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Stature and life-time labor market outcomes: Accounting for unobserved differences*

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TIIVISTELMÄ

Tutkimuksessa tarkastellaan henkilön pituuden vaikutusta ansiotuloihin ja työllisyyteen. Tarkastelu perustuu suomalaiseen kaksosaineistoon, jonka avulla on mahdollisuus ottaa huomioon havaitsemattomien tekijöiden vaikutus aikaisempia tutkimuksia paremmin. Näitä tekijöitä ovat mm. henkilöiden kognitiivinen kyvykkyys. Tulokset osoittavat, että identtisten naiskaksosten välillä on pituuteen liittyvä palkkapreemio, mutta vastaavaa vaikutusta ei saada identtisille mieskaksosille. Tulosta voidaan tulkita siten, että ei-havaittava kognitiivinen kyvykkyys selittää pituuden vaikutuksen elinkaaren tuloihin miehillä. Sen sijaan naisilla lisätarkastelut antavat viitteitä siitä, että pituuden palkkaa kasvattava vaikutus voi selittyä osaltaan syrjinnällä lyhyitä naisia kohtaan.

ABSTRACT

This paper uses twin data matched to register-based individual information on earnings and employment to examine the effect of height on life-time labor market outcomes. The use of twin data allows us to remove otherwise unobserved ability and other differences. The twin pair difference estimates from instrumental variables estimation for genetically identical twins reveal a significant height-wage premium for women but not for men. This result implies that cognitive ability explains the effect of height on life-time earnings for men. Additional findings using capital income as the outcome variable suggest that discrimination against short persons may play a role for women.

JEL classification: I10, J23, J31

Keywords: Height; Weight; BMI; Height premium; Earnings; Employment

1. INTRODUCTION

Non-economic attributes, such as beauty and height, are widely rewarded in the labor market (Hamermesh and Biddle, 2004; Berggren et al., 2010; Guéguen, 2012). Several empirical studies document that taller individuals both receive higher wages and have better employment prospects (e.g., Sargent and Blanchflower, 1994; Schultz, 2002; Judge et al., 2004; Persico et al., 2004; Heineck, 2005; Case and Paxson, 2008; Hübler, 2009; Lundborg et al., 2009; Kortt and Leigh, 2010). Because these estimates cover a wide range of different institutional settings, there is a need to understand the underpinnings of the height premium.[1] Previous studies have used cross-sectional information on earnings, and they have not been able to account for unobserved ability effects in the height premium, which we can accomplish in this paper using twin data.

There are many potential explanations for the existence of the height premium. Some authors argue that the effect arises because height is associated with non-cognitive skills, such as social skills (Persico et al., 2004).[2] Others maintain that cognitive skills are more important contributors to the height wage premium (Case and Paxson, 2008).[3] In particular, Case and Paxson (2008a) argue that 30-50% of the height premium can be attributed to cognitive ability measured in childhood and youth. Thus, taller persons receive higher wages because they have better cognitive ability, which is rewarded in the labor market. Lundborg et al. (2009) claim that the positive effect of height on earnings can be explained by the positive association between height and a person's physical capacity.[4] They demonstrate that physical capacity explains 80% of the observed height premium for men. Furthermore, the height premium has also been explained by a correlation between height and authority (Lindqvist, 2012) or by the existence of discrimination against short persons in the labor market (e.g., Cinnirella and Winter, 2009).

We contribute to the debate on two frontiers by examining the effects of height on both earnings and employment using twin data. Using data on non-identical twins is effectively the same as controlling for sibling effects (the family environment).[5] Additionally, identical twins have the same genes, implying largely similar cognitive abilities[6] and usually the same early life experiences and largely the same social contacts (non-cognitive skills).[7] With data on genetically identical twins, we can remove the otherwise unobserved ability differences that constitute the most prominent explanation for the height premium according to Case and Paxson (2008). In addition, all other unobserved factors that closely correlate with genetics are removed for identical twins. In our data, height is self-reported, but twin pair differences can be instrumented with measurements from another time point to alleviate the attenuation bias caused by the potential measurement error in self-reported height.

Secondly, to examine the cumulative effects of height, we match the twin data to register-based data on life-time labor market outcomes. This matching is important because previous studies on the height premium have almost exclusively used cross-sectional self-reported information on labor market outcomes. Short-term, cross-sectional measures of income, such as yearly earnings and hourly wages, contain idiosyncratic components that diminish the precision of the estimates (cf. Dahl et al., 2011). Register-based life-time earnings have much less measurement error than short-term measures. This accuracy increases the efficiency of the estimates, which is particularly important for relatively small samples, as in the twin pair differences.

We also examine the role of social skills in the height premium. This is important because Persico et al. (2004) argue that social skills explain the height premium. Furthermore, the literature has used only earnings as the outcome variable. We extend the literature by estimating separate effects on capital income that may provide additional insights about the underpinnings of the height premium. In addition, we evaluate the effect of height during different business cycle conditions, an effect that has been overlooked previously.

To best of our knowledge, only one earlier study has used twin data to examine the height premium (Behrman and Rosenzweig, 2001). Their sample is restricted to female twins based on the Minnesota Twin Registry, and the estimates are obtained for cross-sectional, self-reported earnings. Using twin pair differences, Behrman and Rosenzweig (2001) find evidence for the existence of the height premium but no evidence for a wage penalty associated with obesity.[8] In contrast to Behrman and Rosenzweig (2001), we explore both male and female same-sex twins and thereby examine the possibility that outward attributes are treated differently in the labor market for men and women.

The remainder of the paper is structured as follows. The following section introduces the data. Section 3 outlines our empirical specifications. Section 4 reports descriptive evidence and the baseline estimation results. Section 5 discusses several additional specifications for assessing the robustness of the baseline results. Section 6 concludes.

2. DATA

The twin data used in this study are based on the Older Finnish Twin Cohort Study of the Department of Public Health at the University of Helsinki. The initial twin data gathered in 1974 contain almost all same-sex DZ (dizygotic) and MZ (monozygotic) twins in the Finnish population born before 1958 (see Kaprio et al., 1979; Kaprio and Koskenvuo, 2002; Hyytinen et al., 2012).[9] The identification of twins was initially based on the comprehensive population register. Later, blood markers were tested for a small subsample of initially identified twins to confirm the identification of DZs and MZs. Height and weight are self-reported in the survey waves conducted in 1975, 1981 and 1990.[10] The twin sample contains retrospective, self-reported information on weight differences between twins at the ages of 10, 20 and 30 years reported in 1990.

We link the twin sample to the FLEED (Finnish Longitudinal Employer-Employee Data) maintained by Statistics Finland using personal ID codes owned by every person residing in Finland. This matching is exact, and there are no misreported ID codes. We therefore avoid problems associated with errors in record linkages (e.g., Ridder and Moffitt, 2007). The FLEED sample is constructed from a number of different registers of individuals and firms maintained by Statistics Finland. We use FLEED to measure earnings and exact labor market status as an average of the annual values over the period 1990-2004. In particular, FLEED contains information from Employment Statistics that record the number of employment months during the year originating from the state-run pension registers that cover all legal employment contracts. Earnings data originate from comprehensive tax registers. Earnings are not top coded. Because the data on earnings contain some outliers, we have truncated the observations outside the 1st and 99th percentiles. Hyytinen et al. (2012) document that the life-time labor market outcomes of the linked twin data are representative of the Finnish population.

