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ABSTRACT

Are Tall People Less Risk Averse than Others?

This paper examines the question of whether risk aversion of prime-age workers is negatively correlated with human height to a statistically significant degree. A variety of estimation methods, tests and specifications yield robust results that permit one to answer this question in the affirmative. Hausman-Taylor panel estimates, however, reveal that height effects disappear if personality traits and skills, parents' behaviour, and interactions between environment and individual abilities appear simultaneously. Height is a good proxy for these influences if they are not observable. Not only one factor but a combination of several traits and interaction effects can describe the time-invariant individual effect in a panel model of risk attitude.

JEL Classification: D90, J13, J24

Keywords: height, risk preference

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1. Introduction

Recent theoretical and empirical analyses of the relationship between height and wages demonstrate that height is not only a biological but also an economic category. It has been argued that earnings increase with height because tall people have physical advantages, are more disease-resistant, possess greater authority and have better verbal and non-verbal abilities than do others (Persico et al. 2004, Case and Paxson 2008, Heineck 2009, Hübler 2009). Epidemiological studies interpret height as a proxy for nutritional advantages. A further indirect mechanism might be the following: Tall people are as a rule more willing than others to take risks, and this willingness leads to higher income. Dohmen et al. (2010, 2011) incorporate height as a control variable in their empirical risk function and find a significant positive effect, but they do not discuss this interesting result in detail. Of course, height cannot have a direct causal influence on risk behaviour, but a statistical relationship is possible. Two channels may induce such an association. Either there exist variables (z_1) that have independent effects on height and risk attitudes or height produces personal characteristics (z_2) that are relevant to risk behaviour. If z_1 and z_2 are completely observable then the height effect should disappear. The variables z_1 should be characteristics that are hereditary or formed early in life, before height is fixed; z_2 are determinants that develop later on.

Height can be used as proxy for z_1 and z_2, if these variables are not observable. Is such information relevant to social policy? Yes, if people are too risk-averse or too risk-prone and the behaviour that results is disadvantageous to economic development. In this case, social policy may influence z_1 or z_2 and thus change risk attitude in the long run. It is possible to determine which of the z_1 and z_2 variables are most influenced by social policy and which of these are the most risk effective.

This paper explores whether the height-risk relationship is robust to controlling for several other variables that have effects on risk attitudes. In Section 2 some literature is briefly summarized and hypotheses are formulated. Section 3 presents the data and some descriptive statistics. The econometric results can be found in Section 4. Section 5 concludes.

2. Related literature and hypotheses

As we have mentioned, when either z_1 or z_2 variables are omitted they can induce a statistical relationship between height and risk attitude. Two strands, theoretical and empirical literature regarding the determinants of height and of risk behaviour, explain why some characteristics affect both.

In recent years, a multitude of empirical studies have related certain personal characteristics to a certain degree of risk aversion (Cesarini et al. 2008, Dohmen et al. 2005, 2006, 2010, 2011, Hopfensitz and Wranik 2008, Hryshko et al. 2011) and to consequences of risk aversion (Ferrer-i-Carbonell and Ramos 2010, Grund and Sliwka 2007, Jaeger et al. 2010). These studies demonstrate that an individual's attitude towards risk are largely determined by genetic factors, parental educational achievements, and personal characteristics such as cognitive abilities, health, age, sex and religion. Furthermore, individual behaviour varies not only over time and with environmental conditions but also across industries, occupational status, and, in the case of an individual employed by a firm, his or her position within the firm's hierarchy. Schooling, occupational status and wages are factors, as well.

In general, tall people possess more authority than others, and are more risk-tolerant. These character traits are formed during adolescence and enhanced during working life. However, the statistical impact of height on an individual's risk tolerance might also be explained by any of three indirect (confounding) channels. First, environmental and family conditions during early adolescence may jointly determine both height and risk tolerance. Second, height is positively associated with disease resistance, and healthy people are more willing than others to take risks. Third, height is positively associated with self-confidence, and hence with well-paying professional occupations. Hopfensitz and Wranik (2008) argue that self-efficacy is related to a personal profile characterized by confidence in decision-making, competence, optimism, and lack of anxiety. A relatively high degree of risk tolerance is a logical consequence of this set of positive character traits. Above-average wages permit the acquisition of property, which in turn provides protection in the event of losses from risky activities. Fourth, tall people tend to think of themselves as leaders and therefore opt for managerial positions and self-employment occupations, which require a relatively high degree of risk tolerance.

