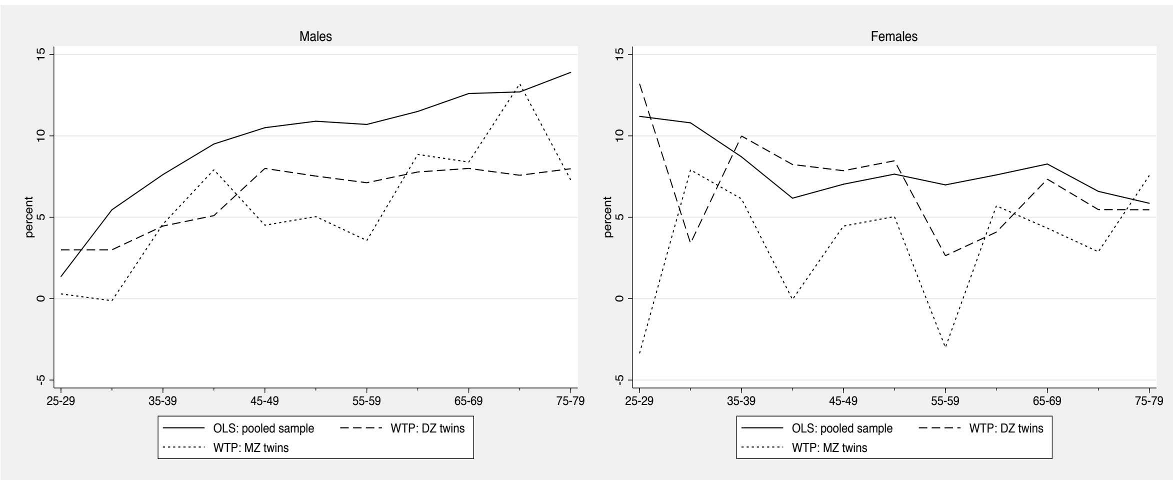


Figure 10
Height premium in earnings given labor market participation

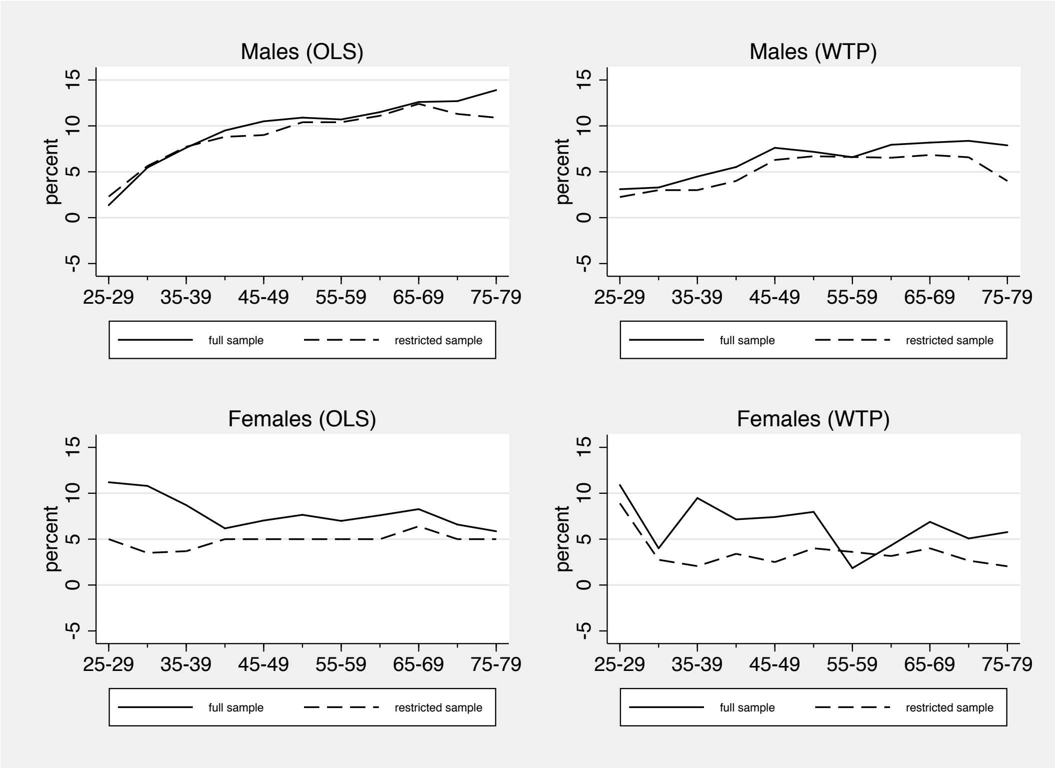


Figure 11a
Height premium in earnings: controlling for birth weight

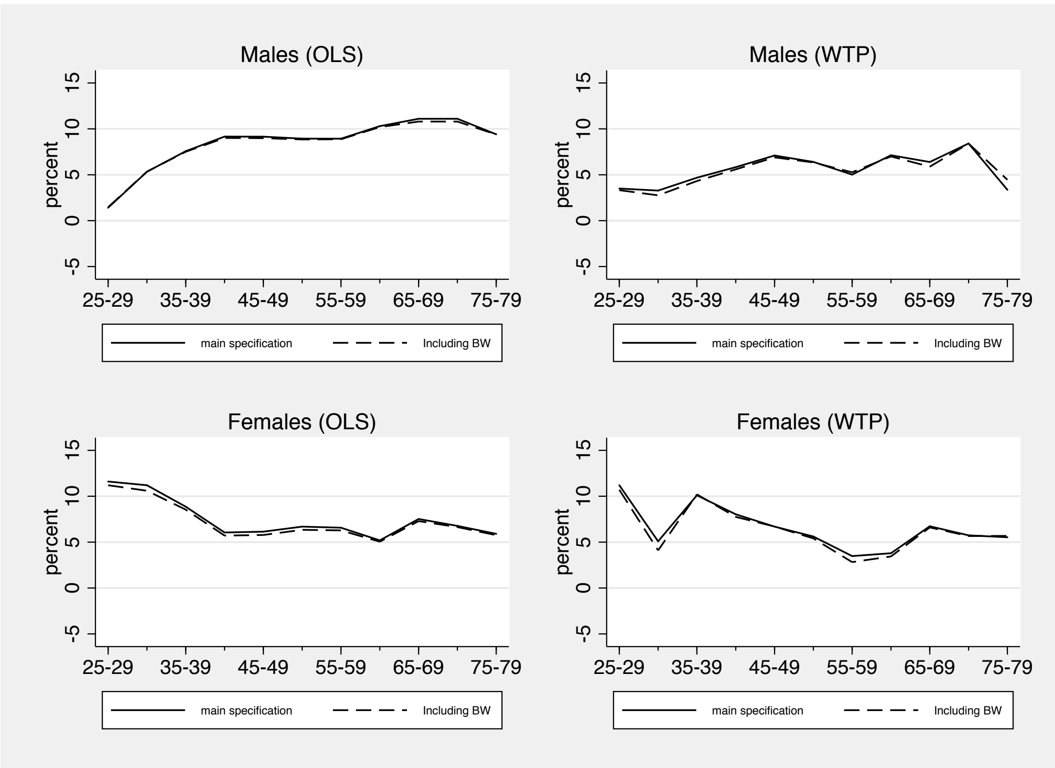


Figure 11b
Height premium in earnings: controlling for birth height

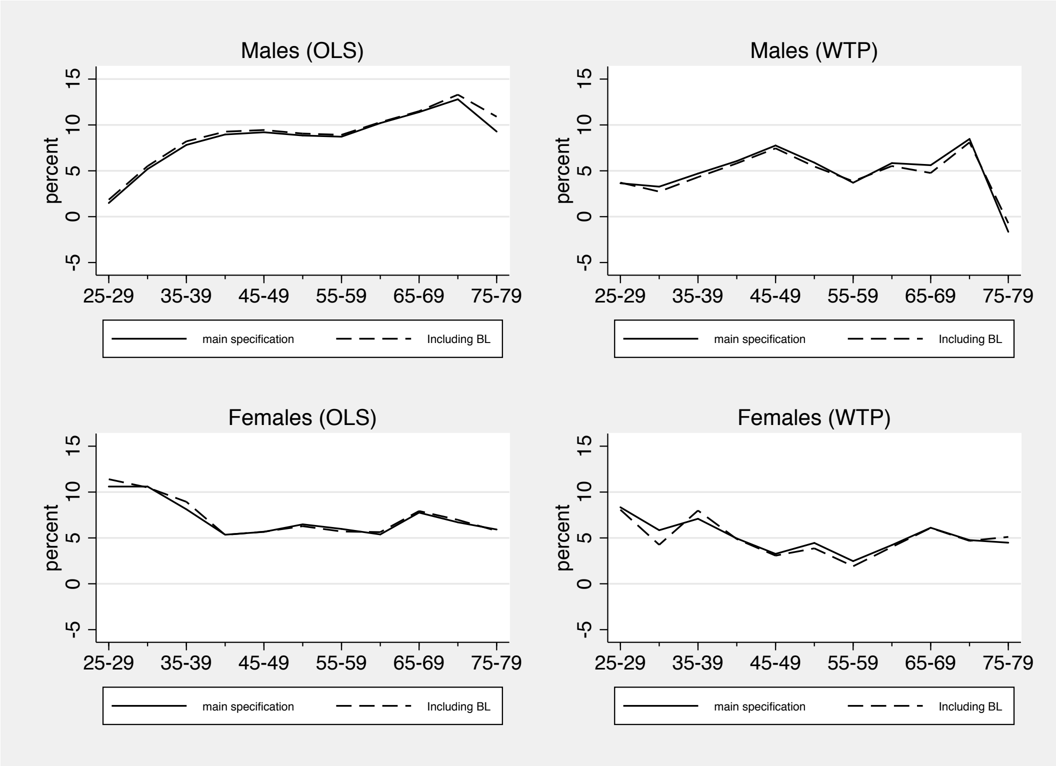


Figure 12
Height premium in earnings: controlling for educational attainment

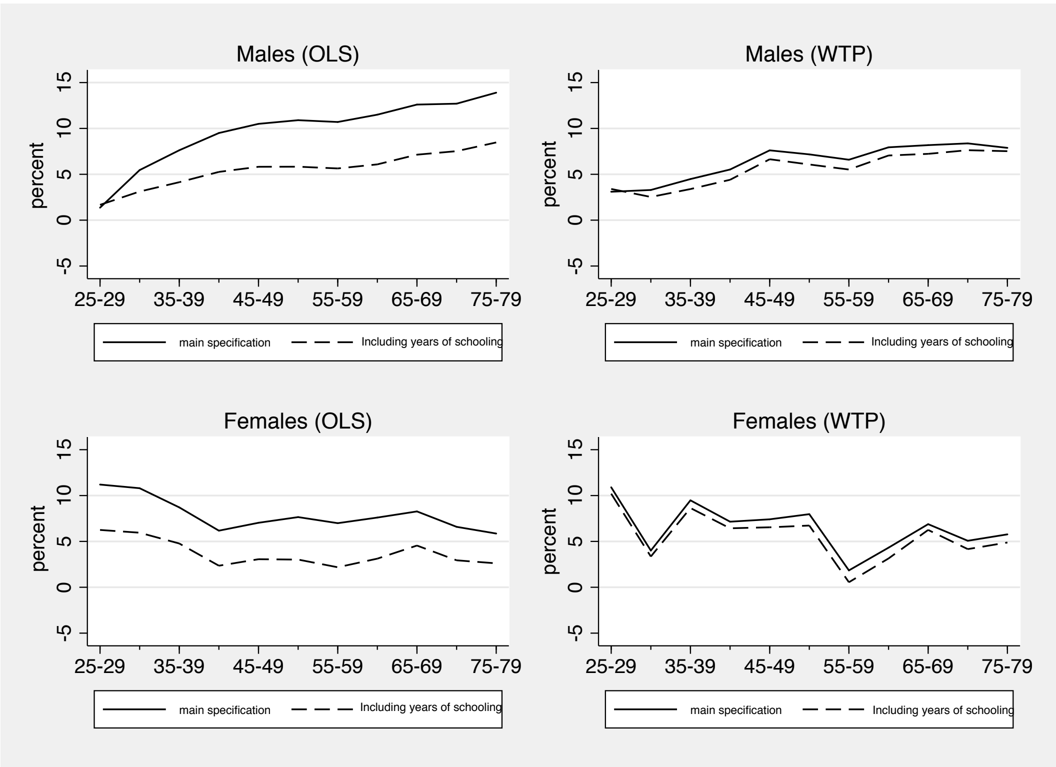
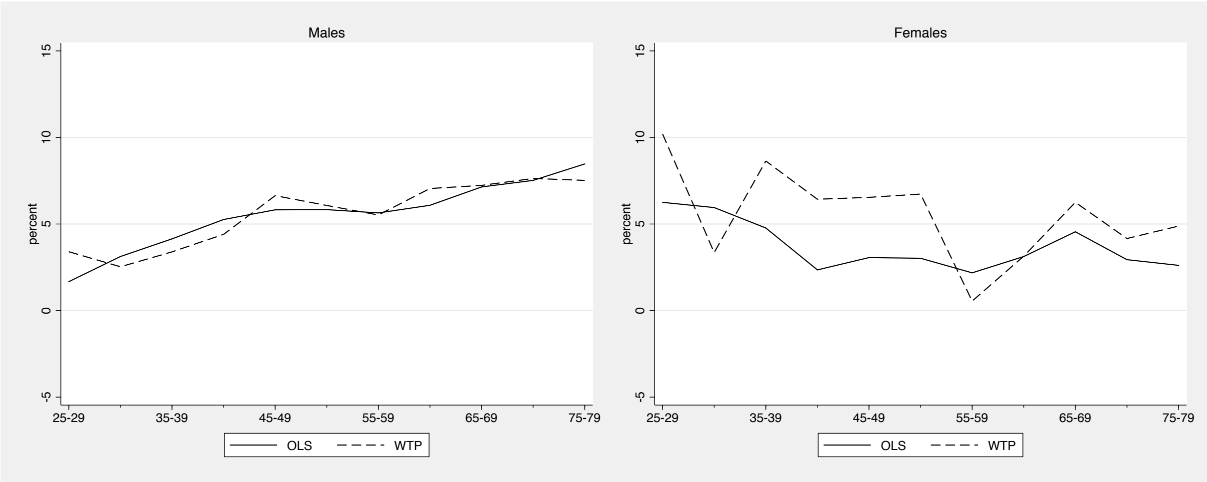


Figure 13
Height premium in earnings and educational attainment: OLS versus WTP estimates



Tables

Table 1
Descriptive statistics

	males		females	
	DZ	MZ	DZ	MZ
Height				
Height in cm	176.4	176.1	163.6	163.5
	(6.8)	(6.7)	(5.9)	(5.8)
Within twin pair height difference in cm	5.0	2.3	4.6	2.1
	(4.1)	(2.5)	(3.7)	(2.4)
Number of zero differences in height	956	1,592	1,224	2,132
Educational Attainment				
Years of Schooling	9.6	9.8	9.2	9.7
	(3.3)	(3.4)	(3.2)	(3.2)
Within twin pair difference in schooling	1.909	1.360	1.607	1.300
