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

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Abstract

Using data on approximately 30,000 dizygotic and monozygotic twins born in Sweden 1918-58, we analyze how the height premium in earnings develops over the adult lifespan. Overall, the unconditional estimated premium increases with age for men and decreases for women. For men, within twin-pair fixed effects (WTP) estimates are on average about 40 percent lower than the corresponding unconditional OLS estimates. Including years of schooling as an explanatory variable induces a similar reduction (about 40 percent) of the estimated OLS height premium, but has no effect whatsoever on the WTP estimates, implying that the OLS and WTP estimates tend to coincide. Hence, it seems as if schooling mediates the association between height and earnings among unrelated male individuals but not among twins. For women, the estimations are less precise, but limiting the sample to those with earnings above a threshold level mirroring half time earnings at a very low wage level, the estimated OLS and WTP premiums are rather constant with age. This indicates that, for women, the unconditional premiums may well be influenced by height-related variation in labor market participation. Overall, the height premium patterns do not vary substantially between monozygotic and dizygotic twins, indicating that environmentally and genetically induced height differences affect earning levels similarly.

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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). Why this *height premium* arises is not yet fully understood. However, previous studies show that it can be 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 and unrelated people (aged 30-40) and it is still not known how the height premium develops over the life cycle. Knowledge on how the height premium evolves with age will deepen the understanding of its importance as well as its origin. If, for instance, the returns to tallness increase over the full labor market career, studies based on young people will tend to understate the general importance of height. 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. Although 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

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

the same point in time but not necessarily at the same age. This may be important if 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 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 14,801 same-sex twin pairs from the Swedish Twin Registry, born 1918-58. 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, using an unbalanced panel.[2] By also studying the development of the height premium over the life cycle for two consecutive birth cohorts, we address whether it has changed over time for different age groups. A twin differencing design (*within twin-pair fixed effects, WTP*) is employed in order to provide new evidence on the association between height and earnings (the *conditional height premium*). Under the assumption that the height variation among monozygotic (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 dizygotic (DZ) twins could be of either genetic or environmental origin (or both), a comparison of the height premium in respective sample will indicate the relative importance of environmentally and genetically induced variations in height for earnings.

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 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

[2] We cannot follow all individuals over the entire age span considered in the main analysis (25-79), since data on earnings are only available from 1968 (when individuals born 1918 (1958) were 50 (10) years old) to 2007 (when individuals born 1918 (1958) were 89 (49) years old).

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)

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

people. In recent research, Böckerman and Vainiomäki (2013) analyze the height premium of average earnings 1990-2004 among 10,000 Finnish MZ twins born 1944-58. Exploiting within twin differences in self-reported height, they find a statistically significant premium among female twins but not for male twins.[4]

From the perspective taken here, the shape of the height premium over the labor market career could shed some light on its origin. If, for instance, the height premium results from discrimination in the form of employers accrediting tall new employees with virtues or skills they do not in fact possess – misperceptions that unfold over time – the height premium would tend to decrease with age of the employees. On the other hand, if tall employees due to taste based discrimination are systematically being promoted to positions with steeper career paths, the height premium may well increase with age. A similar argument could be formulated if there are true initial height related variations in ability, and such variations are reinforced over time as people of higher ability (taller) ends up in positions where they continuously accumulate more human capital. But initial variations in abilities or productivity could also decrease due to e.g. interaction and knowledge spill-overs between employees, which would imply decreasing height premium over time (with age).

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 (that depends on height) 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 representation of the earnings-height relationship can be as follows:

[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 exceed 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).

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

where the subscript *i* refers to individual i, y is earnings, h is adult height, and *X* is a vector of individual control variables, δ is a vector of environmental and social family background variables that are fixed in adult life, and μ represents heritable traits (genetic endowment), all of which are affecting earnings.[6] If the entire vector *X*, δ, and μ are observable the estimate of β_A 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 due to unobservable factors, resulting in omitted variable bias. If, for instance, unobservable background factors simultaneously govern height and cognition (which also are unobservable), creating a positive association between the two (and the latter also influences earning), OLS estimation of the height-earnings relationship 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 sex) twins and take the first difference of these two equations:

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

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 δ 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:

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

where Δ represents the first difference between twin *i* and *j* for each given twin pair *s* and $v_{s,A}$ represents the first difference in the error.

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

Equation [4] will be estimated for eleven consecutive 5-year windows of age (*age waves*) ranging from 25-29 to 75-79 in order to capture the dynamics of the earnings-height relationship over the life cycle. In our base case scenario we will assume that the entire X vector will be neutralized when applying the twin-differencing approach. In order to account for plausible cohort effects, we also include birth year fixed effects in all OLS regression specifications. 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.

To fully capture the 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 fundament of our study relies 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 and 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 e.g. 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 the majority also differ in adult height). It should also be noted that twin estimates are likely to reflect a population average of the considered effects, as differences 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 95-98 percent accuracy (see Lichtenstein et al., 2002, for a comprehensive description of STR). The sample used in this paper includes only (same-sex) twin pairs with known zygosity, DZ or MZ. We also restrict the main sample to twins born 1918-58 in order to make sure that (1) height is reported at age 18-45, and (2) included cohorts are still of working age at the first earnings observation of each individual. 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 at the same age for both twins within a pair.[8] Moreover, we restrict our sample to twin pairs that reported their height before age 46, since older people tend to slightly shrink and the perception of own height becomes less accurate as people reach older ages (see e.g. Dahl et al 2010).

Since height is self-reported, there is an issue of possible measurement errors in the explanatory variable. Under 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 centimeters. The authors also show that the misclassification

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

increases with age (0.038 centimeters per year, which is less than 0.8 centimeters over 20 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 centimeters per decade for men and about 1-2 centimeters for women. From this perspective it should be noted that we control for annual birth cohort in every OLS regression in order to base our height premium parameter estimates on intra-cohort height variations (and not 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 have assessed the potential importance of measurement error in height indirectly by using correlations and variances based on the self-reported height measure, the results suggesting that measurement errors are not heavily influencing the results (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 e.g. Lundborg et al. 2014, and 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 Swedish men who were in their thirties 2003. 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.[9]

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 1973-74 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 1968-72/73 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. Moreover, including birth year fixed effects in the OLS regression specification ensures comparison between individuals within a given year (since our earnings variable is specified for a given age). 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]

Years of Schooling

The education variable originates from several sources. For twins still alive in 1990 (about 96 percent of our sample), 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 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.

[9] Since 1963 the Swedish pension system has been mainly based on indiviudally earned pension rights via labor market participation and income.

[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.

Average years of schooling are 10.0-10.5 years and the mean difference in schooling ranges from 1.4 (MZ females) to 2.1 (DZ males) (see Table 1). About half of the twin pairs have zero difference in years of schooling (not shown).

Birth Weight and Length

Data on birth weight and length is obtained from the STR BIRTH study, which is available for twins born 1926-58 and taken from the birth records. Due to the sampling scheme, the birth weight and length information is only available for twins that survived until 1972. For the full sample used in the main analysis, we have access to 19,614 observations on birth weight and 19,480 on birth length. The average within twin-pair difference in birth length is about 1.5 centimeters, and the variation in birth weight ranges from about 300 grams (MZ twins) to about 350 grams (DZ twins).

4 Results

4.1 Descriptive Statistics

The full sample used in the main analysis contains observations on 17,956 DZ twins and 11,646 MZ twins, 46 percent 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 length for the full sample are presented in the first four columns of Table 1. Average height is similar across zygosity, with men being about 13 centimeters taller than women. The average height difference between twins is close to 5 centimeters for DZ twin pairs and about 2 centimeters for MZ twin pairs. The distribution of height differences between twins within a pair is illustrated in Figure 1.[13] As for height, average earnings at age 30-39 is similar across zygosity, with men having nearly 100 percent higher average earnings than women. No large differences in birth weight and length between DZ and MZ twins stand out, although female MZ twins have slightly lower average birth weight and length.

Since the data set at hand includes information on birth cohorts covering four decades (1918-58), these cohorts may well differ due to secular trends in, for example, height and years of schooling. Therefore we also present descriptive statistics for two different birth

[13] 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. The majority of the coefficients obtained in the sensitivity analyses do not differ considerably from our main results. Results available upon request.

cohorts born 1918-38 and 1939-58, also presented in Table 1.[14] As shown, height has increased over time by about 3.5 and 2.0 centimeters per cohort for males and females, respectively. 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 1936-40 to 1950-55, the average height of Swedish conscripts rose from 174.2 to 175.7. In the twin sample the reported mean height for the first cohort is 175.5 and 174.6 for DZ and MZ twins respectively.[15] For the second cohort the reported height is 178.8 (DZ) and 178.4 (MZ) whereas the conscript mean height records increases from 176.1 to 179.0 between 1951-55 and 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. Years of schooling have increased from about 9 to more than 11 years over the cohorts under study. Birth weight and length do not seem to have changed over the time periods that the two birth cohorts cover.

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.

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 presented by Table 2, the OLS coefficients for males are 7.2 (DZ) and 6.3 (MZ) 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 earnings. By applying a within-sibling specification they get a height premium of 4.2 percent, which is close to our WTP height

[14] 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.

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

coefficient for both the DZ twin-pair (3.8) and MZ twin-pair sample (3.9), (the latter being statistically insignificant). Hence, the associations between height and earnings obtained via differencing between twins using self-reported height is similar to that obtained from 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. Moreover, comparing the OLS estimates with those from WTP estimation, it appears as if about half of the crude height premium at age 30-39 for men can be explained by common factors operating at the twin level. Taken literally, the similarity in the estimated WTP height premium for DZ and MZ twins indicates that the magnitude of the height premium is insensitive to the origin of the height difference (i.e. whether it is of environmental or genetic character).