Schick and Steckel (2010) find that among children above-average height is correlated with above-average scores on both cognitive and non-cognitive tests. Cesarini et al.(2008) show that genetic factors determine risk behaviour. Korniotis and Kumar (2011) choose height as a proxy for the lifelong experiences unique to a given individual. This choice is motivated by evidence from research in the field of psychology demonstrating that from early childhood on height is directly correlated with positive experiences and hence with optimism. Using data from several European countries as well as the U.S., they show that tall individuals are, as a rule, not only smarter, healthier, more optimistic and socially more active than those of average or below-average height, but also more likely to participate in financial markets, and then to opt for relatively risky financial portfolios.

Inherent attributes, family background, and environmental factors during adolescence belong to the class of variables that affect height. Boys are taller than girls. The parents' degree of educational attainment and their attentiveness to their children's welfare are positively correlated with their children's nutrition in the early stages of development, which in turn is positively correlated with growth and fitness. The fact that well-educated parents are relatively well informed about nutrition may also give their children an edge, both socially and professionally, later in life. Height also varies at the regional level, and hence at the national one as well, on account of ethnic differences.

In Germany, for example, native Germans are on average taller than other residents, those in the west are taller than those in the east, and city-dwellers are taller than their rural counterparts (Komlos/Kriwy 2003).

Because these attributes are likely to influence risk behaviour, we include them among the z_1 variables. Role incongruence may penalize those women who, counter to gender-based expectations, engage in high-risk activities (Maxfield et al. 2010). Well-educated parents are, on the whole, better able than others to determine the degree of risk in a given situation and explain it to their children, who consequently will be relatively risk tolerant. Lack of information tends to generate uncertainty, which in turn tends to prompt decisions driven by risk aversion.

Between countries, regions, and religions differences in the degree of risk aversion are largely a function of history, cultural norms and ethical standards. Bartke and Schwarze (2008) find that nationality is not a valid determinant of risk attitudes but that it can be broken down into several constituent factors, including religion. Religious faith in general is negatively associated with risk tolerance. Moreover, religious affiliation matters: Muslims tend to be less risk-tolerant than Christians.

While some variables indicate a spurious correlation between height and risk attitude (z_1), others reveal that height and risk are links in a causal chain (z_2). Height may prompt decisions that are a gauge of an individual's degree of risk tolerance. Some of these attributes are already effective in adolescence, while others are developed as adults and in working life.

Tall teenagers tend to develop self-confidence because their peer group tends to appoint them to leadership positions, in which they are obliged to deal with risky situations. Self-confidence helps them to handle conflicts, engaging in debate if need be; the result is that they tend to be relatively risk tolerant. Moreover, it is known that the risk of unemployment is negatively correlated with height. Children with an unemployed father are shorter than others (Rona/Chinn 1991), and there exists an intergenerational transmission of risk to become unemployed (Johnson/Reed 1996). Therefore, tall persons tend to be confident that unemployment is not their fate; by extension, they tend to be relatively risk-tolerant.

Father-son conflicts are an especially useful training ground for gauging the degree of risk in a given situation, and thus for those who eventually find themselves in high-risk professional roles, such as management, self-employment, and perhaps working in the investment and banking sector. Men of below-average height (Hübler 2009) and risk-averse individuals (Pfeifer 2011) tend to prefer the lower-risk public sector.

Kuhn and Weinberger (2005) emphasize that high-school leadership is connected with stamina, energy, the work ethic, persistence and motivation – all character traits that are highly valued in the labour market, making it relatively easy for tall individuals to reach positions in the upper echelons of the corporate hierarchy, where financial compensation is positively associated with the risk tolerance required at that level.

The positive correlation between height and certain skills can also be observed in sectors other than the professional one. For example, because tall young people tend to have an edge over others in competitive sports, these activities lead them to associate risk tolerance with winning. The same pattern seems to hold in the realm of musical collaboration – see Table A.2 and A.3 - but it remains to be determined whether this is a matter of their possessing exceptional talent or of their underlying self-confidence, and hence their enthusiasm for team efforts generally, which in turn encourage them to be risk-tolerant, since in case of failure the responsibility is shared.