	(2.286)	(1.940)	(2.021)	(1.828)
Observations	12,372	7,610	14,462	9,036
Annual Earnings				
Average annual earnings at age 30-39	237,015	241,796	123,165	128,096
	(87,524)	(87,257)	(69,865)	(70,609)
Observations	7,502	4,830	7,574	5,322
Birth weight				
Birth weight in grams	2,756	2,661	2,644	2,494
	(508)	(497)	(497)	(492)
Observations	6,616	4,190	7,006	4,900
Birth height				
Birth height in cm	48.27	47.53	47.56	46.77
	(2.739)	(2.800)	(2.769)	(2.828)
Observations	6566	4174	6966	4876

Notes: Mean coefficients with standard deviations in parentheses presented by zygosity and gender. Annual earnings (SEK) in 2010 price levels, winsorized at the 1st and the 99th percentiles. Data on birth weight is restricted to a subsample born 1925-1958.

Table 2
Descriptive statistics: Cohorts born 1900-1919, 1920-1939, 1940-1958

Variable	males		females	
	DZ	MZ	DZ	MZ
Cohort born 1900-1919				
Height				
Height in cm	173.3	173.1	161.8	161.3
	(6.3)	(6.1)	(5.9)	(5.7)
Within twin pair height difference in cm	5.2	2.5	4.8	2.6
	(4.3)	(2.4)	(3.9)	(3.0)