The unconditional height premium for women aged 30-39 is 11.3 and 10.3 percent for DZ and MZ twins, respectively. Differencing between DZ twins yield an estimate of similar magnitude, 10 percent. Restricting the sample to MZ twins, however, the WTP estimate shrinks to 3.3 percent and becomes statistically insignificant. This implies that genetic endowment, as opposed to family background, is driving a sizeable part of the female height premium at age 30-39.

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 DZ and MZ twin-pair samples are illustrated in Figures 3.a-b and Tables 3.a-b. As shown, the unconditional height premium estimate is relatively small at age 25-29 for males. This is not surprising since a substantial fraction of people undergo further education in this age group. From age 30-34 and onwards, the height premium is increasing over the life cycle for men, starting out at about 5 percent higher earnings to reach a magnitude of 10-14 percent higher earnings at age 75-79. There are no statistically significant differences between the DZ and MZ OLS height coefficients (not shown).[16] Hence, any variation between WTP coefficients across zygosity is not due to sample differences from this respect. Differencing between male twins lowers the height coefficients by about 30-40 percent, and the resulting height premium pattern becomes rather constant over the life cycle. A significant part of the crude height premium for men can thus be explained by unobserved factors operating at the twin level.

[16] Results for all tests of differences in estimates between DZ and MZ twins are available upon request.

This implies that ignoring early-life environmental conditions and genetic endowments will substantially bias the OLS estimates upward (the origins of the height premium in terms of environmental versus genetic factors will be discussed further below). The life-cycle pattern of the height-earnings relationship of males could be due to taller (shorter) men being positively (negatively) discriminated against by employers and being systematically promoted to higher positions and thus have steeper height-earnings profiles. Since the WTP estimates are fairly constant over the lifespan, it is unlikely that height is correlated with ability that is *reinforced* and thus that taller men accumulate higher levels of human capital (relative to shorter men) over time (age). However, the data set at hand does not allow us to define the true cause of the height-earnings relationship in this particular setting.

Close to the opposite trend is found for women. Being 10 centimeter taller is associated with 9-13 percent higher earnings for women aged 25-29. As the women grow older, the height premium decreases and levels off to about 5-8 percent. As for men, no statistically significant differences in the OLS height coefficients between DZ and MZ twins are found. Differencing between female twins yield less precise results, some estimates being larger than the OLS estimates while others are smaller. The reason to why the height coefficient dips at some age waves may be explained by factors such as labor supply choices among the women in our sample (see discussion below). Considering the similarity of the life-cycle patterns of the OLS and the WTP estimates for females, it is not farfetched to believe that, as opposed to men, taller (shorter) women are being discriminated positively (negatively) when young. However, later in life their true capabilities unfolds, and height becomes a less important determinant of height. Again, the data set at hand does not allow us to fully find the causal explanation to why the height premium arises.

Taken together, it appears as that, in the long run, tallness is of more importance for determining earnings for men than what it is for women. Moreover, factors shared by twins appear to be of greater relative importance for the height premium among males than females, suggesting that men and women are treated differently in terms of their height in the labor market (which also spills over to their retirement benefits). Furthermore, it could also be that taller (shorter) men and women have different labor supply preferences. This is investigated further in a sensitivity analysis presented below.

The Height Premium Over Time: Analysis of Two Birth Cohorts

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 at age 35-69 for two different birth cohorts, born 1918-38 and 1939-58 (see Tables 4.a-b).[17] As shown in the upper part of Figure 4, the male unconditional height premiums appear to have decreased over time for the two birth cohorts, with statistically significantly lower OLS height coefficients for the ages 40-59 (not shown). The lower part of Figure 4 indicates a similar trend for women, although the differences in the height coefficient are statistically insignificant (not shown). Differencing between male twins unfolds that the WTP height coefficients are rather constant over the two birth cohorts considered. For women, on the other hand, it appears as that the conditional height premium has decreased over time for younger individuals (35-54), but has remained constant for older ages (55-69). However, due to large standard errors, no statistically significant differences between the two cohorts are found (not shown). The overall results from the birth cohort analysis imply that tallness has become a less important determinant of earnings for unrelated individuals. However, the conditional height premium seems to have remained at about the same level for male and (older) female twins during the time period the analyzed birth cohorts cover. The childhood and youth of the studied birth cohorts, ranging from 1918-58, 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. However, a decrease in the (unconditional) height premium over time would also be consistent with structural changes of the labor market in which, for example, height-based discrimination is decreasing.

Comparison of MZ and DZ twin pairs

Comparing OLS regression estimates with the height coefficients resulting from differencing out factors operating at the twin level, as we have discussed so far, does not give the full picture on how important genetic versus environmental factors 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 conditions (MZ twins), we compare WTP estimates for DZ twin pairs with those for MZ twin pairs. WTP analysis of the MZ-twin sample will difference out all

[17] We limit this analysis to the age 35-69 in order to be able to compare the two birth cohorts at all age waves considered (sufficiently large samples for the older (younger) birth cohort covers the age 35-79 (25-69).

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 5 (see also Tables 3.a-b) demonstrates the OLS and the WTP height coefficients obtained from separate analyses on DZ and MZ twin pairs. For men, there is no general difference between the two samples from this respect. The difference between the OLS and the WTP coefficients are on average very similar for the DZ and MZ samples. The WTP line representing the MZ twins is more unstable curving below and above the less volatile DZ line, indicating that there is no systematic variation in the height premium depending on whether its origin is solely environmentally (MZ twins) induced or a function also of genetic inheritance (DZ twins). There are in fact no statistically significant differences in the WTP height coefficients between DZ and MZ twins (not shown). Hence, the magnitude of the height premium for men seems to be independent of whether variations in height are environmentally or genetically induced.

For women, moving from OLS regression analysis to estimates obtained from WTP analysis yield no systematic difference in the height premium for neither the DZ nor the MZ twin-pair sample, although the WTP estimates for young MZ twins appear to be lower than the OLS estimates (see Figure 5). This implies that variations in early life environmental conditions may be explaining part of the height premium for young women (see also analysis on women aged 30-39 above). However, environmentally induced differences in height seem to have little importance for the height-earnings relationship over most of the life cycle for women. Shared family background (as DZ twins have) among female twins does not yield any indications of being of great importance for the height premium.

The dissimilarity of the male and female height coefficients over the life cycle indicates that the origins of (at least part of) the height-earnings association may be different across genders. For men, since the WTP coefficients are considerably smaller than those of the OLS estimation, it is reasonable to believe that the height premium arises partly because of endowments of genetic and early-life conditions over the life cycle. In contrast, the female OLS and WTP height coefficients are fairly equal over most of the lifespan, suggesting that most of the height-earnings relationship is caused by external factors, such as height-based discrimination.

Years of Schooling as a Mediator

Several studies have shown that height and cognitive ability is positively correlated over the lifespan, 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 years of schooling could function as a mediating variable for the height-earnings relationship over the life cycle.

Figures 6.a-c illustrates the height coefficients for the main specification and specifications in which we include years of schooling (see also Tables 5.a-b). Variations in schooling between individuals as captured in the main unconditional OLS model decreases the height premium estimates by approximately 40 percent for the male sample and about 50 percent for the female sample, on average. 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 premiums at all. Moreover, and as highlighted by Figure 6.c, introducing years of schooling into the model specification yields almost identical OLS and WTP height coefficients. 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 years of schooling between families (i.e. unrelated individuals). It also suggests that the height premium within twin pairs is not mediated through pronounced height related variations in schooling. This is also confirmed by regressing years of schooling on height, which yields much higher OLS estimates (on average amounting to 0.65 additional years per decimeter height), than the corresponding WTP estimates (on average about 0.2) (see Table 6).

Birth Weight and Length as Proxies for In Utero Environmental Conditions

The relationship between height and earnings could also be a function of in utero and infancy conditions, which in turn should be mirrored by birth weight and birth length.[20] For instance, 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). 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.

[20] For the (pooled) sample used in this study, the correlation between adult height and birth weight is 0.18 (0.19) for men (women) and statistically significant.

Introducing birth weight or birth length into our model leaves the estimated height premium coefficients nearly identical to the main specification, which can be seen in Figures 7.a-b and Tables 7.a-b. Hence, we conclude that within twin-pair differences of in utero and infancy conditions, do not explain differences in the height premium to the same extent as environmentally induced height variations occurring during childhood.

Labor Supply Choices and the Height Premium

The path of height premium profile over the female adult lifespan is quite unstable and no obvious trend can be seen (see e.g. Figure 5). The underlying cause of this may be that the returns to tallness are highly dependent on factors such as labor supply choices.

The sample utilized in this paper constitutes of people born 1918-58. The majority of the men of these cohorts did work during most of their adult life, whereas the women did not participate in the labor market to the same extent. Therefore, many of the women in the sample have very low (or zero) earnings at one or more of the 11 age waves, 25-29 to 75-79. In order to investigate how strong the association between stature and earnings is over the life cycle given a certain level of earnings, and hence the importance of labor supply preferences in this respect, we re-estimate the main analyses on twins that had annual earnings of at least two *price base amounts* (PBAs), which amounts to SEK 84,800 (about $12,000 in 2010).[21]

Table 8 reports the size and the difference in size of the *original (full) sample* and the sample in which only twins with annual earnings of at least SEK 84,800 are included (*restricted sample*). The number of individuals (and thus twin pairs) that have average annual earnings of less than two PBAs 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 8 and Table 9. Imposing the earnings restriction leaves the estimates for the male sample almost unchanged, whereas it 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

[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 42,400 (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.

height and labor supply preferences. 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.