Other abilities, non-verbal as well as verbal, are positively correlated not only with height (Case/Paxson 2008) but also with risk tolerance. For example, above-average abilities tend to garner good grades, which in turn enhance their self-confidence. A negative correlation between this indicator and risk aversion seems plausible. The above-average rhetorical abilities of tall students - for instance those who get good grades in German (we are referring, of course, to German students) - mean that they are particularly well adapted to leadership roles.

This summary presentation of the literature generates five hypotheses:

Hypothesis 1: An individual who, on account of inexperience and insufficient information, cannot decide whether a risk is tolerable or not will probably choose not to take it.

Hypothesis 2: Tall individuals tend to have had more experience during adolescence in gauging risks and therefore tend to be relatively risk tolerant.

Hypothesis 3: Tall individuals tend to be chosen during adolescence for leadership positions and to succeed in team efforts; their consequent self-confidence makes for a relatively high level of risk tolerance later in life, as well.

Hypothesis 4: Verbal and non-verbal abilities tend to be positively correlated with height and with risk tolerance.

Hypothesis 5: An unobserved bundle of inherent and acquired traits combined with environmental conditions helps to explain the positive correlation between height and risk tolerance.

In the absence of data permitting the direct testing of these hypotheses, characteristics specific to adolescents and working adults can be successfully exploited for checks.

3. Data, variables, and descriptive results

3.1 Data and variables

Drawing on data from the German Socio-Economic Panel (GSOEP) – see Wagner et al. (2007) – we analyse the relationship between height and risk aversion. This longitudinal data set is a representative survey started in 1984. In this article we use information from 2004, 2006 and 2008. Heights as well as attitudes towards risk in these years are surveyed. However, because information on self-confidence is unavailable for 2008, most estimates are limited to 2004 and 2006. As an adult's height from age 25 to age 55 is essentially fixed, the sample is restricted to this age interval, following Schultz (2002). Furthermore, some information that is relevant to risk attitude is unavailable for younger and older people who are not in the labour force. Furthermore, only those persons are considered who have answered a supplementary biography questionnaire. Height is measured in most of the following estimates by the mean of the individual values reported in the three years (2004, 2006 and 2008). In some cases year-specific values are applied. As the height of prime-age persons should be time-invariant, deviations are also handled as errors-in-variables problem (see Section 4.2). Attitude towards risk is measured by a subjective rating: How would you describe yourself? Are you generally willing to take risks, or do you try to avoid risks? A value of 0 means "very risk-averse" and a value of 10 means "fully prepared to take risks." The definitions of further variables that are used in the empirical analysis are presented together with descriptive statistics in Table A.1.

3.2 Descriptive results

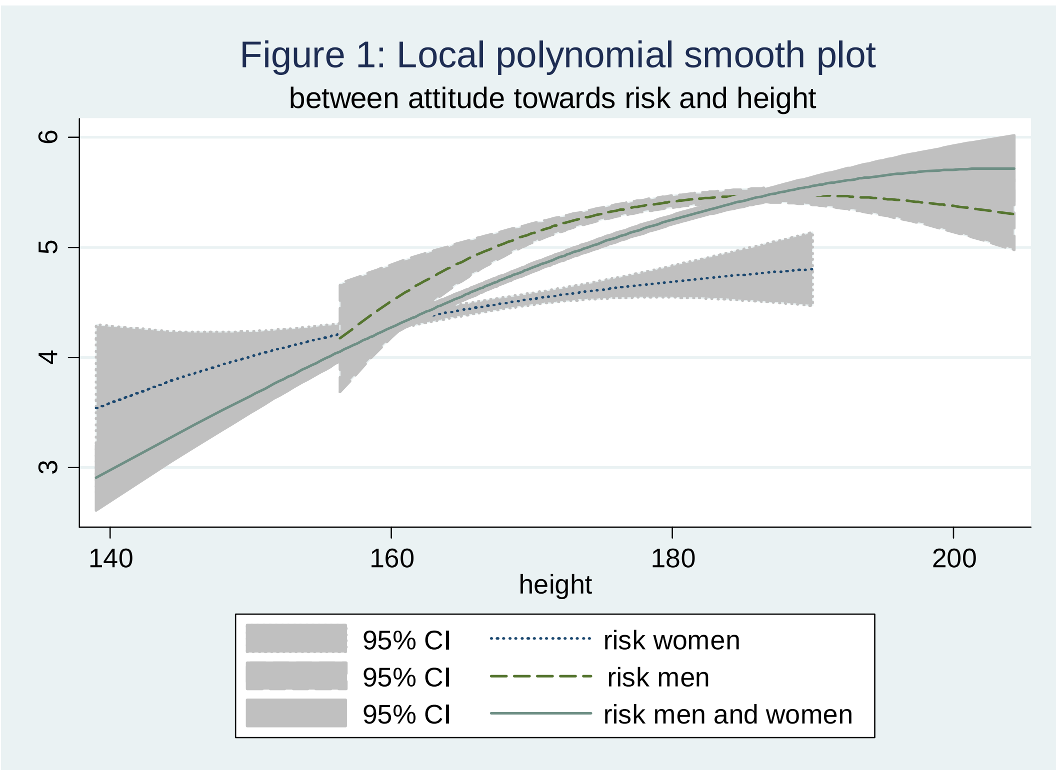
In Table 1 we find that, on average, men are less risk-averse and, not surprisingly, taller than women.