To prevent education and early pension choices from affecting our life-time outcome measures, we restrict the analyses to primary working age persons. Therefore, all empirical specifications are estimated for individuals born after 1944 but before 1958. Thus, the twins are aged 33-59 years over the measurement period 1990-2004 for the life-time labor market outcomes. At the time of the survey years 1975, 1981, and 1990, they are, respectively, 17-30, 24-36, and 33-45 years old.

There are several different measures for social skills in the psychological literature, and there is no consensus on what constitutes the best measure for them (see Lorr et al., 1991). In our empirical analysis, latent social skills are measured by a summary measure containing five different self-reported personality traits in 1981 (open/closed, number of different interests, talkative/quiet, difficulty expressing feelings, and spontaneous/reserved). The responses to each of these five separate items range from 1-5. These traits are related to the ease and possibility of persons to engage in social relationships and thereby develop their social skills or utilize previously accumulated non-cognitive skills. This simple summary measure is closely related to the first factor from the standard principal component analysis. Higher values of the measure indicate that the person has worse social skills. The twin data do not contain the "Big Five" factors of personality, but our summary measure of social skills contains aspects that are closely related to openness and extraversion, which are components of the Big Five.

Our data have some limitations that are important to consider in the interpretation of the estimates. In particular, the twin data do not contain information on birth weight or birth order.[11] Because there is no information on the measures of body composition, such as waist circumference and fat mass, we focus on the effects of height on life-time labor market outcomes.[12] However, we report the results for BMI (Body Mass Index) and discuss them briefly because weight is an important outward characteristic, along with height.[13]

3. EMPIRICAL SPECIFICATIONS

In the empirical analysis, we first estimate individual-level OLS regressions of the following form for all individuals:

$$\text{wage}_{ij1990\text{-}2004} = \text{constant} + a\ \text{Height}_{ij1975} + b\ \text{BMI}_{ij1975} + \text{controls}_{ij} + \text{error}_{ij} \qquad (1)$$

where j=1, 2 (twin index) and i=1…n (twin pair index). The error term of the individual-level OLS regressions, $\text{error}_{ij} = fe_i + u_{ij}$, consists of two different components. The fixed effect, fe_i, represents unobserved factors that vary between twin pairs but do not vary within twin pairs, and u_{ij} represents idiosyncratic individual-level factors. The parameters of interest are the effect of height and weight, as measured by BMI, on life-time earnings. Both height and BMI are measured in 1975. We also estimate OLS specifications that control for observed ability differences using register-based information on education and incorporate age effects.

The twin difference models are estimated as follows:

$$\text{Dwage}_{i1990\text{-}2004} = a\ \text{DHeight}_{i1975} + b\ \text{DBMI}_{i1975} + \text{Dcontrols}_{i} + \text{Du}_{i} \qquad (2)$$

where $\text{Dwage}_{i1990\text{-}2004} = \text{wage}_{i1,1990\text{-}2004} - \text{wage}_{i2,\ 1990\text{-}2004}$ is the difference in wages between twins within the twin pair i, and all the right-hand side variables are defined analogously. Twin difference models are estimated for DZ and MZ twins both pooled and separately. All factors common to both twins in a given twin pair included in fei are differenced out. The MZ estimates remove the influence of both otherwise unobserved genetic traits and common family background.

Structurally identical models are additionally estimated using employment as the outcome variable. All the specifications are estimated separately for women and men because the previous literature has shown that the height premium is larger for men and the obesity wage penalty is typically much larger for women. The additional reasons for separate specifications by gender are occupational sorting and that women are, on average, shorter than men.

Height and weight were measured in 1975, and the life-time labor market outcomes were measured over the period 1990-2004. Due to this timing difference in the variables of interest, we are not worried about a reverse correlation between height and labor market outcomes. However, self-reported height and weight contain potential measurement error that attenuates the effects of height and BMI.14 The measurement error in the right-hand side variables would therefore result in conservative estimates for the effects of height and weight on subsequent labor market outcomes. For this reason, in the preferred specifications, we use Dheight_{i1981} and DBMI_{i1981} as instruments for Dheight_{i1975} and DBMI_{i1975}, respectively, to correct for the attenuation bias caused by random measurement error. Twin-differences in self-reported height and weight are strongly correlated across survey years. The validity of instruments is based on the classical measurement error assumption of non-correlated measurement errors in different survey years. Without the implementation of an instrumental variable (IV) estimation strategy, the estimates for the height premium and wage penalty would be biased towards zero.

Ability components related to both genetic and common family factors are controlled (differenced out) in the estimations that use twin differences. A substantial share of non-cognitive skills is controlled for because they arise, for the most part, from parental inputs and peer group effects that are much more similar for both MZ and DZ twins than for randomly selected individuals for whom the effects of height are usually estimated using cross-sectional data. MZ twins share all genes, and their experiences related to the family environment and family resources are the same. To the extent that a person's cognitive ability is determined by these factors, using twin pair differences for MZs constitutes a particularly strong control for unobserved ability differences between persons. Therefore, twin data are very useful to disentangle different explanations for the effect of height on earnings and employment prospects (Table 1). Development of MZ embryos can lead to discordant MZ twins who are dissimilar for certain characteristics such as height (Van Dongen et al. 2012, p. 3). This is the source of exogenous variation that is not caused by measurement error and can be used to identify the effects of height.

[INSERT TABLE 1 ABOUT HERE]

Individual-level OLS specifications are not able to discriminate between different explanations (Table 1, Column 1). DZ twins share only half of their genes but have similar family environment factors, as do MZ twins, implying that a comparison of DZ twins to cross-sectional individual-level OLS results identifies the contribution of the common family environment component in the height premium and some of the genetic effects. Furthermore, a comparison of DZ and MZ estimates for the effect of height on labor market outcomes identifies the genetic component of unobserved ability differences.

In the twin data setting, the social skills explanation predicts that twin pair differences between DZs should largely remove the effect of height on earnings and employment prospects (Table 1, Column 2), assuming that social skills arise from family background and peer group effects that are mostly similar, even among DZ twins. In contrast, if the height premium is based on cognitive ability, twin pair differences for DZs should diminish it considerably, and twin pair differences should almost completely remove the effect of height on labor market outcomes for MZs. Furthermore, if discrimination is largely non-existent in capital income, it is possible to use additional information on capital income to obtain some suggestive evidence for the existence of discrimination against short persons (Table 1, Panel B, Column 3).