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 tends to increase with age until 50 years and stay rather constant hereafter. Differencing between twins yield a rather constant height premium over the life cycle for men. A non-decreasing 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. Nor is it in line with initial height-related differences in skills and other productivity related characteristics decreasing over time due to, for example, knowledge spillovers between employees. It is, however, consistent with a situation in which taller individuals throughout their careers, regardless of their skills, are positively discriminated also when it comes to promotions to higher, better paid occupations or positions. But, since the WTP estimates are rather similar in magnitude over the lifespan, the findings are unlikely to be consistent with a scenario in which productivity-related individual characteristics such as cognition and non-cognitive skills (and skill development) are reinforced, resulting in higher accumulation of human capital over time (age). Unfortunately the data material at hand does not allow us to fully discriminate between such hypotheses.

The height premium in earnings tends to decrease with age for women, but the estimated pattern is more volatile. However, restricting the sample to those that have annual earnings of at least SEK 84,800 yield a height premium that is rather constant over the life cycle, implying that the unrestricted estimates are heavily influenced by height-related variations in female labor market participation. 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 in the long run.

WTP 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 years of schooling as an explanatory variable has no effect on the WTP 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 a considerable part of the association between height and earnings among unrelated male individuals, but not among twins.

Our findings suggest that the pattern of the height-earnings relationship behaves differently over the lifespan and across genders. Since our data set at hand does not allow us to fully identify the causal effect of height on earnings, future research is needed. For instance, the height premium may well be mediated through choice of occupation in ways that also affect the life-cycle height-earnings profiles. The mediating role of occupation has previously been explored for relatively young people, but not from a life-cycle perspective incorporating the relative importance of environmental versus genetic influences.

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Figures

Figure 1 Distribution of within twin-pair height differences (cm)