Table 1: Descriptive Statistics

Variable	women obs	women mean	women std. dev.	men obs	men mean	men std. dev.
risk	2,702	4.46	2.06	3,041	5.38	2.05
height	2,702	166.49	8.50	3,041	179.74	7.62

Source: GSOEP 2004 and 2006.

The average attitude towards risk for men and women whose height is below the lower and above the upper quartile ($height_{0.25}$; $height_{0.75}$) provides an initial hint that tall people are less risk-avers than others: risk_{men; height<$height_{0.25}$ }= 5.24; risk_{men; height>$height_{0.75}$}=5.52; risk_{women; height<$height_{0.25}$}=4.32 and risk_{women; height>$height_{0.75}$}=4.63.The local polynomial smooth plots with confidence intervals (CI) show that the relationship is almost linear in the main range, especially combined for men and women (Figure 1). We should examine whether estimators, which are more robust to outliers than the mean regression, are preferable.



Next, we present simple correlations between variables previously discussed, height and risk attribute (Table 2).

Table 2: Simple correlation coefficients between risk and height and other variables

	women		men	
Variable	risk	height	risk	height
height	0.062*		0.059*	
conflicts with father	-0.040*	0.011	-0.056*	-0.034*
grade in subject German	-0.072*	-0.059*	-0.020	-0.049*
self-confidence	0.039*	0.056*	0.061*	0.090*
city size in early life	0.059*	-0.033*	-0.076*	0.000
schooling	0.087*	0.052*	0.054*	0.058*
tenure	-0.039*	0.101*	-0.083*	0.060*
trade sector	-0.005	-0.021	0.042*	-0.035*
banking/insurance	0.001	0.027	0.048*	0.042*
real monthly income	0.090*	0.071*	0.105*	0.083*

Note: Only those correlations of risk and height that are significant at the 0.05 level (*) for men or women are presented.

Source: GSOEP 2004 and 2006.

The simple correlation coefficient (r) between height and attitude towards risk, calculated separately for men and women, is further evidence that tall people are less risk-averse than others: r is 0.059 for males and 0.062 for females.

Moreover, the results support some of the statements made in Section 2. Specially, self-confidence correlates positively with both height and risk. Moreover, tall boys tend to have more conflicts with their fathers but are also less risk-averse. Good school grades in German are positively associated with height and risky behaviour. Tall people, who as a rule benefit from a relatively good education and high income, tend to accept some degree of risk.

4. Methods and econometric results

4.1 Methods

First, the relationship between height and risk that take into consideration different control variables is examined by means of pooled regressions (Table 3). Robustness checks with ordered probit, median, instrumental variable and panel estimates follow (Table 4). Three ways of explaining attitudes towards risk are incorporated into the risk specification by means of different determinants: (i) characteristics from adolescence, (ii) characteristics from working life and (iii) general characteristics for adults. The estimates are first determined separately by sex, and only then are combined. Cluster-robust standard errors are presented, since among prime-age workers height is nearly time-invariant. The personal identification number is the group variable. Furthermore, ordered probit approaches may improve the estimates, since risk attitudes are measured by an ordinal rating scale. Because outliers determine attitudes towards risk in the border areas (Figure 1), we add a median estimator. LIML estimates are applied, because interdependencies between risk attitudes and wages are likely. We prefer LIML to 2SLS, following Staiger and Watson (1997), who demonstrate that the latter is strongly biased in contrast to the former.