Number of zero difference in height	210	264	286	386
Educational Attainment				
Years of Schooling	7.4	7.5	7.0	7.2
	(2.5)	(2.5)	(2.1)	(2.2)
Observations	2,624	1,542	3,414	1,794
Cohort born 1920-1939				
Height				
Height in cm	175.6	175.1	163.1	163.1
	(6.3)	(6.4)	(5.6)	(5.6)
Within twin pair height difference in cm	4.9	2.4	4.6	2.0
	(3.9)	(2.7)	(3.6)	(2.1)
Number of zero difference in height	292	498	372	666
Educational Attainment				
Years of Schooling	9.0	9.2	8.5	9.0
	(3.4)	(3.4)	(3.0)	(3.2)
Observations	4,084	2,344	4,850	2,886
Cohort born 1940-1958				
Height				
Height in cm	178.8	178.4	165.4	164.9
	(6.4)	(6.3)	(5.7)	(5.5)
Within twin pair height difference in cm	5.0	2.1	4.5	1.9
	(4.0)	(2.3)	(3.7)	(1.9)
Number of zero difference in height	436	778	518	1,050
Educational Attainment				
Years of Schooling	11.1	11.5	11.3	11.5
	(2.8)	(2.8)	(2.6)	(2.6)
Observations	5,368	3,514	5,750	4,128

Notes: Mean coefficients with standard deviations in parentheses presented by zygosity and gender. Annual earnings (SEK) in 2010 price levels, winsorized at the 1st and the 99th percentiles.