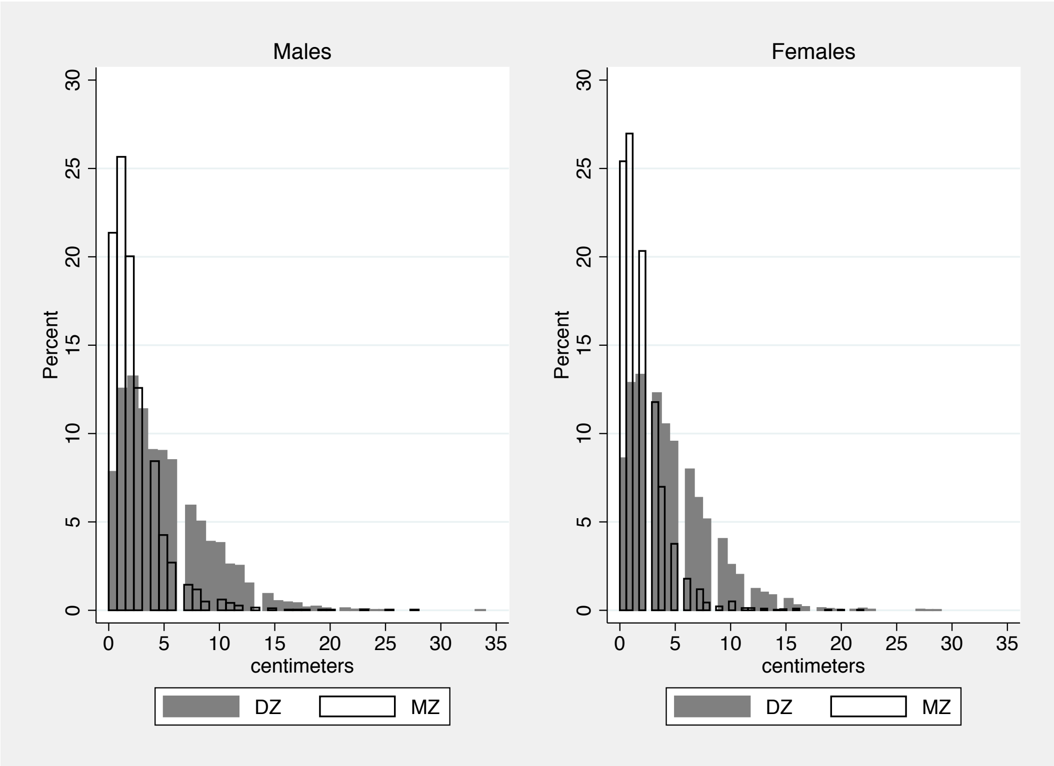


Figure 2 Average annual earnings by age

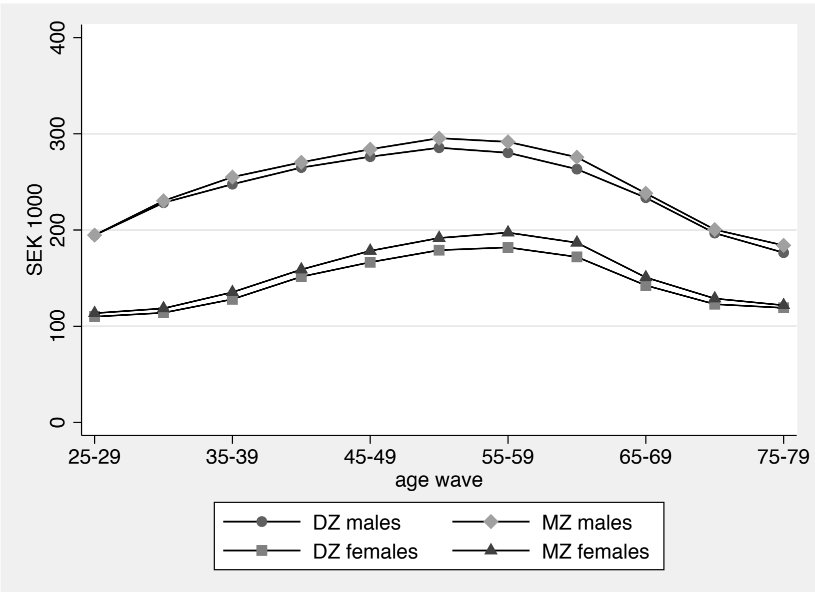


Figure 3.a The unconditional and conditional height premiums in earning, males

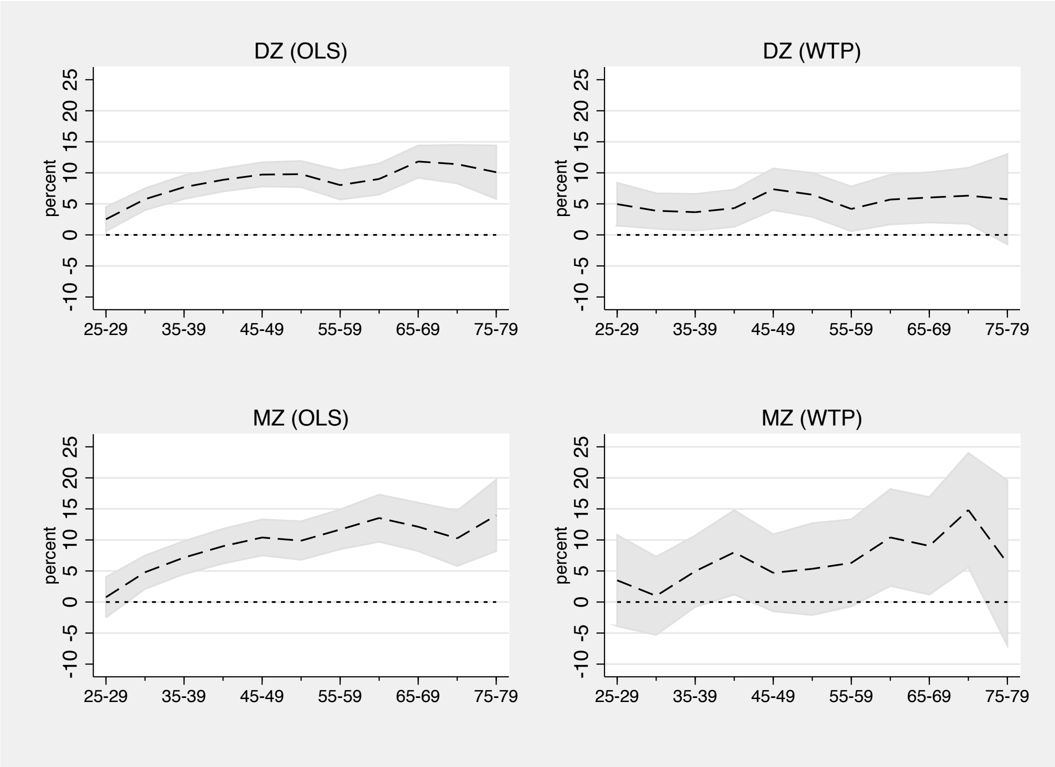


Figure 3.b The unconditional and conditional height premiums in earning, females

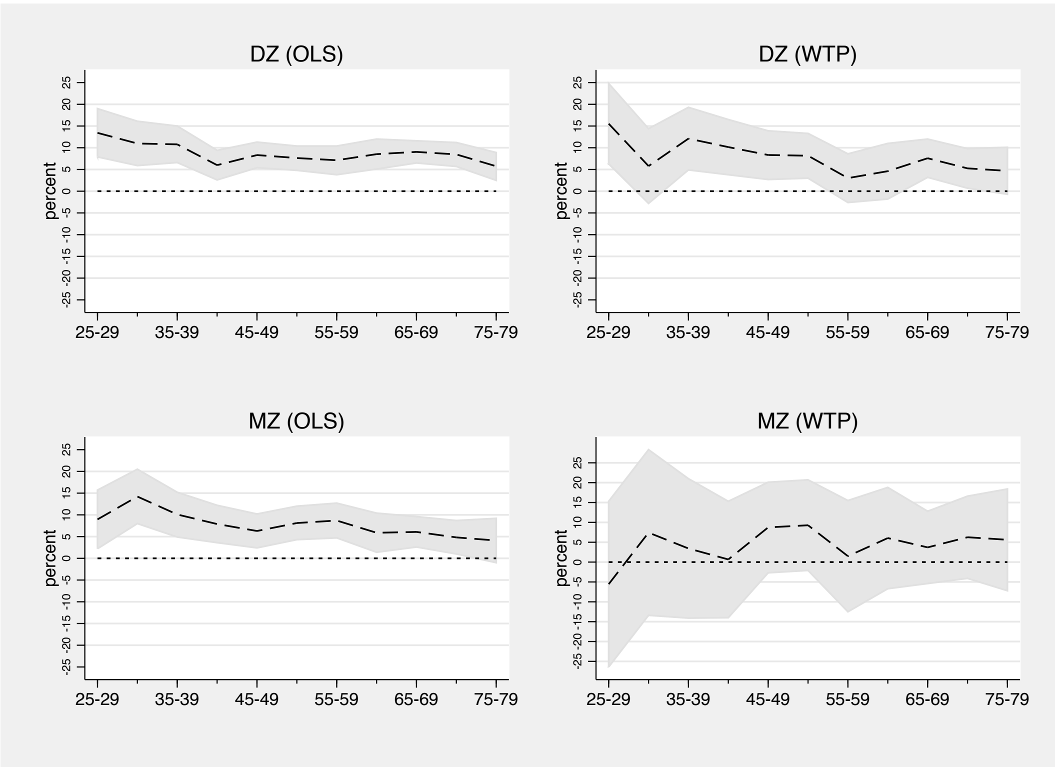


Figure 4 The height premium in earnings: birth cohorts 1918-38 and 1939-58

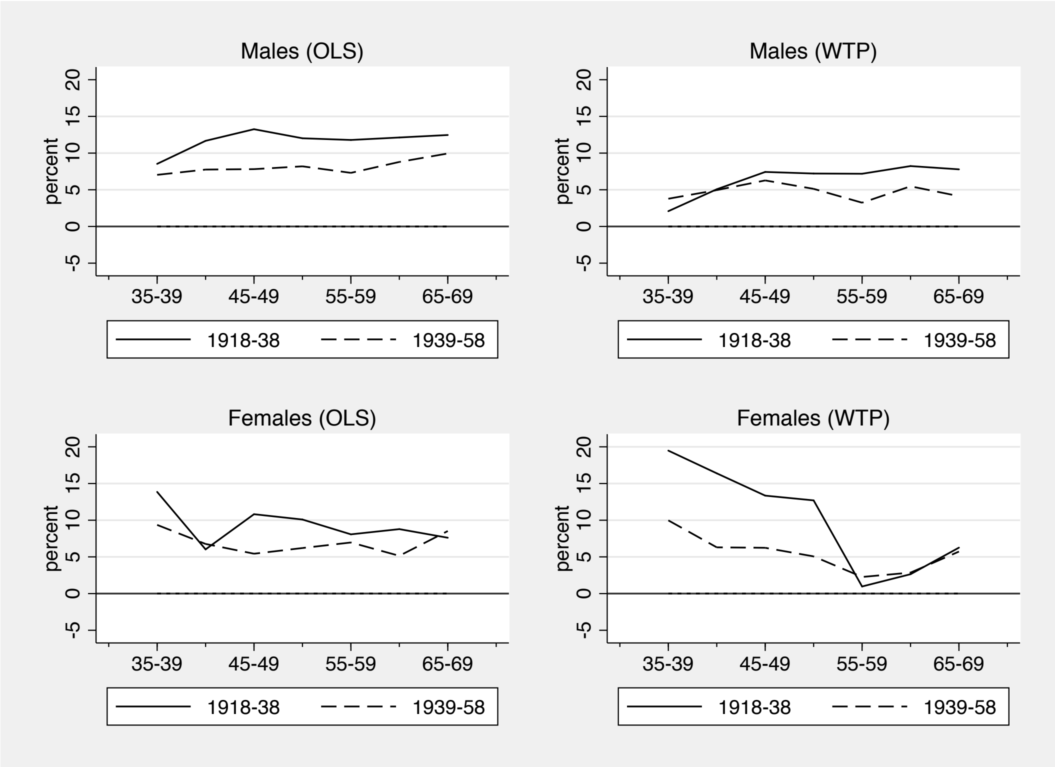


Figure 5 The height premium in earnings: comparison of DZ and MZ twin pairs

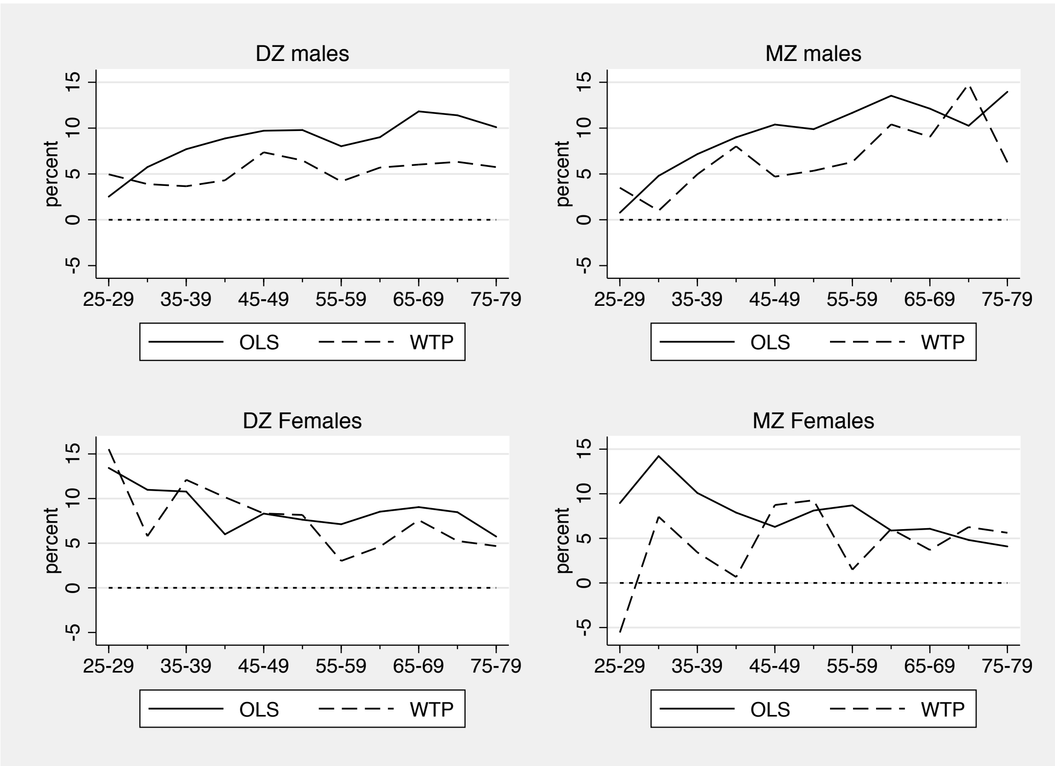


Figure 6.a The height premium in earnings: controlling for years of schooling, males

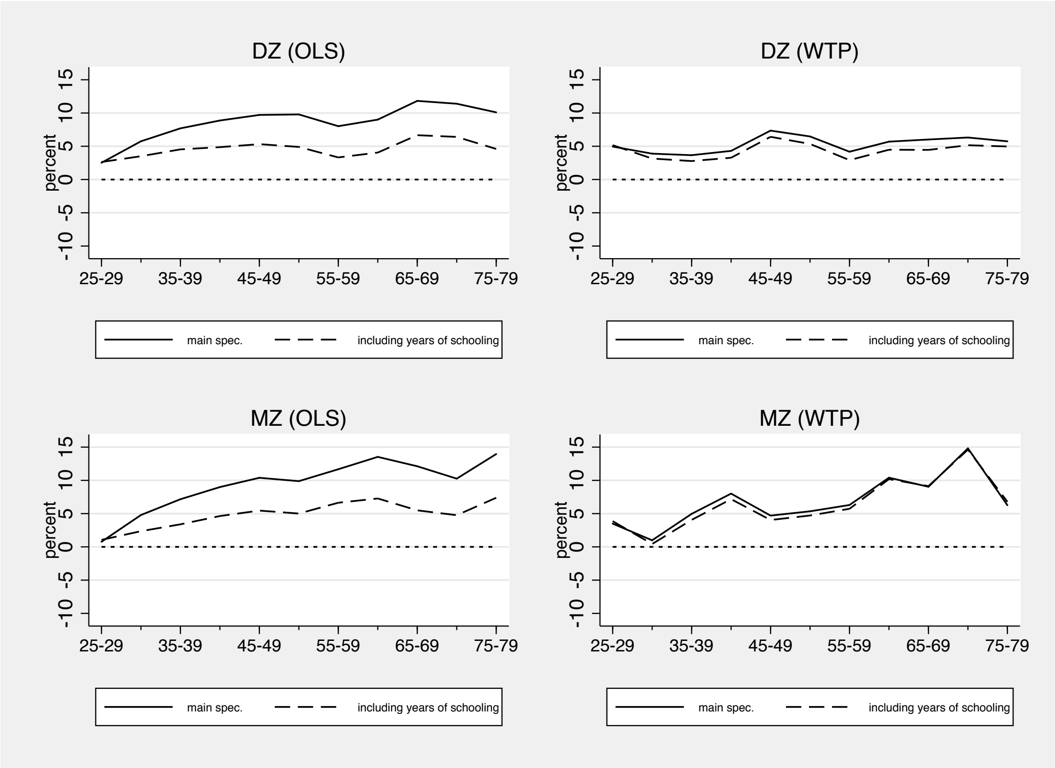


Figure 6.b The height premium in earnings: controlling for years of schooling, females