Panel estimates account for time-invariant individual unobserved heterogeneity. We test, whether these effects exist – see Table 4, B-P tests. Since individual effects are usually correlated with regressors, not only random-effects but also pooled estimates are biased: the case if the omitted traits and skills in question are associated with height. Unfortunately, a fixed-effects approach is problematic here, since height and other variables are time-invariant. The coefficients of these variables cannot be identified, especially in this case, that of the crucial height variable. We adopt an alternative (Table 5), suggested by Hausman and Taylor (1981). The chief limitation of this approach is that it requires that one specify which of the regressors are correlated with the individual effect. The estimates react strongly to alternative assumptions. However, this general problem can be utilized as an advantage in our context. If additional traits and skills that influence height and risk are incorporated, the height effect should diminish and finally disappear. Therefore, under different specifications we can recognize for which pure and combined determinants, assumed as correlated with the individual effect, height is a good proxy. This is the case, if the added variables induce insignificance of the height effect.

4.2 The standard model and alternatives

The pooled estimates, calculated for men and women both separately and jointly, are presented in Table 3; characteristics associated with adolescence and adulthood are also incorporated. The first model is called the standard one (see Panel A and also Table A.2, column (1) for the details). Ramsey's reset approach does not reject the assumption of a correct specification. A test for differences in the height coefficients for men and women does not reject the null hypothesis of no differences (t=-0.55), although differences in attitudes towards risk, height and other characteristics exist across the two sexes.

The estimates of the height coefficient confirm the bivariate result that risk and height are positively associated. However, the coefficient is now substantially lower (men and women: β_{height}=0.0128) than it is in the simple regression, with height as the only regressor (0.0449). The height coefficient bundles effects of personal characteristics if these are omitted from the regression. Nevertheless, the height effect remains statistically significant. If the estimates are not limited to the age interval 25-55 but are extended to younger and older workers who have reported information on the same traits as those in the 25-55 group, we obtain the following coefficient for men and women (not in the tables): β_{height}=0.0106 (std.err=0.0038). The analogous coefficient of separate estimates of workers older than 55 years is): β_{height}=0.0016 (std.err=0.0113).

The described indirect mechanisms cannot completely explain the height-risk relationship. We can exclude the hypothesis that the height effect is transmitted exclusively via the state of health. Moreover, we do not confirm the hypothesis that characteristics developed in adolescence are primarily responsible for the positive association. If working-life characteristics such as income, self-employment and managerial activities are eliminated from the risk function, a greater statistical effect is revealed (men: β_{height}=0.0119 (std.err=0.0063); women: β_{height}=0.0169 (std.err=0.0069); men and women: β_{height}=0.0132 (std.err=0.0047); see Table 3, Panel B). Moreover, these determinants cannot completely explain the fact that tall people tend to be less risk-averse than shorter ones (Table 3, Panel C). Further unobserved effects are responsible for the statistically significant height-risk relationship.

If we consider the entire estimation in Table A.2, column (1), we can see that the effects of the control variables on risk are plausible and in accord with both the empirical literature and the hypotheses presented in Section 2, especially those of childhood determinants of risk aversion. The long shadow of early developments can be observed. Furthermore, workers in the banking and insurance sector tend to be less risk-averse than those in the public sector. The self-employed, managers, and high-income persons tend to be adventurous. The opposite is found for females and those with a bad health status. The nonlinear incorporation of an age variable seems convincing, although the age squared influence is insignificant. Those near the two ends of the age spectrum tend to be more willing to take risks than are those near the middle of it. Those who are about forty years of age are the most risk-averse.