4. RESULTS

4.1. Descriptive evidence

Before the presentation of the estimation results, it is useful to note some essential features of the data. Table 2 reports the descriptive evidence for differences within twin pairs in the variables of interest. Differences in height, BMI and labor market outcomes are all notably smaller for MZs. Relatively small differences in variables between twin pairs may explain some of the variation in the estimates, especially for MZs. These differences do not reflect only measurement error, because self-reported height and weight have been validated for a subsample (see Korkeila et al. 1998). We also find that differences in BMI increase over the period 1975-1990 because twins are ageing. Figure 1 shows the differences between twins separately for DZs and MZs in height and earnings. The range of height differences between twins is non-negligible, even for MZs. The unconditional correlation between height and earnings is positive in all cases except for MZ men.

[INSERT TABLE 2 ABOUT HERE]

[INSERT FIGURE 1 ABOUT HERE]

4.2. Baseline estimates

To begin the analysis of twin differences, we first document that the estimated height premium is comparable to other studies when our twin data are used as standard cross-sectional data. The baseline estimates for the effects of height and weight on life-time earnings are reported in Table 3. The individual-level OLS specifications reveal a positive height premium and a weight penalty for both men and women (Table 3, Panels A-B, Columns 1). The quantitative magnitude of the wage effect[15] of height is 4.5% per 1 cm for men and 2.2% per 1 cm for women. The corresponding wage effect of BMI is -3.6% per 1 unit in BMI for men and -5.6% per 1 unit in BMI for women.[16] Thus, the height premium is considerably larger for men, but the wage penalty associated with obesity is larger for women. This pattern is consistent with earlier studies that used various cross-sections of individuals. It is interesting that the height premium in our data is economically significant even though there is substantial wage compression in the Finnish labor market. The estimated height premium is in the upper range of the values obtained in previous studies. The literature has estimated that an additional inch of height is associated with a 0.025-5.5 percent increase in wages, according to Persico et al. (2004, p. 1020-1021). Our outcome is life-time earnings, not annual earnings, and therefore, the magnitude of our estimates is not completely comparable to those reported in the earlier studies.

[INSERT TABLE 3 ABOUT HERE]

Next, we add controls for the observed ability differences between individuals to the OLS specifications. Observed ability differences related to accumulated human capital are captured by education and work experience measured with age effects. Education is a predetermined variable in our specifications because the labor market outcomes for twins are measured over the primary working ages, whereas education is acquired at younger ages.[17] The estimates for both height and BMI from the models that include register-based education and age among the right-hand side variables are much smaller (Panels A-B, Columns 2). Therefore, controlling for observed ability between individuals lowers the estimates substantially. For men, BMI is no longer statistically significant (Panel A, Column 2).

An alternative explanation for the substantial explanatory power of the observed ability differences is that education correlates with BMI, e.g., through time preference. Obese individuals may discount future outcomes more heavily (Smith et al., 2005; Schlam et al., 2012), and consequently, they acquire less education. However, the diminishing height effect is very difficult to explain with such omitted third factors because a person's height is not her decision variable. Additionally, Persico et al. (2004, p. 1031) argue that controlling for education leads to an underestimate of the effect of height on labor market outcomes, to the extent that human capital investments are jointly determined with greater stature (cf. Vogl 2012).[18]

The specifications that use twin pair differences reveal that for both men and women, BMI is no longer statistically significant (Columns 3). For men, the positive height premium remains almost intact for DZs compared to the cross-sectional OLS results (Panel A, Column 4). This comparison shows that the sibling and family effects are not important determinants of the height premium. The result is consistent with Persico et al. (2004, p. 1030), who report that the height premium does not diminish much when controlling for family resources. However, the height premium disappears for MZs (Column 5). This finding demonstrates that unobserved differences in ability (i.e., genetic traits) explain the height premium for men.

However, for women, the height premium prevails for MZs at the 10% significance level. This result suggests a possible role for discrimination against short persons as an explanation for the height premium for women, which we will discuss more in Section 5.3.

Because both height and weight are self-reported, the estimates in Columns 3-5 may suffer from an attenuation bias. For this reason, in the preferred specifications, we use the IV strategy described earlier. The first stage of the IV approach works well. The F-test statistics are well above 10 when twin pair differences in height and BMI in 1975 are explained with the differences measured in 1981 (not reported).

For both men and women, the IV approach produces a larger point estimate, consistent with the estimates in Column 5 being downwardly biased because of the measurement error in self-reported height and weight. The IV estimates differ strikingly by gender. For men, height remains insignificant in the IV models (Panel A, Column 6). For women, the IV estimate for height is statistically significant. For women, the average wage effect of height in Column 6 is ~19% using the average twin pair differences in height for MZs in Table 2. The addition of twin pair differences in years of education does not change the overall picture (Column 7). The twin-difference estimate for the return to one additional year of education on life-time earnings is reasonable, i.e., ~20% (not reported in Table 3).

The baseline specifications that use average employment months per year over the period 1990-2004 as a measure of labor market attachment are reported in Table 4. For men, the results in Panel A are very similar to those from the earlier wage models. The estimates in Panel B for women reveal that the employment effects of both height and BMI are much smaller than for men. One explanation for this pattern is occupational sorting; i.e., obese and/or short women are more often employed in low-wage occupations. This sorting creates larger effects in earnings than in employment.

[INSERT TABLE 4 ABOUT HERE]

It is also useful to evaluate the quantitative magnitude of these estimates. For men, the employment effect of height is 0.05 months (~1.5 days) per year for each cm and -0.05 months (~1.5 days) per year for each unit of BMI, using the estimates in Column 1 of Table 4. The estimates for women are considerably lower. The employment effect of height is 0.02 months (~0.6 days) per year for each cm and -0.04 months (~1.2 days) per year for each unit of BMI. Thus, the employment effects are generally quantitatively small, which clearly implies that the earnings effects in Table 3 are being driven by the height premium in hourly or monthly wages rather than in labor market attachment.

For women the inclusion of education and age to the individual-level OLS models entirely removes the effects of both height and BMI on employment (Column 2 of Table 4). Another striking pattern of these results is that for women, height is not significant in the models for MZs in Columns 5-7, in contrast to the wage models. These results imply that observed human capital differences that correlate with height create the employment effects. In contrast, any height-related unobserved factors that cause wage differences do not create employment differences for women. This finding is consistent with some type of sorting effects for women. Whether these reflect ability-related occupational self-selection or discrimination against short women in high-wage occupations remains an open issue.

5. ADDITIONAL FINDINGS

To evaluate the sensitivity of the baseline estimates, we have estimated several alternative specifications. These models exploit the most important advantages of our linked data, which provide additional insights into the effects of height and weight on life-time labor market outcomes. We discuss these results briefly and present only the most interesting of them in subsequent tables.

5.1. Role of social skills

Persico et al. (2004) argue that social skills constitute the primary explanation for the existence of the height premium. To study this argument, we have added a measure for social skills to the set of explanatory variables.[19] Persico et al. (2004) used panel data on height and estimated a range of wage regressions with both adult height and teen height. They found that teen height matters for the height premium. Persico et al. (2004) interpreted this finding as evidence that noncognitive skills (i.e., social skills) drive the height premium. Furthermore, they used high-school social activities for white men to measure social skills directly. Following Persico et al. (2004), we take advantage of a direct summary measure for social skills measured in 1981, which precedes the measurement of the labor market outcomes by a decade.