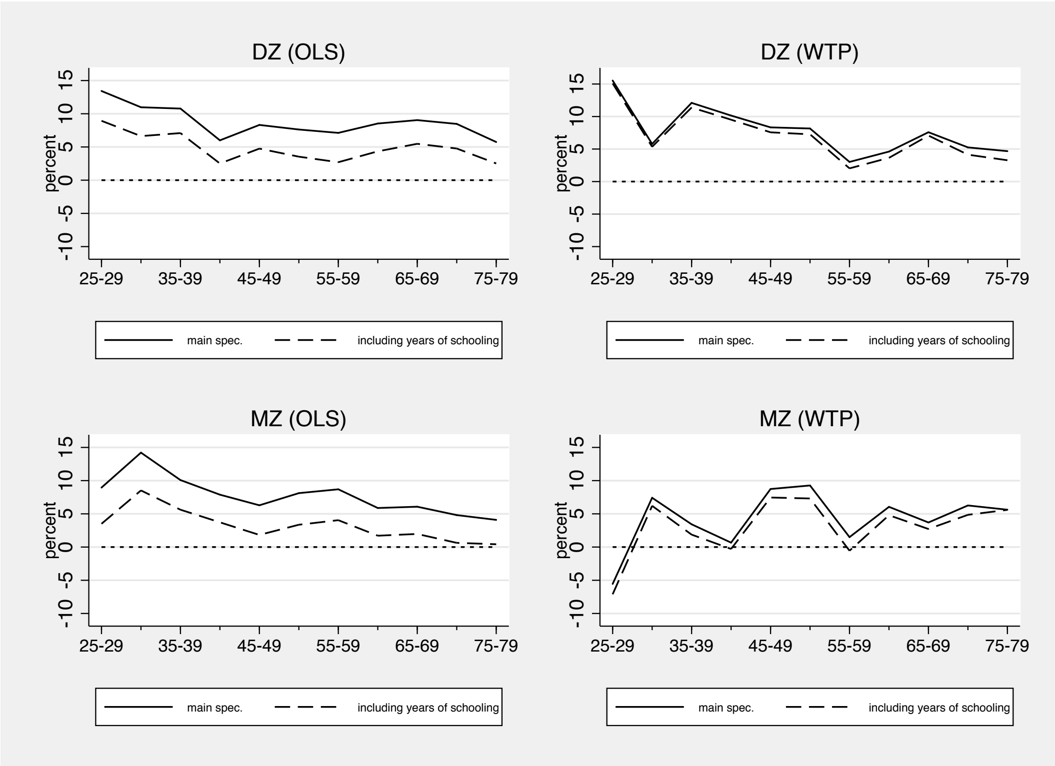


Figure 6.c The height premium in earnings: controlling for years of schooling, OLS vs. WTP