Table 3: OLS estimates of height effects on risk attitudes

	men	women	men and women
	coef.	coef.	coef.
Panel A. Standard model[1]			
β	0.0110*	0.0161**	0.0128***
N	3,041	2,702	5,743
R^2	0.0811	0.0508	0.1066
RESET (p-value)	0.4929	0.2692	0.2502
B-P (p-value)	0.0046	0.5821	0.0101

Panel B. Regressors are only characteristics of adolescents[2]			
β	0.0119*	0.0169**	0.0132***
N	3,168	2,831	5,999
R^2	0.0352	0.0339	0.0746
RESET (p-value)	0.3261	0.2411	0.1454
B-P (p-value)	0.0093	0.6831	0.1205
Panel C. Regressors are only characteristics of adults[3]			
β	0.0130**	0.0184***	0.0150***
N	3,207	2,827	6,034
R^2	0.0659	0.0436	0.0968
RESET (p-value)	0.4128	0.1134	0.7384
B-P (p-value)	0.0709	0.6563	0.0564
Panel D. Self-confidence assumed as time-invariant variable[4]			
β	0.0124***	0.0123**	0.0121***
N	4,180	3,796	7,976
R^2	0.0868	0.0561	0.1098
RESET (p-value)	0.3628	0.4306	0.3251
B-P (p-value)	0.0057	0.8821	0.0226
Panel E. Imputed missing values[5]			
β	0.0124**	0.0145**	0.0129***
N	4,451	4,037	8,488
R^2	0.0805	0.0543	0.1049
RESET (p-value)	0.1320	0.2256	0.6127
B-P (p-value)	0.0138	0.8154	0.0999
Panel F. Year-specific height measurement[6]			
β	0.0108*	0.0164**	0.0129***
N	3,040	2,699	5,739
R^2	0.0811	0.0509	0.1067
RESET (p-value)	0.4873	0.2508	0.2658
B-P (p-value)	0.0052	0.6117	0.0111
Panel G. Height instrumented by four variables[7]			
β	0.0657***	0.0506*	0.0564***
N	3,040	2,699	5,739
R^2	0.0445	0.0343	0.0841
S-Y (statistic)[8]	7.07**	6.99**	7.80**
H (statistic)[9]	-1.93*	-1.89*	-2.66***

Notes: * significance at the 0.10 level; ** significance at the 0.05 level; *** significance at the 0.01 level; based on cluster-robust standard errors, RESET - Ramsey's regression specification error, B-P - Breusch-Pagan test for heteroscedasticity, S-Y - Stock-Yogo (2005) test for weak instruments, H - Hausman test for errors-in-variables.

[1] Control variables are the same as in Table A.2, where the complete estimation is presented for men and women combined.

[2] Only the first nine regressors of Table A.2 are accounted for.

[3] Only the adults' characteristics are incorporated; regressors 2-9 in Table A.2 are excluded.

[4] In the absence of information on self-confidence for 2008, it is assumed that self-confidence is time-invariant.

[5] Missing values are imputed on the basis of the complete subsample.

[6] In contrast to the other estimates, where height is measured as the average of the three years 2004, 2006, and 2008, year-specific height information is used.

[7] Height is instrumented by the following variables: mother's schooling measured by number of years, health status (=1 if very good, …,=5 if bad), native (dummy; =1 if yes), eastern Germany (dummy: =1 if the residence is in this part of Germany).
[8] H_0: weak instruments. The critical value is 5.44.
[9] H_0: no random errors in height.

Source: GSOEP, 2004, 2006 and 2008

Because in GSOEP information on self-confidence is captured in 2004 and 2006 but not in 2008, we limit the analysis to these two years. As a robustness check it is assumed that self-confidence is a time-invariant variable in order to extend the sample. The estimates of Panel D show that the coefficients are similar to those in Panel A but that the p-values are lower: a conventional effect if the sample size increases. The same pattern can be observed if missing values are imputed on the basis of complete subsamples (Panel E).

To supplement the average-height calculations, alternative measurements of height are employed. On the one hand, year-specific values are used. The findings presented in Panel F are very similar results to those presented in Panel A. On the other hand, individual erratic heights are methodically discussed as errors-in-variables. This problem is solved by instrumental-variables estimates.

The major difficulty in implementing the IV estimator is to find valid instruments. The search begins with an estimation of a height function (Table A.3). Following Schultz (2002) and in accord with the results in Table A.3, characteristics of educational attainment of the mother, health status, ethnic and regional information seem to be feasible instruments. In Table 3, Panel G, this approach is applied. A Hausman test rejects the null hypothesis of no errors-in-variables (men and women: t=-2.66). The null hypothesis of weak instruments, following Stock and Yogo (2005), cannot be accepted. The eigenvalue statistic 7.80 exceeds the critical value 5.44, where we are willing to tolerate distortion for a 5% Wald test based on the limited information maximum likelihood (liml) estimator.