Descriptive evidence reveals that taller women have better social skills (Table 5). However, for Finnish men, social skills and height are only weakly related. We also observe that both obese men and obese women have poorer social skills. This relationship is stronger for women.

[INSERT TABLE 5 ABOUT HERE]

The individual-level OLS models show that women with poor social skills have lower wages than women with strong social skills, even after controlling for the effects of accumulated human capital (Table 6, Panel B, Columns 1-2). In contrast, for Finnish men, there are no effects of social skills on life-time earnings (Table 6, Panel A, Column 1). One explanation for this observation is occupational sorting, i.e., men work in jobs where social skills are not required or rewarded. These apparent differences between genders are interesting because Persico et al. (2004) consider the contribution of social skills to the height premium only among white men, a specific fraction of the total population (cf. Case and Paxson, 2008, p. 528).

[INSERT TABLE 6 ABOUT HERE]

The specifications that use twin pair differences based on the IV strategy reveal that social skills are not significant in any of the models using life-time earnings as the outcome variable. Furthermore, the inclusion of social skills does not change the effect of height on earnings. In the specifications for employment, there is no role for social skills, not even in the individual-level OLS models for women (not reported). We conclude that social skills are not the explanation for the existence of a height premium. A caveat is that our summary measure for social skills may contain measurement errors.

5.2. Adding health to the covariates

Lundborg et al. (2009) argue that the height premium in earnings can largely be explained by the positive association between height and physical capacity.[20] Our twin data do not contain direct information on a person's physical capacity. However, we have comprehensive information on various diseases that were self-reported by the twins 15 years before our labor market outcomes in 1975. These diseases include e.g. emphysema, chronic obstructive pulmonary disease, high blood pressure, angina pectoris, peptic ulcer, diabetes, and gout. We use this information to evaluate the role of health as a proxy for physical capacity in the determination of the height premium in our twin sample. In the empirical specifications, we use the total number of different diseases that were self-reported in 1975. Because of the timing difference in the measurement of diseases and the labor market outcomes, reverse correlation is unlikely.

We first run regressions in which we explain the total number of different diseases in 1975 by height in 1975 while controlling for BMI in 1975. These results show that height is generally not even marginally statistically significantly associated with the number of diseases (not reported). Persico et al. (2004, p. 1037) report a similar finding. We have also estimated separate models for MZs. Only for female MZ twins is there some evidence that taller persons have fewer diseases. BMI is strongly positively associated with the number of diseases in all specifications, even for MZs.

Next, we add our health measure to the covariates for the specifications for earnings and employment months (not reported). These results show that the total number of diseases in 1975 is strongly and negatively associated with both of our labor market outcomes over the period 1990-2004. But the effect of height on earnings and average employment months remains intact. Even the quantitative magnitude of the height premium is essentially unchanged. Also, Persico et al. (2004, p. 1035) show that the addition of health covariates does not significantly reduce the estimated height premium. This finding leads to the conclusion that height is not simply a proxy for good health.[21]

To sum, these results reveal that health is not an important determinant of the height premium but that it has an independent effect on earnings and employment. Our health measure captures chronic diseases in adulthood, in contrast to the childhood disease environment or health inputs in the model presented in Vogl (2012), where they act as a common input, creating a positive correlation between health and height as well as height and cognitive ability. This probably explains the lack of correlation between health and height in our twin data.

5.3. Effects on capital income

Using information on the different components of income, we estimate the height and weight effects for capital income.[22] This analysis is an interesting extension of the existing literature because usually, only annual earnings are used as the outcome variable. Bequests that generate unobserved differences in capital income do not cause problems in our analysis because we use data on twins, and bequests are divided equally by default among all children in Finland. Also, a long-term measure of capital income is particularly useful because capital income fluctuates substantially from year to year. To obtain a consistent time-series for capital income, these specifications are estimated for the years 1993-2004, covering the period after Finland adopted a dual income taxation system.

For men, the individual-level OLS models reveal that height has a positive effect on capital income but that BMI is not significant (Table 7, Panel A). For women, there is a height premium and a weight penalty associated with obesity using capital income as the outcome (Table 7, Panel B). The addition of indicators for education groups removes the wage penalty for obese women, but for men, the effects remain intact (not reported). These findings are consistent with the notion that obese women acquire less education. The models that use twin pair differences show that in the pooled sample of DZs and MZs, there is a positive height premium for women but not for men. In the preferred specifications that use twin pair differences for MZs only with or without the IV approach, all the effects are insignificant for both men and women (Table 7, Panels A-B, Column 4).

The tentative conclusion from these estimates is that discrimination against short persons may be part of the explanation of the height-wage premium for women because there is a height premium in wages in Table 3 (Panel B), but not when capital income is the outcome variable. This argument is based on the assumption that discrimination is less prevalent for the acquisition of capital income compared to earnings.[23] Unobserved, ability-related self-selection may create a cross-sectional correlation for height with earnings and capital income. The disappearance of this correlation in twin-pair differences for capital income but not for earnings gives additional support for our discrimination-based interpretation for women.

[INSERT TABLE 7 ABOUT HERE]

5.4. Business cycle variation

We have estimated the effects of height on labor market outcomes during different business cycle conditions (Table 8). These results are particularly important because previous research almost exclusively uses cross-sectional data on earnings for a single year. Our data period, 1990-2004, contains a lot of variation in the income measures because it includes the Great

Depression of the early 1990s in Finland, which represents an exogenous shock caused by the collapse of Soviet trade (see Gorodnichenko et al., 2012). Real GDP fell by 14 percent over the period 1990-1994, and the unemployment rate increased to almost 17 percent from an average of approximately 5 percent during the 1980s. The Great Depression also caused an abundance of variation in life-time labor market outcomes, which is useful in identifying the associated effects, especially for twin pairs.

We find that for both men and women, the height premium in earnings is larger during the bottom of the depression (1993) compared to the peak of the economic upswing (1990). For men, the preferred point estimate for the IV specification in 1993 is 0.2020, with a 95% confidence interval from 0.0325 to 0.3714 (Table 8, Panel B, Column 4). In contrast, the estimate for 1990 is not statistically significantly different from zero (Table 8, Panel A, Column 4). For men, the effects of height and BMI on employment months are also more pronounced during the depression (not reported). The results for both earnings and employment suggest that height is a stronger signal for employers when the labor markets are tight. The finding that the height premium is not constant over the business cycle fluctuations provides one previously overlooked reason for the differences in the estimates of the height premium across earlier studies.

[INSERT TABLE 8 ABOUT HERE]

5.5. Testing alternative IV strategies

We have used retrospective information on weight differences between twins at the age of 20 reported in 1990 as an alternative instrument for BMI in 1975 (not reported). Again, the first stage of this IV approach works well. The F-test statistics are well above 10, the threshold proposed by Staiger and Stock (1997) for a weak instrument. These results show that BMI remains statistically insignificant for both men and women (not reported). Therefore, we conclude that there is no evidence for an obesity-related wage penalty.