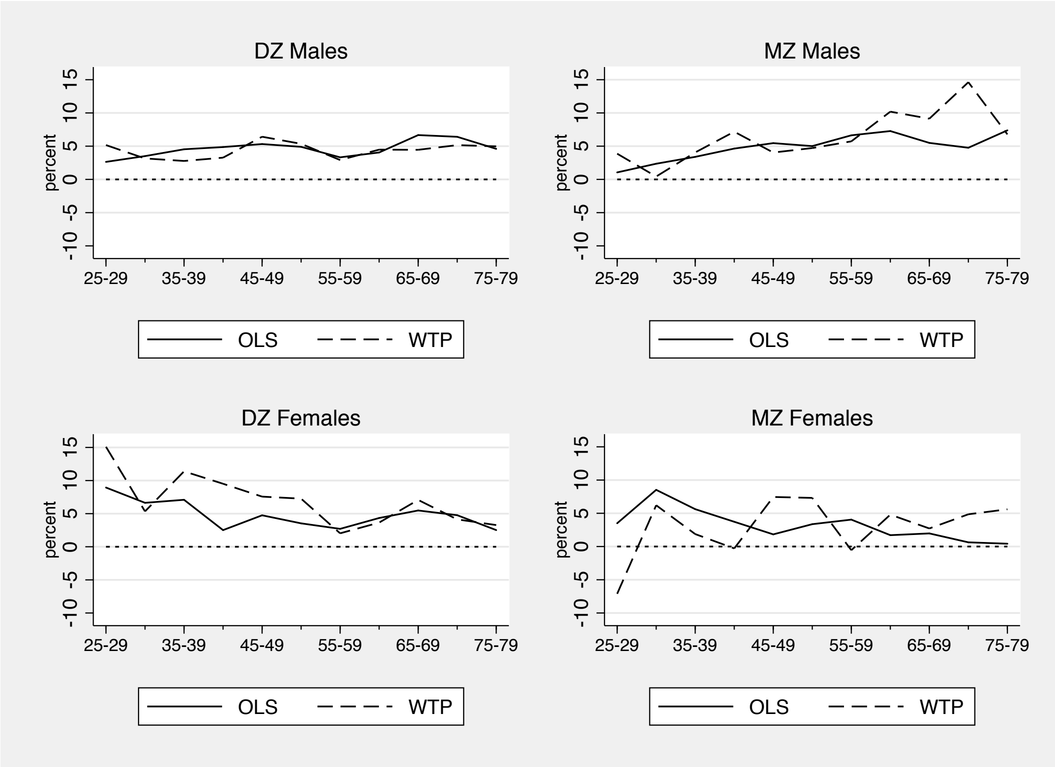


Figure 7.a The height premium in earnings: controlling for birth weight

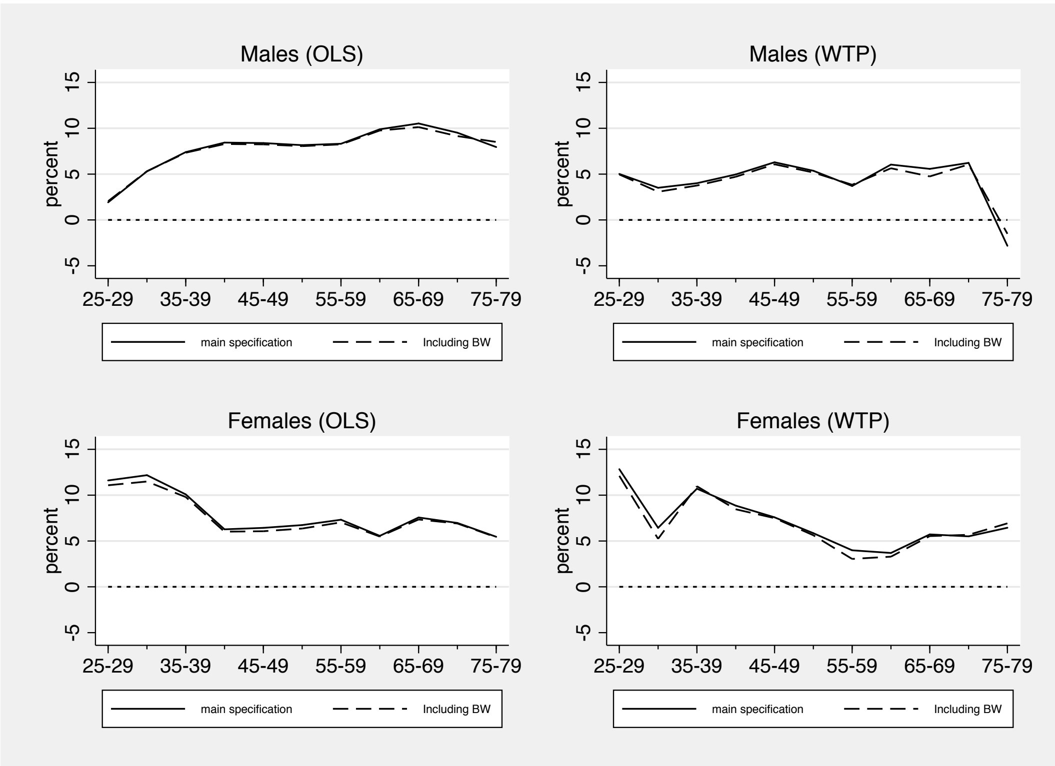


Figure 7.b The height premium in earnings: controlling for birth length

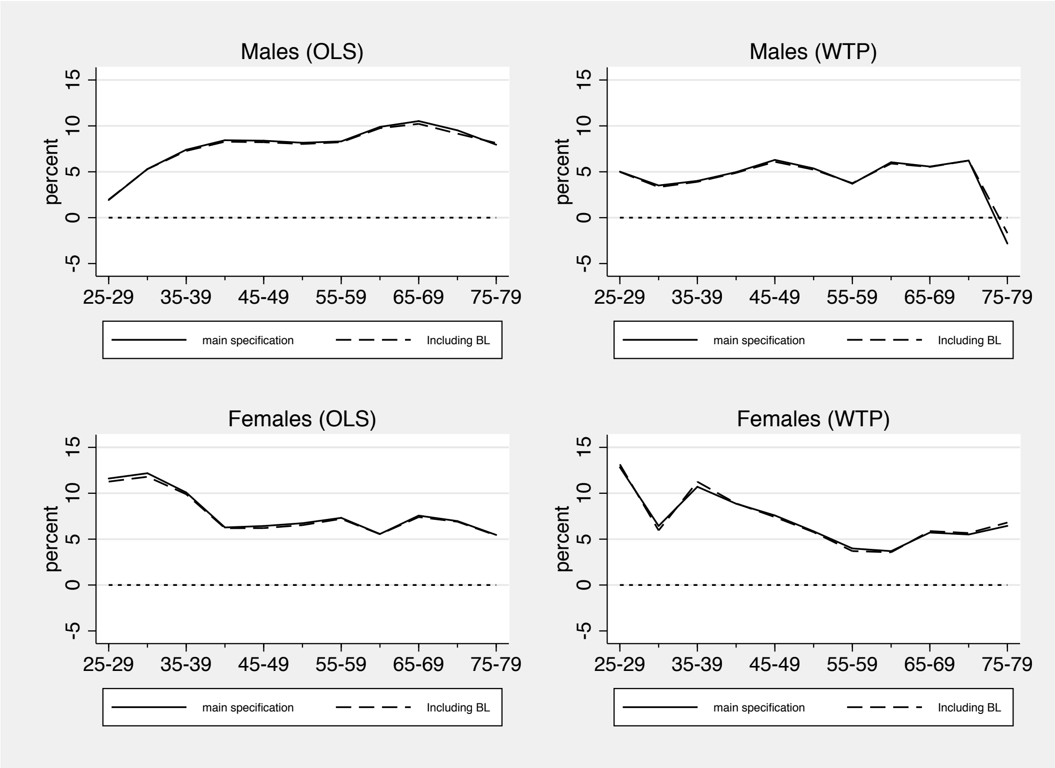
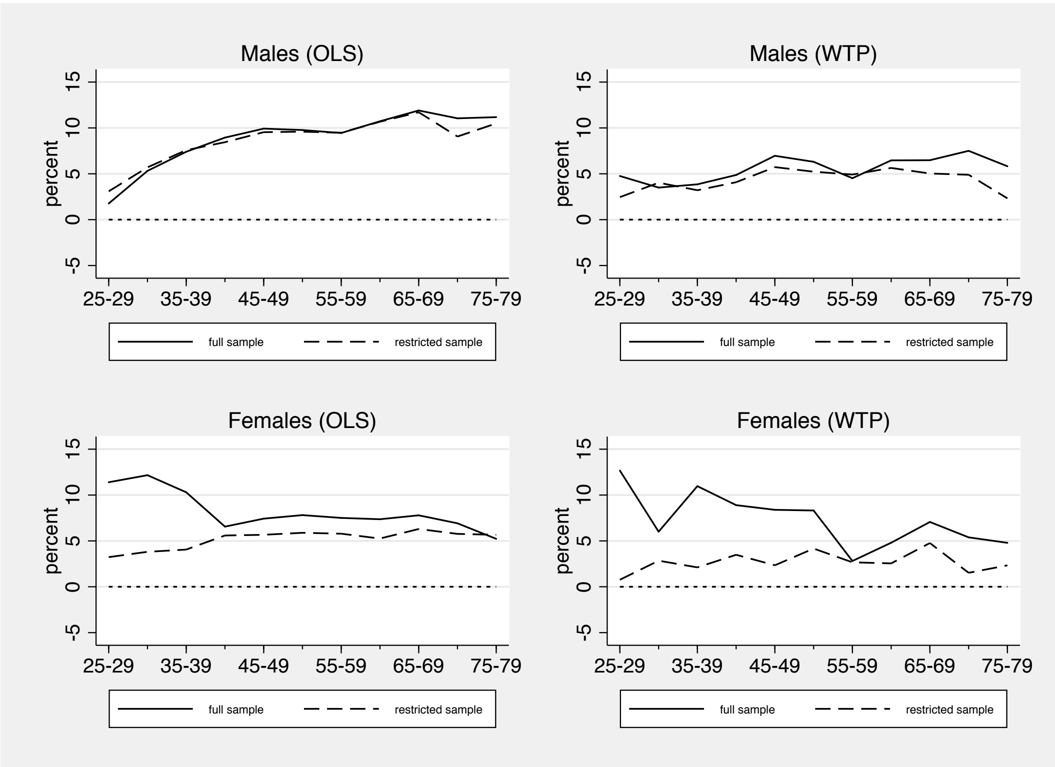


Figure 8 The height premium in earnings and labor supply choice



Tables

Table 1 Descriptive statistics

Birth cohort	All				1918-38				1939-58			
	males		females		males		females		males		females	
	DZ	MZ	DZ	MZ	DZ	MZ	DZ	MZ	DZ	MZ	DZ	MZ
Height												
Height (cm)	177.4	177.1	164.3	164.2	175.5	174.9	163.0	163.0	178.8	178.4	165.4	164.9
	(6.5)	(6.5)	(5.8)	(5.8)	(6.2)	(6.3)	(5.6)	(5.5)	(6.4)	(6.2)	(5.7)	(5.5)
Within twin-pair height	4.9	2.2	4.5	1.9	4.8	2.4	4.6	2.0	4.9	2.1	4.5	1.8
difference (cm)	(3.9)	(2.4)	(3.6)	(2.0)	(3.8)	(2.6)	(3.7)	(2.2)	(4.0)	(2.3)	(3.6)	(1.9)
Education												
Years of schooling	10.2	10.5	10.0	10.4	8.9	9.0	8.3	8.8	11.1	11.4	11.3	11.5
	(3.3)	(3.3)	(3.1)	(3.1)	(3.3)	(3.8)	(2.9)	(3.1)	(2.8)	(2.8)	(2.7)	(2.7)
Within twin-pair schooling	2.1	1.5	1.8	1.4	2.2	1.7	2.3	2.1	2.0	1.3	1.9	1.3
difference (years)	(2.3)	(1.9)	(2.0)	(1.8)	(2.6)	(2.3)	(2.3)	(2.1)	(2.0)	(1.7)	(1.9)	(1.6)
Observations	*8,400*	*5,262*	*9,556*	*6,384*	*3,496*	*2,036*	*4,232*	*2,476*	*4,904*	*3,226*	*5,324*	*3,908*
Annual Earnings												
Average annual earnings	238.0	243.3	123.3	128.7	236.6	240.6	90.9	98.7	238.5	244.2	132.6	136.2
at age 30-39 (1000 SEK)	(87.1)	(88.3)	(70.0)	(71.0)	(97.7)	(98.5)	(71.1)	(77.1)	(83.1)	(84.6)	(66.9)	(67.3)
Observations	*6,562*	*4,274*	*6,744*	*4,820*	*1,690*	*1,064*	*1,494*	*970*	*4,872*	*3,210*	*5,250*	*3,850*
Birth Weight												
Birth weight (grams)	2,762	2,628	2,639	2,493	2,762	2,581	2,650	2,489	2,762	2641	2636	2494
	(506)	(495)	(500)	(490)	(502)	(495)	(489)	(480)	(508)	(494)	(503)	(493)
Observations	*5,620*	*3,612*	*6,054*	*4,328*	*1,246*	*788*	*1,424*	*948*	*4,374*	*2,824*	*4,630*	*3,380*
Birth Length												
Birth length (cm)	48.3	47.6	47.5	46.8	48.3	47.6	47.6	47.0	48.3	47.6	47.5	46.7
	(2.7)	(2.8)	(2.8)	(2.8)	(2.7)	(2.9)	(2.8)	(2.8)	(2.7)	(2.7)	(2.8)	(2.8)
Observations	*5,576*	*3,586*	*6,012*	*4,306*	*1,226*	*778*	*1,408*	*940*	*4,350*	*2,808*	*4,604*	*3,366*

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 The height premium in earnings at age 30-39

	OLS		WTP	
	DZ	MZ	DZ	MZ
	Males			
Height	0.072***	0.063***	0.038***	0.039
	(0.009)	(0.013)	(0.013)	(0.024)
Observations	*6,562*	*4,274*	*6,562*	*4,274*
	Females			
Height	0.113***	0.103***	0.100***	0.033
	(0.022)	(0.026)	(0.036)	(0.084)
Observations	*6,774*	*4,820*	*6,774*	*4,820*

Notes: Columns 1-2 present OLS regression coefficients, of which both model specifications include birth-year fixed effects. Columns 3-4 present WTP 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 3.a The height premium in earnings over the life cycle, 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*
							DZ					
OLS	Height	0.025**	0.058***	0.077***	0.089***	0.097***	0.098***	0.080***	0.090***	0.118***	0.114***	0.101***
		(0.010)	(0.009)	(0.010)	(0.010)	(0.010)	(0.010)	(0.012)	(0.013)	(0.013)	(0.016)	(0.022)
WTP	Height	0.050***	0.039***	0.037**	0.043***	0.074***	0.065***	0.042**	0.057***	0.060***	0.063***	0.058
		(0.018)	(0.015)	(0.015)	(0.015)	(0.017)	(0.018)	(0.018)	(0.021)	(0.021)	(0.023)	(0.037)
	Observations	*4,884*	*5,764*	*6,500*	*6,970*	*7,936*	*7,778*	*6,412*	*4,914*	*3,466*	*2,184*	*1,190*
							MZ					
OLS	Height	0.008	0.048***	0.072***	0.090***	0.104***	0.099***	0.117***	0.135***	0.121***	0.103***	0.140***
		(0.017)	(0.014)	(0.013)	(0.014)	(0.015)	(0.016)	(0.016)	(0.019)	(0.020)	(0.023)	(0.030)
WTP	Height	0.035	0.010	0.050*	0.080**	0.047	0.054	0.063*	0.104***	0.090**	0.148***	0.063
		(0.038)	(0.032)	(0.029)	(0.035)	(0.032)	(0.038)	(0.036)	(0.040)	(0.040)	(0.047)	(0.068)
	Observations	*3,208*	*3,762*	*4,236*	*4,530*	*4,980*	*4,884*	*4,030*	*3,132*	*2,030*	*1,292*	*714*

Notes: Columns 1-11 present the height coefficients for earnings at the 11 age waves, 25-79, for men. All OLS specifications include birth year fixed effects. 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 3.b The height premium in earnings over the life cycle, 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*
		DZ										
OLS	Height	0.134***	0.110***	0.108***	0.060***	0.083***	0.076***	0.071***	0.085***	0.090***	0.085***	0.058***
		(0.028)	(0.026)	(0.022)	(0.017)	(0.015)	(0.014)	(0.017)	(0.018)	(0.013)	(0.014)	(0.016)
WTP	Height	0.155***	0.058	0.121***	0.102***	0.083***	0.082***	0.030	0.046	0.076***	0.053**	0.047*
		(0.047)	(0.044)	(0.037)	(0.032)	(0.029)	(0.026)	(0.029)	(0.033)	(0.022)	(0.023)	(0.028)
	Observations	*4,582*	*5,484*	*6,606*	*7,316*	*8,276*	*8,366*	*7,136*	*6,060*	*4,490*	*3,110*	*1,970*
		MZ										
OLS	Height	0.090***	0.142***	0.101***	0.079***	0.063***	0.081***	0.087***	0.059**	0.061***	0.0481**	0.041
		(0.034)	(0.032)	(0.026)	(0.022)	(0.020)	(0.020)	(0.020)	(0.023)	(0.018)	(0.020)	(0.026)
WTP	Height	-0.056	0.074	0.034	0.007	0.087	0.093	0.015	0.061	0.037	0.063	0.056
		(0.106)	(0.106)	(0.090)	(0.075)	(0.058)	(0.058)	(0.071)	(0.065)	(0.047)	(0.053)	(0.065)
	Observations	*3,448*	*4,076*	*4,748*	*5,238*	*5,732*	*5,698*	*4,782*	*3,946*	*2,762*	*1,882*	*1,212*