Table 3
The height premium in earnings at age 30-39

	(1) DZ	(2) MZ	(3) DZ	(4) MZ
	Males			
Height	0.074***	0.063***	0.042***	0.029
	(0.008)	(0.011)	(0.013)	(0.023)
Observations	7,502	4,830	7,502	4,830
	Females			
Height	0.102***	0.088***	0.078***	0.070
	(0.021)	(0.025)	(0.034)	(0.078)
Observations	7,574	5,322	7,574	5,322

Notes: Columns 1-2 present OLS regression coefficients, of which both model specifications include birth-year fixed effects. Columns 3-4 present within twin pair regression coefficients. Columns 1 and 3 report coefficients for the dizygotic (DZ) twin sample and columns 2 and 4 report coefficients for the monozygotic (MZ) twin sample. Standard errors in parentheses, clustered by twin pair in all specifications. Significance level: *** p<0.01, ** p<0.05, * p<0.1. Dependent variable is logarithm of average annual earnings at age 30-39, winsorized at the 1st and 99th percentiles. Height coefficients are presented in terms of decimeters.

Table 4
Number of observations in original sample and sample in which annual earnings is at least SEK 84,800

	males			females		
Sample	Original	> SEK 84,800	Difference (%)	Original	> SEK 84,800	Difference (%)
Age						
25-29	9,220	6,978	24%	8,956	5,050	44%
30-34	10,870	10,144	7%	10,686	5,706	47%
35-39	12,226	11,502	6%	12,658	7,780	39%
40-44	13,600	12,776	6%	14,452	10,514	27%
45-49	15,102	14,062	7%	16,120	12,478	23%
50-54	15,926	14,710	8%	17,004	13,246	22%
55-59	14,646	13,296	9%	15,662	11,776	25%
60-64	12,542	11,150	11%	14,718	9,422	36%
65-69	9,806	8,326	15%	12,860	6,146	52%
70-74	7,184	5,434	24%	10,136	4,116	59%
75-79	4,594	3,132	32%	7,624	2,868	62%

Note: The table reports the number of observations in the original sample used in the main analysis and the number of observations in the sample of twin pairs in which both have average annual earnings of at least SEK 84,800 (in 2010 prices). The relative difference (%) in sample sizes relative to original sample size is also presented.

Appendix

Measurement Error in Self-Reported Height Among Twins

Measurement errors in explanatory variables may induce an attenuation bias in the estimation of such variables. In the presence of such errors, the bias of the OLS estimator of an explanatory variable is given by σ_v/σ_S, where σ_v is the variance of the actual misreports and σ_S is the variance in the reported value of the explanatory variable (see, for example, Neumark, 1999; Bound and Solon, 1999). In the case of classical measurement errors, this bias is inflated when differencing among, for example, twins, and the bias now becomes $\sigma_v/[\sigma_S(1-\rho_S)]$, where ρ_S is the correlation between the reported explanatory variable within twin pairs. Hence, the attenuation bias increases in the correlation (ρ_S), as long as this correlation is positive. According to our previous argument, we expect the measurement errors to be rather mild in the present study, and also non-classical as they ought to be correlated within twin pairs implying that the actual error of the *difference* in height between twins will be less pronounced than any misreports per se. From this perspective it is reassuring that our WTP height premium estimate (4.2 percent per decimeter height) among male DZ twins aged 30-39 coincides with the corresponding estimate obtained via differencing of administratively recorded height data among a large-scale representative sample of brothers by Lundborg et al. (2014).

If measurement errors were not correlated within twin pairs we would expect the variance of the difference between twins to grow substantially with age since the measurement errors per se are likely to grow with age. As indicated by Table 2, however, it seems that this is not the case. For DZ male twin pairs, the average difference in height and the corresponding variance hereof (in parenthesis) amounts to 5.0 (4.0), 4.9 (3.9) and 5.2 (4.3) for the cohorts born 1940-1958, 1920-1939 and 1900-1919, respectively. The corresponding figures for male MZ twin pairs are 2.1 (2.3), 2.4 (2.7) and 2.5 (2.4). For women the DZ figures are 4.5 (3.7), 4.6 (3.6) and 4.8 (3.9) and for MZ twins they are 1.9 (1.9), 2.0 (2.1) and 2.6 (3.0). Apart from the oldest female cohort MZ twin sample, the difference in height between twins and the variance hereof are remarkable stable across cohorts.

Unfortunately we do not have data on the measurement errors in height in our sample making direct analysis of actual measurement errors impossible. However, an indirect assessment of the importance of measurement errors could be obtained by comparing MZ and DZ twins from this respect. The magnitude in WTP parameter estimations of the bias from measurement errors (assumed to be randomly distributed among the twins) hinges critically on the correlation of the reported heights of the twins within a pair (see, for example, Griliches, 1977; Griliches, 1979; Neumark, 1999; Bound and Solon 1999). In our sample the within twin pair correlation of height amounts to (0.55, 0.87) and (0.50, 0.85) for (DZ, MZ) men and women respectively. Combined with the variance of the reported height in the respective sample (46, 45; 35,34: see the reported standard errors in Table 1) this implies that the downward bias should be about four times greater in the MZ sample compared to the DZ sample. Now, the absolute values of these biases are dependent on the variance of the measurement error, which we do not have. Fortunately, this has been estimated to amount to 4.4 centimeters in a subsample of the data used here for people aged 40-88 (mean age 63.9) by Dahl et al. (2010). Using this value (which is probably an overestimate, since the measurement error increases with age) in our computations, the measurement error bias would amount to about 10 percent in the OLS, 20-25 percent in the WTP DZ estimations and 75-90 percent in the WTP MZ estimations. Hence, in the presence of randomly distributed classical measurement errors, we would expect the DZ estimates to be much closer to the OLS than to the MZ estimates, which in turn should be close to zero. From this respect, the fact that the DZ estimates is much closer to the MZ ones implies not only that, within twin pairs, the height variation has similar effect on earnings regardless of whether it is genetically or environmentally induced, but also that the estimates are rather unaffected by measurement errors. Though admittedly circumstantial, the arguments above suggest that measurement errors are not heavily influencing the results.