One useful feature of our data is that they contain three different independent measurement points for both height and BMI. These measurements facilitate an alternative approach to managing the measurement error in self-reported information to test the robustness of our IV approach in the baseline specifications (not reported). We use the average of height and BMI over the three measurement points (1975, 1981 and 1990) as an explanatory variable to reduce the effect of classical measurement error. All the estimation results are similar to those in Tables 2-3. Notably, the results for MZs remain the same as in the previous models.

5.6. Accounting for age differences and using different measures for height

Our explanatory variables for height and weight are measured in 1975. But twin pairs were of different ages in 1975. This difference may cause some problems for the interpretation of the estimates. By estimating models with age groups in 1975 interacted with twin pair height differences, we can account for the fact that twin pairs had different ages in 1975 (not reported). In the individual-level OLS models, there is evidence that the effect of height on earnings is positive for the youngest age group (18-20) but not significant among the older age groups. The pattern is statistically stronger for men than women. The estimates based on twin pair differences show that the effect of height is positive and statistically significant for the youngest age groups in the models for MZs. This pattern is statistically somewhat stronger for women than men.

We have also used information from the different measurement points for height and BMI, estimating separate specifications for 1981 and 1990 (not reported). The estimates of height and BMI measured in 1981 and 1990 are lower than the ones that use the measures from 1975, especially for men.

Both the specifications based on age groups in 1975 interacted with twin pair height differences and the specifications estimated separately using weight and height in 1981 and 1990 are consistent with the argument that height differences at young ages are especially important for life-time labor market outcomes. Persico et al. (2004) raise this exact point. However, our results using direct measures for social skills are not consistent with their explanation that this finding reflects the importance of non-cognitive skills. Alternatively, the measurement error in twin pair differences affects the estimation results arguably less for the young if the noise-to-signal ratio is smaller for them.[24]

6. CONCLUSIONS

In this paper, we examined the effect of height on life-time labor market outcomes using Finnish same-sex twin data to account for the unobserved biases in the earlier studies. The employment effects of height are quantitatively small, even in cross-sectional OLS specifications. Therefore, the earnings effect of height is driven by the height premium in hourly or monthly wages rather than in labor market attachment.

Accounting for unobserved ability and family effects using twin pair differences for genetically identical twins, we find no evidence for the effect of height on employment. This pattern prevails for both men and women. The observation supports the conclusions in Case and Paxton (2008) about the importance of cognitive ability in explaining the effect of height on employment.

But the role of cognitive ability is more complex when using life-time earnings over the 15 year period as the outcome variable. The preferred estimates of twin pair differences with IV for genetically identical twins reveal a significant height premium for women but not for men. This finding implies that cognitive ability explains the effect of height on life-time earnings for men but not for women. Therefore, we conclude that differences in cognitive ability do not fully account for the height premium in life-time earnings. The use of information on different sources of income provides some light on this issue. In particular, the additional results using capital income as the outcome variable suggests that discrimination against short persons may play some role in explaining the height premium for women.

The possibility of within-twin differences in ability reinforces our conclusion regarding the non-existence of the height-wage premium for men. Within-twin differences in ability imply that the height effect based on twin-pair differences is upward biased due to ability bias and therefore twin-difference estimates constitute an upper-bound for the true estimate of height on earnings (cf. Bound and Solon, 2004; Krashinsky, 2004, p. 789). We argue that within-twin differences in ability do not explain the female height premium either, because it begs the question, why it would affect women but not men, and ability bias should show up in the capital income estimates also if it is important.

We explicitly considered the potential contribution of social skills as the determinant of the height premium, following Persico et al. (2004). The results reveal that women with poor social skills have lower wages, based on individual-level OLS. However, this pattern does not prevail for men, and social skills do not play any role in twin pair difference estimates. Also, social skills do not account for the differences in employment in any of the models, not even the models based on individual-level OLS for women. Furthermore, both the estimates for life-time earnings and employment show that twin differences for DZs, which control for the family environment that constitutes the base for social contacts, are unable to remove the positive effect of height on life-time labor market outcomes. All these results point to the conclusion that social skills do not constitute a comprehensive explanation for the existence of the height premium, at least not in our twin sample.

Height may be just a marker of good health. However, we do not obtain evidence for the explanation that health is an important determinant of the height premium using information on the prevalence of various diseases measured 15 years before our labor market outcomes. Health is an important determinant of life-time labor market outcomes, and persons with worse health obtain considerably lower wages later in life. But the effect of height on the labor market outcomes remains intact after adding information on diseases to the covariates.

We also find that the height premium is not constant over business cycle fluctuations; it is substantially larger during a depression. This countercyclical nature of the height premium has not been documented elsewhere. Thus, height is a more valuable characteristic when the labor markets are tight. While this new finding is interesting *per se*, it is impossible to use the result to settle the explanation for the height premium.

All the empirical specifications that we estimated included BMI among the explanatory variables. In the preferred specifications, we find no evidence for a wage penalty from obesity. This finding applies to both men and women, and it is additionally robust to the use of an alternative instrument for BMI. Thus, we confirm the results in Behrman and Rosenzweig (2001) for men and women and using life-time labor market outcomes with different instrument variables strategies. This result is particularly important because the obesity-related wage penalty is widely reported in the literature using non-twin data.