Notes: Columns 1-11 present the height coefficients for earnings at the 11 age waves, 25-79, for men. All OLS specifications include birth year fixed effects. 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 4.a The height premium in earnings over the life cycle by birth cohorts 1918-38 and 1939-58, males

		(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Age	*35-39*	*40-44*	*45-49*	*50-54*	*55-59*	*60-64*	*65-69*
					Birth cohort 1918-38			
OLS	Height	0.085***	0.117***	0.133***	0.120***	0.118***	0.121***	0.125***
		(0.017)	(0.015)	(0.014)	(0.013)	(0.013)	(0.013)	(0.012)
WTP	Height	0.021	0.051*	0.074***	0.072***	0.072***	0.082***	0.078***
		(0.028)	(0.026)	(0.024)	(0.023)	(0.021)	(0.021)	(0.020)
	Observations	*2,754*	*3,620*	*5,174*	*5,346*	*5,090*	*4,774*	*4,294*
					Birth cohort 1939-58			
OLS	Height	0.070***	0.078***	0.078***	0.082***	0.073***	0.088***	0.099***
		(0.009)	(0.009)	(0.010)	(0.012)	(0.014)	(0.018)	(0.024)
WTP	Height	0.045***	0.048***	0.067***	0.057**	0.019	0.037	0.015
		(0.016)	(0.017)	(0.020)	(0.023)	(0.025)	(0.033)	(0.048)
	Observations	*7,982*	*7,880*	*7,742*	*7,316*	*5,352*	*3,272*	*1,202*

Notes: Columns 1-7 present the height coefficients for earnings at the 7 age waves, 35-69, for men. All OLS specifications include birth year fixed effects. 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 4.b The height premium in earnings over the life cycle by birth cohorts 1918-38 and 1939-58, females

		(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Age	*35-39*	*40-44*	*45-49*	*50-54*	*55-59*	*60-64*	*65-69*
		Birth cohort 1918-38						
OLS	Height	0.139***	0.060*	0.108***	0.101***	0.081***	0.088***	0.076***
		(0.046)	(0.035)	(0.024)	(0.023)	(0.021)	(0.019)	(0.012)
WTP	Height	0.195**	0.164**	0.134**	0.127***	0.010	0.026	0.063***
		(0.090)	(0.072)	(0.055)	(0.047)	(0.043)	(0.040)	(0.023)
	Observations	*2,418*	*3,626*	*5,178*	*5,800*	*5,752*	*6,016*	*5,802*
		Birth cohort 1939-58						
OLS	Height	0.094***	0.068***	0.054***	0.062***	0.070***	0.051***	0.085***
		(0.017)	(0.013)	(0.013)	(0.011)	(0.015)	(0.020)	(0.022)
WTP	Height	0.085**	0.056*	0.050**	0.048**	0.048	0.086**	0.110**
		(0.035)	(0.029)	(0.023)	(0.022)	(0.030)	(0.042)	(0.048)
	Observations	*8,936*	*8,928*	*8,830*	*8,264*	*6,166*	*3,990*	*1,450*

Notes: Columns 1-7 present the height coefficients for earnings at the 7 age waves, 35-69, for men. All OLS specifications include birth year fixed effects. 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 5.a Height premium in earnings: controlling for years of schooling, DZ twins

		(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					
OLS	Height	0.026***	0.035***	0.045***	0.049***	0.053***	0.049***	0.033***	0.041***	0.067***	0.064***	0.046**
		(0.010)	(0.008)	(0.009)	(0.009)	(0.009)	(0.010)	(0.011)	(0.012)	(0.012)	(0.014)	(0.020)
	Years of schooling	-0.002	0.038***	0.050***	0.058***	0.061***	0.064***	0.058***	0.057***	0.056***	0.052***	0.056***
		(0.003)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.003)	(0.004)
WTP	Height	0.052***	0.032**	0.028*	0.033**	0.064***	0.054***	0.029	0.045**	0.045**	0.052**	0.050
		(0.018)	(0.014)	(0.015)	(0.015)	(0.016)	(0.018)	(0.018)	(0.020)	(0.019)	(0.022)	(0.035)
	Years of schooling	-0.008	0.031***	0.041***	0.045***	0.043***	0.047***	0.043***	0.045***	0.041***	0.036***	0.037***
		(0.005)	(0.004)	(0.003)	(0.003)	(0.003)	(0.003)	(0.004)	(0.004)	(0.004)	(0.004)	(0.007)
	Observations	*4,884*	*5,764*	*6,500*	*6,970*	*7,936*	*7,778*	*6,412*	*4,914*	*3,466*	*2,184*	*1,190*
							Females					
OLS	Height	0.089***	0.066***	0.071***	0.025	0.048***	0.035***	0.027*	0.043**	0.055***	0.048***	0.025*
		(0.027)	(0.025)	(0.021)	(0.017)	(0.014)	(0.013)	(0.016)	(0.017)	(0.012)	(0.013)	(0.015)
	Years of schooling	0.106***	0.099***	0.071***	0.068***	0.070***	0.075***	0.075***	0.068***	0.059***	0.056***	0.054***
		(0.006)	(0.006)	(0.005)	(0.004)	(0.003)	(0.003)	(0.003)	(0.003)	(0.002)	(0.002)	(0.003)
WTP	Height	0.151***	0.053	0.114***	0.095***	0.076***	0.073***	0.020	0.036	0.071***	0.041*	0.033
		(0.047)	(0.043)	(0.036)	(0.032)	(0.028)	(0.026)	(0.028)	(0.033)	(0.022)	(0.023)	(0.027)
	Years of schooling	0.072***	0.074***	0.051***	0.055***	0.062***	0.066***	0.065***	0.054***	0.043***	0.041***	0.039***
		(0.010)	(0.010)	(0.008)	(0.007)	(0.006)	(0.006)	(0.005)	(0.006)	(0.004)	(0.005)	(0.005)
	Observations	*4,582*	*5,484*	*6,606*	*7,316*	*8,276*	*8,366*	*7,136*	*6,060*	*4,490*	*3,110*	*1,970*

Notes: Columns 1-11 present the height coefficients for earnings for 11 age waves, 25-79. All OLS specifications include birth year fixed effects. 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 5.b Height premium in earnings: controlling for years of schooling, MZ twins

		(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										
OLS	Height	0.011	0.024*	0.034***	0.046***	0.055***	0.050***	0.066***	0.073***	0.055***	0.048**	0.074***
		(0.017)	(0.013)	(0.012)	(0.013)	(0.013)	(0.014)	(0.015)	(0.018)	(0.017)	(0.019)	(0.025)
	Years of schooling	-0.004	0.037***	0.053***	0.059***	0.063***	0.062***	0.059***	0.063***	0.059***	0.052***	0.054***
		(0.004)	(0.003)	(0.002)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.004)	(0.005)
WTP	Height	0.039	0.004	0.041	0.072**	0.040	0.047	0.057	0.102**	0.091**	0.146***	0.068
		(0.038)	(0.032)	(0.029)	(0.034)	(0.031)	(0.038)	(0.035)	(0.040)	(0.040)	(0.048)	(0.068)
	Years of schooling	-0.008	0.013***	0.020***	0.029***	0.027***	0.031***	0.030***	0.026***	0.018***	0.012**	0.014*
		(0.007)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.006)	(0.008)
	Observations	*3,208*	*3,762*	*4,236*	*4,530*	*4,980*	*4,884*	*4,030*	*3,132*	*2,030*	*1,292*	*714*
		Females										
OLS	Height	0.035	0.085***	0.056**	0.037*	0.018	0.034*	0.040**	0.017	0.020	0.006	0.004
		(0.033)	(0.031)	(0.026)	(0.021)	(0.019)	(0.018)	(0.019)	(0.022)	(0.016)	(0.017)	(0.024)
	Years of schooling	0.101***	0.099***	0.073***	0.065***	0.071***	0.074***	0.068***	0.064***	0.058***	0.055***	0.051***
		(0.007)	(0.007)	(0.005)	(0.004)	(0.003)	(0.003)	(0.003)	(0.004)	(0.003)	(0.003)	(0.005)
WTP	Height	-0.071	0.062	0.019	-0.003	0.075	0.073	-0.005	0.048	0.027	0.049	0.056
		(0.105)	(0.106)	(0.089)	(0.075)	(0.058)	(0.057)	(0.071)	(0.065)	(0.046)	(0.052)	(0.065)
	Years of schooling	0.059***	0.065***	0.052***	0.038***	0.052***	0.055***	0.053***	0.037***	0.028***	0.033***	0.032***
		(0.016)	(0.016)	(0.013)	(0.010)	(0.008)	(0.007)	(0.007)	(0.007)	(0.006)	(0.007)	(0.009)
	Observations	*3,448*	*4,076*	*4,748*	*5,238*	*5,732*	*5,698*	*4,782*	*3,946*	*2,762*	*1,882*	*1,212*

Notes: Columns 1-11 present the height coefficients for earnings for 11 age waves, 25-79. All OLS specifications include birth year fixed effects. 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 6 The height-schooling relationship

	OLS		WTP	
	DZ	MZ	DZ	MZ
	Males			
Height	0.721***	0.780***	0.245***	0.219
	(0.057)	(0.085)	(0.080)	(0.147)
Observations	*8,400*	*5,262*	*8,400*	*5,262*
	Females			
Height	0.511***	0.653***	0.137**	0.353**
	(0.054)	(0.076)	(0.069)	(0.147)
Observations	*9,556*	*6,384*	*9,556*	*6,384*

Notes: Columns 1-2 present OLS regression coefficients, of which both model specifications include birth-year fixed effects. Columns 3-4 present WTP 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 years of schooling. Height coefficients are presented in terms of decimeters.