Table A.1
The height premium in earnings over the life cycle

		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
	Age	*25-29*	*30-34*	*35-39*	*40-44*	*45-49*	*50-54*	*55-59*	*60-64*	*65-69*	*70-74*	*75-79*
		Males										
(A)	*Height*	0.014	0.055***	0.076***	0.095***	0.105***	0.109***	0.107***	0.115***	0.126***	0.127***	0.139***
		(0.008)	(0.007)	(0.007)	(0.007)	(0.008)	(0.008)	(0.009)	(0.009)	(0.009)	(0.010)	(0.0133)
	Observations	9,220	10,870	12,226	13,600	15,102	15,926	14,646	12,542	9,806	7,184	4,594
(B)	*Height*	0.031**	0.033***	0.045***	0.055***	0.076***	0.072***	0.066***	0.079***	0.082***	0.084***	0.079***
		(0.015)	(0.012)	(0.013)	(0.013)	(0.014)	(0.015)	(0.015)	(0.016)	(0.014)	(0.017)	(0.023)
	Observations	9,220	10,870	12,226	13,600	15,102	15,926	14,646	12,542	9,806	7,184	4,594
		Females										
(C)	*Height*	0.112***	0.108***	0.087***	0.062***	0.070***	0.077***	0.070***	0.076***	0.083***	0.066***	0.059***
		(0.021)	(0.019)	(0.016)	(0.013)	(0.011)	(0.011)	(0.013)	(0.013)	(0.008)	(0.009)	(0.009)
	Observations	8,956	10,686	12,658	14,452	16,120	17,004	15,662	14,718	12,860	10,136	7,624
(D)	*Height*	0.109***	0.040	0.095***	0.072***	0.074***	0.080***	0.018	0.043*	0.069***	0.051***	0.058***
		(0.040)	(0.038)	(0.032)	(0.027)	(0.024)	(0.022)	(0.025)	(0.026)	(0.015)	(0.015)	(0.016)
	Observations	8,956	10,686	12,658	14,452	16,120	17,004	15,662	14,718	12,860	10,136	7,624

Notes: Columns 1-11 present the height coefficients for earnings at the 11 age waves, 25-79. Row (A) and (C) reports the OLS regression coefficients, of which all model specifications include birth year fixed effects. Row (B) and (D) report within twin pair regression coefficients. All model specifications are for the pooled sample (DZ and MZ twins). Standard errors parentheses, clustered by twin pair in all model specifications. Significance level: *** p<0.01, ** p<0.05, * p<0.1. Dependent variable is logarithm of average annual earnings, winsorized at the 1st and 99th percentiles. Height coefficients are presented in terms of decimeters.

Table A.2
The unconditional height premium in earnings: birth cohorts born 1900-1919, 1920-1939, 1940-1958, males

		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
	Age	*25-29*	*30-34*	*35-39*	*40-44*	*45-49*	*50-54*	*55-59*	*60-64*	*65-69*	*70-74*	*75-79*
		Cohort born 1900-1919										
(A)	*Height*	-	-	-	-	-	0.158***	0.141***	0.129***	0.136***	0.137***	0.148***
		-	-	-	-	-	(0.033)	(0.025)	(0.021)	(0.018)	(0.018)	(0.021)
	Observations	-	-	-	-	-	1,666	2,834	3,456	3,576	2,910	2,090
		Cohort born 1920-1939										
(B)	*Height*	-	0.080***	0.096***	0.123***	0.137***	0.127***	0.125***	0.125***	0.126***	0.121***	0.112***
		-	(0.019)	(0.015)	(0.012)	(0.012)	(0.012)	(0.012)	(0.012)	(0.011)	(0.012)	(0.016)
	Observations	-	2,044	3,498	4,968	6,328	6,190	5,912	5,584	5,064	3,880	2,100
		Cohort born 1940-1958										
(C)	*Height*	0.014	0.049***	0.069***	0.079***	0.081***	0.086***	0.073***	0.086***	0.098***	-	-
		(0.008)	(0.008)	(0.008)	(0.009)	(0.010)	(0.012)	(0.014)	(0.018)	(0.027)	-	-
	Observations	8,874	8,826	8,728	8,632	8,498	8,070	5,900	3,502	1,084	-	-

Notes: Columns 1-11 present the OLS height coefficients for earnings at the 11 age waves, 25-79, of which all model specifications include birth year fixed effects. All model specifications are for the pooled sample (DZ and MZ twins). Standard errors in parentheses, clustered by twin pair in all model specifications. Significance level: *** p<0.01, ** p<0.05, * p<0.1. Dependent variable is logarithm of average annual earnings, winsorized at the 1st and 99th percentiles. Height coefficients are presented in terms of decimeters.

Table A.3
The conditional height premium in earnings: birth cohorts born 1900-1919, 1920-1939, 1940-1958, males

		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
	Age	*25-29*	*30-34*	*35-39*	*40-44*	*45-49*	*50-54*	*55-59*	*60-64*	*65-69*	*70-74*	*75-79*
							Cohort born 1900-1919					
(A)	*Height*	-	-	-	-	-	0.074	0.118***	0.095***	0.102***	0.077***	0.082**
		-	-	-	-	-	(0.052)	(0.037)	(0.032)	(0.025)	(0.027)	(0.036)
	Observations	-	-	-	-	-	1,666	2,834	3,456	3,576	2,910	2,090
							Cohort born 1920-1939					
(B)	*Height*	-	0.050	0.050**	0.059***	0.091***	0.085***	0.092***	0.107***	0.081***	0.082***	0.071**
		-	(0.032)	(0.024)	(0.021)	(0.020)	(0.021)	(0.020)	(0.022)	(0.018)	(0.020)	(0.031)
	Observations	-	2,044	3,498	4,968	6,328	6,190	5,912	5,584	5,064	3,880	2,100
							Cohort born 1940-1958					
(C)	*Height*	0.031**	0.033***	0.045***	0.055***	0.080***	0.072***	0.052***	0.073***	0.067***	-	-
		(0.015)	(0.012)	(0.013)	(0.013)	(0.014)	(0.015)	(0.016)	(0.018)	(0.017)	-	-
	Observations	9,220	10,870	12,226	13,600	14,826	14,260	11,812	9,086	6,148	-	-