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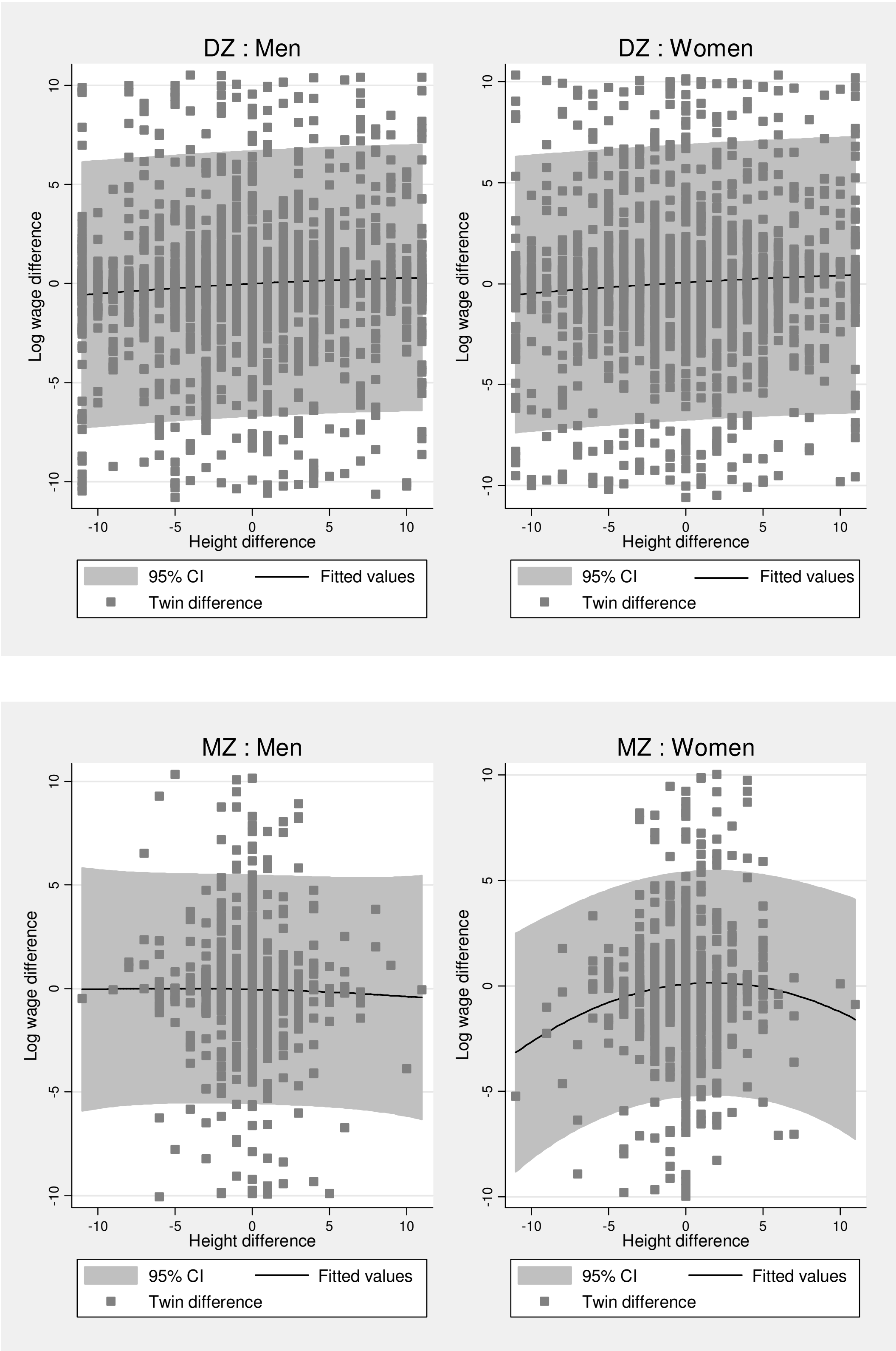
Figure 1. Twin differences in wages and height.



Notes: The 95% confidence level is shaded.

Table 1. Using twin data to differentiate the explanations for the height premium.

Panel A: Earnings	Individual-level OLS	Twin differences: DZ	Twin differences: MZ
Non-cognitive skills	+	0	0
Cognitive skills	+	+ (smaller)	~0
Discrimination	+	+	+
Panel B: Capital income	Individual-level OLS	Twin differences: DZ	Twin differences: MZ
Non-cognitive skills	+	0	0
Cognitive skills	+	+ (smaller)	~0
Discrimination	0	0	0

Notes: The table shows the expected impact of height on earnings and capital income according to different explanations of the height premium, conditional on all other explanatory factors being fully controlled. In Panel A, the outcome is earnings, and in Panel B, the outcome is capital income.

Table 2. Descriptive statistics.

Panel A. Men

		Twin differences	
	DZ and MZ	DZ	MZ
Log wage	1.9956	2.1584	1.6279
Employment months	3.0711	3.3341	2.4769
Height (1975)	3.7231	4.5974	1.7479
Height (1981)	3.8607	4.7425	1.9256
Height (1990)	3.7360	4.5560	2.0473
BMI (1975)	1.7344	1.9790	1.1817
BMI (1981)	2.0756	2.3813	1.4076
BMI (1990)	2.4730	2.7730	1.8542

Panel B. Women

		Twin differences	
	DZ and MZ	DZ	MZ
Log wage	2.0240	2.2168	1.6503
Employment months	3.2447	3.4735	2.8012
Height (1975)	3.3648	4.2624	1.6249
Height (1981)	3.4953	4.4202	1.7321
Height (1990)	3.4071	4.3595	1.7316
BMI (1975)	1.7433	2.0009	1.2441
BMI (1981)	2.1327	2.4447	1.5407
BMI (1990)	2.7554	3.1293	2.1022

Notes: Absolute differences between twin pairs are reported. Log wage is the average log annual wage over the period 1990-2004. Employment months are calculated as the average number of employment months per year over the period 1990-2004. Height (cm) and Body Mass Index (BMI) are measured in 1975, 1981 and 1990. Wage and employment months originate from FLEED. Height and weight are self-reported in the twin data. Descriptive statistics are calculated for individuals born after 1944 but before 1958.

Table 3. Wage regressions.

Panel A. Men

Sample	DZ and MZ	DZ and MZ	DZ and MZ	DZ	MZ	MZ	MZ
Estimation method	OLS	OLS		Twin differences		Twin differences and IV	
Dependent variable	Log wage	Log wage	Log wage	Log wage	Log wage	Log wage	Log wage
Height	0.0449***	0.0332***	0.0352**	0.0397**	-0.0103	0.1387	0.1238
	(0.0070)	(0.0068)	(0.0148)	(0.0156)	(0.0432)	(0.0882)	(0.0843)
BMI	-0.0360**	-0.0063	-0.0074	-0.0140	0.0263	-0.2737	-0.2202
	(0.0160)	(0.0175)	(0.0339)	(0.0378)	(0.0734)	(0.1449)	(0.1671)
Controls	No	Yes	No	No	No	No	Yes
N	4680	4680	2340	1622	718	589	589

Panel B. Women

Sample	DZ and MZ	DZ and MZ	DZ and MZ	DZ	MZ	MZ	MZ
Estimation method	OLS	OLS		Twin differences		Twin differences and IV	
Dependent variable	Log wage	Log wage	Log wage	Log wage	Log wage	Log wage	Log wage
Height	0.0219***	0.0141**	0.0468***	0.0434**	0.0778*	0.1176*	0.1155*
	(0.0070)	(0.0068)	(0.0162)	(0.0173)	(0.0420)	(0.0559)	(0.0558)
BMI	-0.0561***	-0.0386*	-0.0220	-0.0258	-0.0067	-0.0627	-0.0517
	(0.0160)	(0.0160)	(0.0319)	(0.0372)	(0.0572)	(0.1258)	(0.1237)
Controls	No	Yes	No	No	No	No	Yes
N	5060	5060	2530	1669	861	765	765

Notes: Log wage is the average log annual wage over the period 1990-2004. Height and BMI are measured in 1975. In Column 2, education level (6 groups) and age, both squared and cubed, are included in the vector of explanatory variables. In Column 7, the difference in the years of education between twin pairs is included in the right-hand side variables. In Columns 6-7, height and BMI differences measured in 1981 are used as instruments for height and BMI differences in 1975. All specifications are estimated for individuals born after 1944 but before 1958. Robust standard errors are reported in parentheses: *statistically significant at the .10 level; **at the .05 level; ***at the .01 level.

Table 4. Employment regressions.