Table 7.a 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										
OLS	Height	0.020**	0.053***	0.073***	0.083***	0.082***	0.081***	0.082***	0.098***	0.101***	0.091***	0.085***
		(0.009)	(0.008)	(0.008)	(0.008)	(0.009)	(0.010)	(0.011)	(0.013)	(0.014)	(0.017)	(0.027)
	Birth weight	-0.001	-0.000	0.000	0.001	0.001	0.001	0.000	0.001	0.002**	0.001*	-0.001
		(0.001)	(0.001)	(0.000)	(0.000)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
WTP	Height	0.050***	0.031**	0.038***	0.047***	0.061***	0.052***	0.038*	0.056**	0.047*	0.061**	-0.015
		(0.017)	(0.014)	(0.014)	(0.014)	(0.016)	(0.018)	(0.020)	(0.024)	(0.024)	(0.028)	(0.055)
	Birth weight	0.000	0.003*	0.002	0.002	0.002	0.002	-0.001	0.003	0.008**	0.002	-0.010
		(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.003)	(0.003)	(0.003)	(0.004)	(0.008)
	Observations	*7,982*	*9,402*	*10,596*	*10,794*	*10,610*	*10,120*	*8,042*	*5,870*	*3,590*	*1,914*	*730*
		Females										
OLS	Height	0.111***	0.115***	0.098***	0.060***	0.061***	0.064***	0.070***	0.055***	0.073***	0.069***	0.054***
		(0.023)	(0.020)	(0.017)	(0.014)	(0.012)	(0.011)	(0.013)	(0.015)	(0.013)	(0.015)	(0.021)
	Birth weight	0.002	0.003**	0.001	0.001	0.002**	0.002***	0.001**	0.000	0.001**	0.000	0.000
		(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
WTP	Height	0.121***	0.052	0.110***	0.085***	0.075***	0.056***	0.030	0.033	0.055**	0.057**	0.069*
		(0.044)	(0.042)	(0.035)	(0.032)	(0.025)	(0.020)	(0.025)	(0.032)	(0.024)	(0.027)	(0.038)
	Birth weight	0.005	0.008	-0.002	0.003	0.001	0.002	0.007**	0.003	0.002	-0.002	-0.005
		(0.005)	(0.005)	(0.004)	(0.004)	(0.003)	(0.003)	(0.003)	(0.004)	(0.003)	(0.003)	(0.005)
	Observations	*7,906*	*9,416*	*11,180*	*11,984*	*12,100*	*11,556*	*9,400*	*7,208*	*4,548*	*2,586*	*1,134*

Notes: Columns 1-11 present the height coefficients for earnings for 11 age waves, 25-79. All OLS 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. Birth weight coefficients are presented in terms of hg.

Table 7.b Height premium in earnings: controlling for birth length

		(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	0.023**	0.056***	0.080***	0.088***	0.088***	0.083***	0.079***	0.097***	0.104***	0.115***	0.083**
		(0.009)	(0.008)	(0.009)	(0.009)	(0.010)	(0.011)	(0.013)	(0.016)	(0.017)	(0.020)	(0.039)
	Birth length	-0.004**	-0.004*	-0.004**	-0.002	-0.002	-0.001	-0.000	-0.000	0.000	-0.005	-0.014*
		(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.003)	(0.003)	(0.004)	(0.004)	(0.007)
(B)	Height	0.048***	0.026*	0.033**	0.047***	0.061***	0.044**	0.026	0.040	0.031	0.046	-0.049
		(0.018)	(0.015)	(0.015)	(0.016)	(0.018)	(0.021)	(0.023)	(0.027)	(0.030)	(0.035)	(0.072)
	Birth length	-0.002	0.007**	0.006	0.004	0.005	0.007	-0.001	0.008	0.021***	0.016**	-0.001
		(0.004)	(0.003)	(0.004)	(0.004)	(0.004)	(0.005)	(0.006)	(0.007)	(0.007)	(0.008)	(0.015)
	Observations	*7,124*	*8,128*	*8,824*	*8,928*	*8,770*	*8,346*	*6,486*	*4,520*	*2,578*	*1,230*	*452*
		Females										
(C)	Height	0.117***	0.114***	0.093***	0.053***	0.056***	0.061***	0.064***	0.051***	0.075***	0.067***	0.050*
		(0.024)	(0.022)	(0.018)	(0.015)	(0.013)	(0.012)	(0.015)	(0.018)	(0.016)	(0.019)	(0.027)
	Birth length	-0.008	0.002	-0.006*	0.000	-0.001	0.002	0.003	-0.001	-0.002	-0.003	0.000
		(0.005)	(0.005)	(0.004)	(0.003)	(0.002)	(0.002)	(0.003)	(0.004)	(0.003)	(0.004)	(0.005)
(D)	Height	0.107**	0.051	0.088**	0.048	0.031	0.036	0.023	0.028	0.046	0.036	0.069
		(0.047)	(0.046)	(0.040)	(0.035)	(0.027)	(0.023)	(0.029)	(0.039)	(0.029)	(0.034)	(0.051)
	Birth length	0.001	0.021**	-0.011	0.002	0.004	0.009*	0.009	0.010	0.003	-0.003	-0.008
		(0.010)	(0.010)	(0.009)	(0.007)	(0.005)	(0.005)	(0.006)	(0.009)	(0.006)	(0.006)	(0.009)
	Observations	*6,992*	*8,082*	*9,282*	*9,778*	*9,794*	*9,314*	*7,432*	*5,468*	*3,208*	*1,650*	*684*

Notes: Columns 1-11 present the height coefficients for earnings for 11 age waves, 25-79. All OLS 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. Birth length coefficients are presented in terms of centimeters.

Table 8 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	8,092	7,286	10%	8,030	4,192	48%
30-34	9,526	8,922	6%	9,560	5,156	46%
35-39	10,736	10,120	6%	11,354	6,986	38%
40-44	11,500	10,816	6%	12,554	9,278	26%
45-49	12,916	12,034	7%	14,008	10,952	22%
50-54	12,662	11,344	10%	14,064	11,344	19%
55-59	10,442	9,740	7%	11,918	9,688	19%
60-64	8,046	7,428	8%	10,006	7,430	26%
65-69	5,496	5,144	6%	7,252	4,654	36%
70-74	3,476	3,182	8%	4,992	2,928	41%
75-79	1,904	1,682	12%	3,182	1,804	43%

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.

Table 9 Height premium in earnings given yearly earnings are at least SEK 84,800

		(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										
OLS	Height	0.031***	0.057***	0.076***	0.085***	0.095***	0.096***	0.095***	0.107***	0.117***	0.0906***	0.105***
		(0.005)	(0.006)	(0.006)	(0.006)	(0.006)	(0.007)	(0.007)	(0.009)	(0.010)	(0.011)	(0.014)
WTP	Height	0.025**	0.040***	0.032***	0.041***	0.057***	0.052***	0.049***	0.056***	0.050***	0.049***	0.023
		(0.010)	(0.010)	(0.011)	(0.011)	(0.011)	(0.012)	(0.013)	(0.015)	(0.016)	(0.018)	(0.025)
	Observations	*7,286*	*8,922*	*10,120*	*10,816*	*12,034*	*11,812*	*9,740*	*7,428*	*5,144*	*3,182*	*1,682*
		Females										
OLS	Height	0.032***	0.038***	0.041***	0.056***	0.057***	0.059***	0.058***	0.053***	0.063***	0.058***	0.057***
		(0.008)	(0.008)	(0.007)	(0.007)	(0.006)	(0.006)	(0.007)	(0.008)	(0.010)	(0.011)	(0.013)
WTP	Height	0.008	0.028*	0.021	0.035***	0.023**	0.042***	0.027**	0.026	0.048**	0.015	0.023
		(0.017)	(0.017)	(0.015)	(0.013)	(0.011)	(0.012)	(0.013)	(0.016)	(0.019)	(0.021)	(0.026)
	Observations	*4,192*	*5,156*	*6,986*	*9,278*	*10,952*	*11,344*	*9,688*	*7,430*	*4,654*	*2,928*	*1,804*

Note: Columns 1-11 present the height coefficients for earnings for 11 age waves, 25-79. All OLS 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. The sample is restricted to twin pairs of which both earn at least SEK 84,800.

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 (3.8 percent per decimeter height) among male DZ twins aged 30-39 comes very close to 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 standard errors hereof (in parenthesis) amounts to 4.8 (3.8), 4.9 (3.9) and 5.0 (4.1) for the cohorts born 1918-31, 1932-45 and 1945-58, respectively. The corresponding figures for male MZ twin pairs are 2.4 (2.6), 2.3 (2.4) and 2.0 (2.3). For women the DZ figures are 4.7 (3.7), 4.5 (3.6) and 4.4 (3.6) and for MZ twins they are 2.1 (2.4), 1.9 (2.0) and 1.8 (1.8). As can be seen, 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 (0.53, 0.87) and (0.49, 0.88) for (DZ, MZ) men and women respectively. Combined with the variance of the reported height in the respective sample (42, 42; 34, 31: 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.