Notes: Columns 1-11 present the WTP height coefficients for earnings at the 11 age waves, 25-79. All model specifications are for the pooled sample (DZ and MZ twins). Standard errors in parentheses, clustered by twin pair in all model specifications. Significance level: *** p<0.01, ** p<0.05, * p<0.1. Dependent variable is logarithm of average annual earnings, winsorized at the 1st and 99th percentiles. Height coefficients are presented in terms of decimeters.

Table A.4
The unconditional height premium in earnings: birth cohorts born 1900-1919, 1920-1939, 1940-1958, females

		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
	Age	*25-29*	*30-34*	*35-39*	*40-44*	*45-49*	*50-54*	*55-59*	*60-64*	*65-69*	*70-74*	*75-79*
		Cohort born 1900-1919										
(A)	*Height*	-	-	-	-	-	0.075	0.094*	0.108***	0.096***	0.075***	0.072***
		-	-	-	-	-	(0.058)	(0.050)	(0.032)	(0.015)	(0.014)	(0.013)
	Observations	-	-	-	-	-	1,264	2,256	3,58	4,738	4,152	3,576
		Cohort born 1920-1939										
(B)	*Height*	-	0.144**	0.118***	0.079***	0.103***	0.103***	0.072***	0.075***	0.073***	0.063***	0.051***
		-	(0.067)	(0.040)	(0.030)	(0.022)	(0.020)	(0.020)	(0.018)	(0.011)	(0.011)	(0.014)
	Observations	-	1,348	3,082	4,888	6,500	6,846	6,766	6,996	6,766	5,518	3,516
		Cohort born 1940-1958										
(C)	*Height*	0.109***	0.103***	0.077***	0.053***	0.047***	0.057***	0.058***	0.046**	0.076***	-	-
		(0.021)	(0.020)	(0.016)	(0.012)	(0.012)	(0.011)	(0.015)	(0.019)	(0.024)	-	-
	Observations	8,808	9,338	9,576	9,564	9,470	8,894	6,640	4,142	1,266	-	-

Notes: Columns 1-11 present the OLS height coefficients for earnings at the 11 age waves, 25-79, of which all model specifications include birth year fixed effects. All model specifications are for the pooled sample (DZ and MZ twins). Standard errors in parentheses, clustered by twin pair in all model specifications. Significance level: *** p<0.01, ** p<0.05, * p<0.1. Dependent variable is logarithm of average annual earnings, winsorized at the 1st and 99th percentiles. Height coefficients are presented in terms of decimeters.

Table A.5
The conditional height premium in earnings: birth cohorts born 1900-1919, 1920-1939, 1940-1958, females

		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
	Age	*25-29*	*30-34*	*35-39*	*40-44*	*45-49*	*50-54*	*55-59*	*60-64*	*65-69*	*70-74*	*75-79*
		Cohort born 1900-1919										
(A)	*Height*	-	-	-	-	-	0.109	0.005	0.007	0.056**	0.071***	0.060***
		-	-	-	-	-	(0.129)	(0.093)	(0.060)	(0.025)	(0.022)	(0.022)
	Observations	-	-	-	-	-	1,264	2,256	3,580	4,738	4,152	3,576
		Cohort born 1920-1939										
(B)	*Height*	-	-0.081	0.173**	0.113*	0.123**	0.105***	0.003	0.041	0.065***	0.048**	0.044*
		-	(0.128)	(0.080)	(0.060)	(0.048)	(0.039)	(0.038)	(0.037)	(0.021)	(0.021)	(0.025)
	Observations	-	1,348	3,082	4,888	6,500	6,846	6,766	6,996	6,766	5,518	3,516
		Cohort born 1940-1958										
(C)	*Height*	0.109***	0.040	0.095***	0.072***	0.078***	0.077***	0.021	0.058**	0.076***	-	-
		(0.040)	(0.038)	(0.032)	(0.027)	(0.024)	(0.021)	(0.024)	(0.028)	(0.019)	-	-
	Observations	8,956	10,686	12,658	14,452	15,970	15,740	13,406	11,138	8,032	-	-

Notes: Columns 1-11 present the WTP height coefficients for earnings at the 11 age waves, 25-79. All model specifications are for the pooled sample (DZ and MZ twins). Standard errors in parentheses, clustered by twin pair in all model specifications. Significance level: *** $p<0.01$, ** $p<0.05$, * $p<0.1$. Dependent variable is logarithm of average annual earnings, winsorized at the 1st and 99th percentiles. Height coefficients are presented in terms of decimeters.