Panel A. Men

Sample	DZ and MZ	DZ and MZ	DZ and MZ	DZ	MZ	MZ	MZ
Estimation method	OLS	OLS		Twin differences		Twin differences and IV	
Dependent variable	Employment months	Employment months	Employment months	Employment months	Employment months	Employment months	Employment months
Height	0.0509***	0.0462***	0.0491**	0.0533**	0.0012	0.0991	0.0837
	(0.0096)	(0.0096)	(0.0211)	(0.0223)	(0.0648)	(0.1197)	(0.1170)
BMI	-0.0548**	-0.0309	-0.0260	-0.0312	0.0008	-0.1648	-0.1096
	(0.0224)	(0.0245)	(0.0473)	(0.0525)	(0.1066)	(0.2557)	(0.2506)
Controls	No	Yes	No	No	No	No	Yes
N	4680	4680	2340	1622	718	589	589

Panel B. Women

Sample	DZ and MZ	DZ and MZ	DZ and MZ	DZ	MZ	MZ	MZ
Estimation method	OLS	OLS		Twin differences		Twin differences and IV	
Dependent variable	Employment months	Employment months	Employment months	Employment months	Employment months	Employment months	Employment months
Height	0.0177**	0.0125	0.0389*	0.0429*	0.0043	0.0620	0.0623
	(0.0100)	(0.0099)	(0.0233)	(0.0247)	(0.0676)	(0.1018)	(0.1020)
BMI	-0.0401*	-0.0290	-0.0068	0.0084	-0.0753	-0.1847	-0.1864
	(0.0229)	(0.0231)	(0.0445)	(0.0518)	(0.0822)	(0.1849)	(0.1851)
Controls	No	Yes	No	No	No	No	Yes
N	5060	5060	2530	1669	861	765	765

Notes: Employment months are calculated as the average number of employment months per year over the period 1990-2004. Height and BMI are measured in 1975. In Column 2, education level (6 groups) and age, both squared and cubed, are included in the vector of explanatory variables. In Column 7, the difference in the years of education between twin pairs is included in the right-hand side variables. In Columns 6-7, height and BMI differences measured in 1981 are used as instruments for height and BMI differences in 1975. All specifications are estimated for individuals born after 1944 but before 1958. Robust standard errors are reported in parentheses: *statistically significant at the .10 level; **at the .05 level; ***at the .01 level.

Table 5. Correlations between height, BMI and social skills.

Panel A. Men	Height (1975)	BMI (1975)	Social skills (1981)
Height (1975)	1		
BMI (1975)	-0.0411*** (0.0000)	1	
Social skills (1981)	-0.0087** (0.0277)	-0.0291*** (0.0000)	1

Panel B. Women	Height (1975)	BMI (1975)	Social skills (1981)
Height (1975)	1		
BMI (1975)	-0.0675*** (0.0000)	1	
Social skills (1981)	-0.0296*** (0.0000)	-0.0636*** (0.0000)	1

Notes: Social skills are measured as explained in the text. Higher values indicate worse social skills. The correlations are calculated for individuals born after 1944 but before 1958. p-values in parentheses. Statistical significance: *** p<0.01, ** p<0.05, * p<0.1.

Table 6. Wage regressions with a measure for social skills.

Panel A. Men

Sample	DZ and MZ	DZ and MZ	DZ and MZ	DZ	MZ	MZ	MZ
Estimation method	OLS	OLS	Twin differences			Twin differences and IV	
Dependent variable	Log wage	Log wage	Log wage	Log wage	Log wage	Log wage	Log wage
Height	0.0332***	0.0233***	0.0331**	0.0325**	-0.0324	0.0809	0.0688
	(0.0067)	(0.0066)	(0.0151)	(0.0160)	(0.0447)	(0.0687)	(0.0652)
BMI	-0.0570***	-0.0062	-0.0123	-0.0098	0.0275	-0.2452	-0.1830
	(0.0167)	(0.0182)	(0.0355)	(0.0395)	(0.0789)	(0.1697)	(0.1624)
Social skills	-0.0102	-0.0052	-0.0049	-0.0138	-0.0260	-0.0273	-0.0285
	(0.0093)	(0.0092)	(0.0141)	(0.0163)	(0.0270)	(0.0273)	(0.0267)
Controls	No	Yes	No	No	No	No	Yes
N	4052	4052	1840	1270	570	566	566

Panel B. Women

Sample	DZ and MZ	DZ and MZ	DZ and MZ	DZ	MZ	MZ	MZ
Estimation method	OLS	OLS	Twin differences			Twin differences and IV	
Dependent variable	Log wage	Log wage	Log wage	Log wage	Log wage	Log wage	Log wage
Height	0.0203***	0.0144**	0.0421**	0.0391**	0.0701*	0.1237*	0.1216*
	(0.0070)	(0.0068)	(0.0168)	(0.0180)	(0.0434)	(0.0578)	(0.0574)
BMI	-0.0473***	-0.0189*	-0.0259	-0.0221	-0.0399	-0.0928	-0.0810
	(0.0162)	(0.0165)	(0.0331)	(0.0388)	(0.0594)	(0.1290)	(0.1268)
Social skills	-0.0300***	-0.0219***	-0.0108	-0.0121	0.0081	-0.0079	-0.0019
	(0.0080)	(0.0079)	(0.0123)	(0.0150)	(0.0199)	(0.0964)	(0.0199)
Controls	No	Yes	No	No	No	No	Yes
N	4599	5060	2149	1404	745	735	735

Notes: Log wage is the average log annual wage over the period 1990-2004. Height and BMI are measured in 1975. In Column 2, education level (6 groups) and age, both squared and cubed, are included in the vector of explanatory variables. In Column 7, the difference in the years of education between twin pairs is included in the right-hand side variables. In Columns 6-7, height and BMI differences measured in 1981 are used as instruments for height and BMI differences in 1975. Social skills are measured as explained in the text. Higher values indicate worse social skills. All specifications are estimated for individuals born after 1944 but before 1958. Robust standard errors are reported in parentheses: *statistically significant at the .10 level; **at the .05 level; ***at the .01 level.

Table 7. Explaining capital income.

Panel A. Men				
Sample	DZ and MZ	DZ and MZ	MZ	MZ
Estimation method	OLS	Twin differences		Twin differences and IV
Dependent variable	Log capital income	Log capital income	Log capital income	Log capital income
Height	0.0410***	0.0129	-0.0141	0.0372
	(0.0064)	(0.0135)	(0.0383)	(0.0636)
BMI	-0.0020	-0.0109	-0.0665	0.0490
	(0.0157)	(0.0293)	(0.0753)	(0.1775)
Controls	No	No	No	No
N	4596	2307	710	582

Panel B. Women				
Sample	DZ and MZ	DZ and MZ	MZ	MZ
Dependent variable	Log capital income	Log capital income	Log capital income	Log capital income
Estimation method	OLS	Twin differences		Twin differences and IV
Height	0.0161***	0.0226*	0.0320	0.0609
	(0.0058)	(0.0123)	(0.0331)	(0.0540)
BMI	-0.0244**	-0.0268	-0.0344	0.0849
	(0.0244)	(0.0236)	(0.0526)	(0.1020)
Controls	No	No	No	No
N	4992	2503	853	759

Notes: Log capital income is the average of log annual capital income over the period 1993-2004. Height and BMI are measured in 1975. In Column 4, height and BMI differences measured in 1981 are used as instruments for height and BMI differences in 1975. All specifications are estimated for individuals born after 1944 but before 1958. Robust standard errors are reported in parentheses: *statistically significant at the .10 level; **at the .05 level; ***at the .01 level.