Table A.6
The height premium in earnings: importance of early life conditions and genes

		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
	Age	*25-29*	*30-34*	*35-39*	*40-44*	*45-49*	*50-54*	*55-59*	*60-64*	*65-69*	*70-74*	*75-79*
							Males					
							DZ twins					
(A)	*Height*	0.035**	0.038***	0.045***	0.051***	0.081***	0.075***	0.071***	0.078***	0.082***	0.076***	0.080***
		(0.017)	(0.014)	(0.014)	(0.014)	(0.015)	(0.016)	(0.016)	(0.017)	(0.016)	(0.019)	(0.025)
	Observations	5,568	6,584	7,436	8,294	9,318	9,836	9,090	7,774	6,188	4,516	2,816
							MZ twins					
(B)	*Height*	0.003	-0.001	0.046	0.079**	0.045	0.050	0.0357	0.089**	0.084***	0.132***	0.073
		(0.039)	(0.031)	(0.028)	(0.031)	(0.029)	(0.034)	(0.031)	(0.041)	(0.032)	(0.034)	(0.052)
	Observations	3,652	4,286	4,790	5,306	5,784	6,090	5,556	4,768	3,618	2,668	1,778
							Females					
							DZ twins					
(C)	*Height*	0.132***	0.034	0.100***	0.082***	0.079***	0.085***	0.026	0.041	0.073***	0.055***	0.055***
		(0.044)	(0.041)	(0.035)	(0.029)	(0.026)	(0.024)	(0.028)	(0.029)	(0.017)	(0.016)	(0.018)
	Observations	5,156	6,178	7,424	8,512	9,610	10,208	9,500	9,106	8,138	6,440	4,862
							MZ twins					
(D)	*Height*	-0.034	0.079	0.061	-0.001	0.045	0.050	-0.030	0.057	0.043	0.029	0.076**
		(0.102)	(0.097)	(0.082)	(0.068)	(0.053)	(0.052)	(0.062)	(0.056)	(0.034)	(0.034)	(0.037)
	Observations	3,800	4,508	5,234	5,940	6,510	6,796	6,162	5,612	4,722	3,696	2,762

Notes: Columns 1-11 present the within twin-pair height coefficients for earnings at the 11 age waves, 25-79. Standard errors parentheses, clustered by twin pair in all model specifications. Significance level: *** p<0.01, ** p<0.05, * p<0.1. Dependent variable is logarithm of average annual earnings, winsorized at the 1st and 99th percentiles. Height coefficients are presented in terms of decimeters.

Table A.7
Height premium in earnings given labor market participation

		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
	Age	*25-29*	*30-34*	*35-39*	*40-44*	*45-49*	*50-54*	*55-59*	*60-64*	*65-69*	*70-74*	*75-79*
							Males					
(A)	*Height*	0.024***	0.056***	0.077***	0.088***	0.100***	0.104***	0.104***	0.111***	0.124***	0.113***	0.109***
		(0.008)	(0.005)	(0.006)	(0.006)	(0.006)	(0.006)	(0.007)	(0.007)	(0.008)	(0.009)	(0.011)
	Observations	6,978	10,144	11,502	12,776	14,062	14,710	13,296	11,150	8,326	5,434	3,132
(B)	*Height*	0.023	0.039***	0.038***	0.045***	0.063***	0.067***	0.066***	0.065***	0.068***	0.066***	0.044**
		(0.015)	(0.009)	(0.010)	(0.010)	(0.010)	(0.010)	(0.011)	(0.012)	(0.012)	(0.014)	(0.020)
	Observations	6,978	10,144	11,502	12,776	14,062	14,710	13,296	11,150	8,326	5,434	3,132
							Females					
(C)	*Height*	0.057**	0.035***	0.037***	0.055***	0.056***	0.060***	0.060***	0.056***	0.065***	0.059***	0.053***
		(0.024)	(0.008)	(0.007)	(0.006)	(0.006)	(0.006)	(0.006)	(0.007)	(0.008)	(0.009)	(0.011)
	Observations	5,050	5,706	7,780	10,514	12,478	13,246	11,776	9,422	6,146	4,116	2,868
(D)	*Height*	0.089*	0.028*	0.020	0.034***	0.026**	0.045***	0.036***	0.032**	0.049***	0.027	0.020
		(0.047)	(0.016)	(0.014)	(0.012)	(0.010)	(0.011)	(0.012)	(0.014)	(0.016)	(0.017)	(0.020)
	Observations	5,050	5,706	7,780	10,514	12,478	13,246	11,776	9,422	6,146	4,116	2,868

Note: Columns 1-11 present the height coefficients for earnings for 11 age waves, 25-79. Row (A) and (C) reports the OLS regression coefficients, of which all model specifications include birth year fixed effects. Row (B) and (D) report within twin pair regression coefficients. All model specifications are for the pooled sample (DZ and MZ twins). Standard errors parentheses, clustered by twin pair in all model specifications. Significance level: *** p<0.01, ** p<0.05, * p<0.1. Dependent variable is logarithm of average annual earnings, winsorized at the 1st and 99th percentiles. Height coefficients are presented in terms of decimeters. The sample is restricted to twin pairs of which both earn at least SEK 84,800.

Table A.8
Height premium in earnings: controlling for birth weight

		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
	Age	*25-29*	*30-34*	*35-39*	*40-44*	*45-49*	*50-54*	*55-59*	*60-64*	*65-69*	*70-74*	*75-79*
		Males										
(A)	*Height*	0.015*	0.053***	0.075***	0.090***	0.090***	0.089***	0.089***	0.102***	0.108***	0.108***	0.094***
		(0.009)	(0.007)	(0.007)	(0.007)	(0.008)	(0.009)	(0.010)	(0.012)	(0.012)	(0.015)	(0.024)
	Birth weight	-0.00032	-0.00005	0.00031	0.00074*	0.00078*	0.00046	0.00027	0.00062	0.00160***	0.00132*	0.00006
		(0.00061)	(0.00047)	(0.00045)	(0.00044)	(0.00045)	(0.00050)	(0.00053)	(0.00059)	(0.00060)	(0.00068)	(0.00106)
	Observations	9,112	10,748	12,082	12,874	12,680	12,154	9,816	7,270	4,556	2,564	1,118
(B)	*Height*	0.033**	0.028**	0.043***	0.056***	0.069***	0.063***	0.053***	0.070***	0.059***	0.084***	0.045
		(0.016)	(0.013)	(0.013)	(0.013)	(0.014)	(0.016)	(0.018)	(0.022)	(0.021)	(0.025)	(0.046)
	Birth weight	0.00132	0.00418**	0.00291	0.00205	0.00166	0.00056	-0.00202	0.00105	0.00441	0.00007	-0.00608
		(0.00192)	(0.00172)	(0.00179)	(0.00175)	(0.00178)	(0.00218)	(0.00242)	(0.00286)	(0.00293)	(0.00346)	(0.00610)
	Observations	9,112	10,748	12,082	12,874	12,680	12,154	9,816	7,270	4,556	2,564	1,118
		Females										
(C)	*Height*	0.112***	0.106***	0.085***	0.057***	0.058***	0.063***	0.063***	0.051***	0.073***	0.066***	0.058***
		(0.022)	(0.019)	(0.016)	(0.013)	(0.011)	(0.010)	(0.013)	(0.015)	(0.012)	(0.014)	(0.018)
	Birth weight	0.00162	0.00258**	0.00148	0.00157**	0.00172***	0.00163***	0.00136**	0.00070	0.00123**	0.00062	0.00107
		(0.00139)	(0.00118)	(0.00096)	(0.00074)	(0.00065)	(0.00063)	(0.00062)	(0.00070)	(0.00053)	(0.00058)	(0.00077)
	Observations	8,794	10,496	12,434	13,812	14,060	13,554	11,220	8,722	5,696	3,458	1,758
(D)	*Height*	0.107***	0.041	0.102***	0.078***	0.067***	0.054***	0.028	0.034	0.066***	0.057**	0.057
		(0.042)	(0.039)	(0.033)	(0.029)	(0.023)	(0.020)	(0.023)	(0.029)	(0.022)	(0.025)	(0.035)
	Birth weight	0.00325	0.00669	-0.00118	0.00222	-0.00003	0.00164	0.00543*	0.00304	0.00148	0.00117	-0.00291
		(0.00477)	(0.00459)	(0.00392)	(0.00330)	(0.00254)	(0.00302)	(0.00299)	(0.00346)	(0.00287)	(0.00301)	(0.00448)
	Observations	8,794	10,496	12,434	13,812	14,060	13,554	11,220	8,722	5,696	3,458	1,758

Notes: Columns 1-11 present the height coefficients for earnings for 11 age waves, 25-79. Row (A) and (C) reports the OLS regression coefficients, of which all model specifications include birth year fixed effects. Row (B) and (D) report within twin pair regression coefficients. All model specifications are for the pooled sample (DZ and MZ twins). Standard errors parentheses, clustered by twin pair in all model specifications. Significance level: *** p<0.01, ** p<0.05, * p<0.1. Dependent variable is logarithm of average annual earnings, winsorized at the 1st and 99th percentiles. Height coefficients are presented in terms of decimeters. Birth weight coefficients are presented in terms of hectograms (hg).

Table A.9
Height premium in earnings: controlling for educational attainment

		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
	Age	*25-29*	*30-34*	*35-39*	*40-44*	*45-49*	*50-54*	*55-59*	*60-64*	*65-69*	*70-74*	*75-79*
		Males										
(A)	*Height*	0.017**	0.031***	0.041***	0.053***	0.058***	0.058***	0.056***	0.061***	0.0714***	0.075***	0.085***
		(0.008)	(0.007)	(0.007)	(0.007)	(0.007)	(0.008)	(0.008)	(0.009)	(0.008)	(0.009)	(0.012)
	Years of schooling	-0.005**	0.036***	0.050***	0.059***	0.062***	0.065***	0.062***	0.064***	0.064***	0.061***	0.067***
		(0.002)	(0.002)	(0.001)	(0.001)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
	Observations	9,220	10,870	12,226	13,600	15,102	15,926	14,646	12,542	9,806	7,184	4,594
(B)	*Height*	0.034**	0.025**	0.034***	0.044***	0.066***	0.061***	0.055***	0.071***	0.072***	0.076***	0.075***
		(0.015)	(0.012)	(0.012)	(0.012)	(0.013)	(0.014)	(0.014)	(0.015)	(0.014)	(0.016)	(0.022)
	Years of schooling	-0.009**	0.024***	0.035***	0.040***	0.038***	0.042***	0.039***	0.040***	0.035***	0.031***	0.036***
		(0.004)	(0.003)	(0.003)	(0.002)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.004)
	Observations	9,220	10,870	12,226	13,600	15,102	15,926	14,646	12,542	9,806	7,184	4,594
		Females										
(C)	*Height*	0.063***	0.060***	0.048***	0.024*	0.031***	0.030***	0.022*	0.031**	0.046***	0.029***	0.026***
		(0.020)	(0.018)	(0.015)	(0.012)	(0.011)	(0.010)	(0.012)	(0.012)	(0.008)	(0.008)	(0.008)
	Years of schooling	0.106***	0.098***	0.071***	0.068***	0.070***	0.077***	0.078***	0.075***	0.067***	0.066***	0.063***
		(0.005)	(0.004)	(0.003)	(0.003)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
	Observations	8,956	10,686	12,658	14,452	16,120	17,004	15,662	14,718	12,860	10,136	7,624
(D)	*Height*	0.102**	0.034	0.086***	0.064**	0.065***	0.067***	0.005	0.031	0.063***	0.042***	0.049***
		(0.040)	(0.037)	(0.032)	(0.027)	(0.024)	(0.022)	(0.025)	(0.026)	(0.015)	(0.015)	(0.016)
	Years of schooling	0.065***	0.067***	0.048***	0.047***	0.059***	0.064***	0.066***	0.055***	0.041***	0.040***	0.037***
		(0.008)	(0.008)	(0.007)	(0.005)	(0.004)	(0.004)	(0.004)	(0.005)	(0.003)	(0.003)	(0.004)
	Observations	8,956	10,686	12,658	14,452	16,120	17,004	15,662	14,718	12,860	10,136	7,624

Notes: Columns 1-11 present the height coefficients for earnings for 11 age waves, 25-79. Row (A) and (C) reports the OLS regression coefficients, of which all model specifications include birth year fixed effects. Row (B) and (D) report within twin pair regression coefficients. All model specifications are for the pooled sample (DZ and MZ twins). Standard errors parentheses, clustered by twin pair in all model specifications. Significance level: *** p<0.01, ** p<0.05, * p<0.1. Dependent variable is logarithm of average annual earnings, winsorized at the 1st and 99th percentiles. Height coefficients are presented in terms of decimeters.