Table 8. Wage regressions for men in 1990 and 1993.

Panel A. Men (1990)				
Sample	DZ and MZ	DZ and MZ	MZ	MZ
Estimation method	OLS		Twin differences	Twin differences and IV
Dependent variable	Log wage	Log wage	Log wage	Log wage
Height	0.0301***	0.0222	-0.0437	0.0749
	(0.0065)	(0.0140)	(0.0454)	(0.0774)
BMI	-0.0093	-0.0232	0.0216	0.1021
	(0.0146)	(0.0302)	(0.0687)	(0.1696)
Controls	No	No	No	No
N	4680	2340	718	589

Panel B. Men (1993)				
Sample	DZ and MZ	DZ and MZ	MZ	MZ
Dependent variable	Log wage	Log wage	Log wage	Log wage
Estimation method	OLS		Twin differences	Twin differences and IV
Height	0.0392***	0.0370**	0.0178	0.2020**
	(0.0082)	(0.0178)	(0.0551)	(0.0863)
BMI	-0.0432**	-0.0232	0.1817**	0.0573
	(0.0189)	(0.0323)	(0.0859)	(0.2003)
Controls	No	No	No	No
N	4592	2530	710	582

Notes: Log wage is the log annual wage in 1990 (Panel A) or in 1993 (Panel B). Height and BMI are measured in 1975. In Column 4, height and BMI differences measured in 1981 are used as instruments for height and BMI differences in 1975. All specifications are estimated for individuals born after 1944 but before 1958. Robust standard errors are reported in parentheses: *statistically significant at the .10 level; **at the .05 level; ***at the .01 level.

[1] In this literature, earnings are more commonly used than employment as a measure of labor market success. In this paper, the term ‘height premium’ refers to both earnings and employment outcomes.

[2] Persico et al. (2004) use the National Longitudinal Survey of Youth (NLSY) from 1979 and focus on white men. Their baseline specifications explain wages with height measured at the age of 7, 11, 16 and 33. Persico et al. (2004, p. 1033) find that among all recorded heights, only height at age 16 has an economically large and statistically significant effect on adult wages. Their additional specifications take advantage of information on participation in high school social activities.

[3] The study by Case and Paxson (2008) is partly based on the same data as the one by Persico et al. (2004) but Case and Paxson (2008) use additional information on childhood cognitive ability.

[4] Lundborg et al. (2009) use data from the Swedish military enlistment register over the period 1984-1997 and income data for 2003. They estimate wage regressions for 2003 with height, cognitive and non-cognitive skills, and physical strength as explanatory variables.

[5] Björklund and Jäntti (2012) stress the importance of the family environment on various labor market outcomes using Swedish sibling data.

[6] The twin correlation for general cognitive ability and verbal ability is in the range of 0.7-0.8 for identical twins and about half that amount for non-identical twins (see McClearn et al. 1997, p. 1562; Plomin and DeFries, 1998, p. 66).

[7] There is a growing literature on the effects of early life experiences on subsequent labor market outcomes in economics (e.g., Case et al., 2005). Early life experiences may additionally shape personality (e.g., McCrae et al., 2000).

[8] Behrman and Rosenzweig (2001) report that each additional inch of height is associated with a 3.5-5.5 percent increase in wages for female identical twins.

[9] Dizygotic or ‘fraternal’ twins share, on average, 50% of their genes. There are some exceptions to the rule that MZ twins are genetically identical (Van Dongen et al. 2012, p. 11).

[10] Earlier studies have used the height information in the Finnish twin data (e.g., Silventoinen et al. 2000, 2001, 2004). However, none of these studies have examined the effect of height on labor market outcomes.

[11] Behrman and Rosenzweig (2004) and Black et al. (2005) consider the importance of birth weight on subsequent labor market outcomes.

[12] In the medical literature, BMI alone is not considered a valid measure of obesity or a sufficient predictor of obesity-related health outcomes (Yusuf et al., 2005). One reason is that BMI blurs the distinction between fat and fat-free mass, such as muscle and bone. Only some recent empirical studies have used body composition in economics to examine the labor market effects of obesity (see Burkhauser and Cawley, 2008, Johansson et al., 2009; Wada and Tekin, 2010).

[13] Body mass index is calculated as a person’s weight in kilograms divided by height in meters squared.

[14] Systematic measurement error regarding self-reported height may occur. Persons who have higher wages may have higher self-confidence, and consequently, they could overstate their actual height. This error would imply that the estimates for self-reported height on labor market outcomes are downwardly biased.

[15] We use the terms ‘wage effect’ and ‘earnings effect’ interchangeably when the dependent variable is life-time earnings. Later, the results for employment confirm that the earnings effects arise mostly from wage differences rather than employment differences.

[16] Böckerman et al. (2010) have reported earlier the existence of a height premium in Finland using the Health 2000 data set. With the same data, Johansson et al. (2009) document the wage penalty associated with various measures of obesity, including the measures that capture different aspects of body composition. Sarlio-Lähteenkorva et al. (2004) have also examined the effects of obesity on labor market outcomes in the Finnish context.

[17] Decision variables among the right-hand side covariates would be 'bad controls' when estimating the effects on earnings (Persico et al., 2004, p. 1031; Neal and Johnson, 1996).

[18] Silventoinen et al. (2004) observe that the association between body height and education is largely due to the correlation of the shared environmental factors affecting these two traits.
[19] There is a large literature in psychology on the association between social skills and various labor market outcomes, including promotions and earnings (see Barrick and Mount, 1991).

[20] Vogl (2012) reports that taller Mexican workers sort into occupations that require greater intelligence and lower physical strength.

[21] The explanation based on health and physical strength may be more relevant in developing countries (cf. Case and Paxson 2008, p. 500).

[22] To compress the presentation of the additional results, in Tables 7-8 we focus only on the most interesting specifications.

[23] The focus on capital income removes, for the most part, the effect of discrimination on hiring decisions, but discrimination by consumers against short persons may still have some impact on the amount of capital income. However, our capital income measure contains also income from financial investments where discrimination by consumers is not possible.

[24] We have also applied two alternative ways to calculate life-time earnings (not reported). In the baseline models, we calculate the average earnings over the period 1990-2004 first by taking a logarithmic transformation of yearly earnings and then calculating the average. The idea is to normalize the earnings data and suppress the effect of outliers caused by the Great Depression and other transitional earnings effects. The first alternative wage measure is based on the sum of yearly earnings after which we next take the logarithmic transformation. These results are generally similar to the ones in Table 3. The second alternative wage measure is also based on the sum of yearly earnings. But we take the logarithmic transformation without taking the zero earnings into account. The individual-level OLS models show that the point estimates are much lower, especially for women. This pattern is expected because there are many more zero earnings for women than for men, and we eliminate the labor market participation decision by dropping zeros in these specifications.