The height coefficients in Panel G are substantially higher than those in Panel A. It seems to be a systematic result that IV estimates are larger than pooled estimates (Card 2001, Hryshko et al. 2011, Imbens/Angrist 1994, Schultz 2002). As an alternative, mother's schooling and nationality dummy (=1 if native) are used as instruments only because health status and eastern Germany are also strong direct determinants of risk behaviour (see column (1) of Table A.2). In this model the height coefficients are larger (e.g., men and women: β_{height}=0.0799 (std.err=0.0200) -- not in the tables) than in Table 3, Panel G. The disadvantage of this approach is that the Stock-Yogo test does not reject the null hypothesis of weak instruments.

In a further specification, the time series are extended to 1992-2008 under the assumption that height, risk attitude and self-confidence do not change within this period. The individual average values from the years, for which information exists, are used as imputed values for missing values. In this case the number of observations is N=18,177 and the height coefficient of men and women is β=0.0125 (std.err=0.0018) – not in the tables. There is only a slight deviation from Table 3, Panel A.

4.3 Alternative estimation methods

When we check for additional possible methodological problems (Table 4), we do not detect any remarkable deviations in the estimated effect of height on risk aversion presented in Table 3. The only exception is the ordered-probit approach; OLS and interval regression estimates are similar.

Table 4: Ordered probit, interval, quantile, liml, and random-effects estimation

	height coef.	robust std. err	tests: P-T p-value	B-P p-value	H p-value	S-Y statistic
ordered probit	0.0065***	0.0024	0.064			
interval	0.0131***	0.0042	0.161			
quantile (median)	0.0118***	0.0049	0.062			
liml	0.0118**	0.0048				84.62***
random effects	0.0126***	0.0048		0.000	0.001	

Note: N=5,743; * significance at the 0.10 level; ** significance at the 0.05 level; *** significance at the 0.01 level; cluster-robust standard errors (clusters in individuals). Pregibon-Tukey (P-T) - specification test, Breusch-Pagan (B-P) – test for individual effects, Hausman (H) - test for correlation between individual effects and regressors, Stock-Yogo (S-Y) - test for weak instruments. As instruments of real wage income the following are used: schooling, tenure, tenure^2, experience, experience^2 and eastern Germany. The null hypothesis – weak instruments – has to be rejected if the test statistic (84.62) exceeds the critical value (6.48). The control variables are the same as in Appendix Table A.2.

Source: GSOEP 2004 and 2006.

Following these methods, the height impact is also positively significant, and the P-T test (Pregibon 1980, Tukey 1949) reveals no problems with the specification. The importance of outliers is not as important as expected. The coefficient on height in the median regression model is not far from the OLS estimates. Furthermore, the LIML estimator does not influence our main result. The earnings function is specified according to the Mincer equation (schooling, tenure, tenure^2, experience, experience^2) supplemented by a dummy (d=1 if eastern Germany). These variables are no weak instruments, as the Stock-Yogo test demonstrates. The eigenvalue statistic 84.62 is larger than the critical value 6.46.

A panel estimator seems helpful, as the Breusch-Pagan test for individual effects demonstrates. The random-effects estimator has little effect on the height coefficient compared with the pooled estimator. However, since we find that the individual effects μ correlate with the regressors using the Hausman test, a fixed-effects estimator should be preferred. With this approach the time-invariant height effect cannot be identified. The Hausman-Taylor estimator overcomes this problem. Eighteen different assumptions are made in regard to the correlation between childhood determinants and the individual effect. The results of the estimated height coefficients are presented in Table 5.

The complete estimation of approaches (1), (11) and (18) can be found in Table A.2, columns (2)-(4). Following Manski (2011), the influence of interaction variables (IA) between genetic covariates and environmental factors is also tested – see lines (12)-(18). The environmental factors of city size in early life, no religion and religion other than Christianity, assumed as correlates with the individual effect μ, have evidently effects on the height coefficient. Nevertheless, the height effect remains significant – see line (1) of Table 5. If further variables are added as correlates with μ, the significant height effect on risk disappears in several cases – see lines (3) and (10)-(18) of Table 5. These are influences on risk which can be reproduced by the height effect. In other words, height is a good proxy of these bundles of adolescents' characteristics and interactions with environmental variables.

Table 5: Hausman-Taylor estimates of height effects on risk attitudes

Variables correlated with the individual effect	height coef.	std. err
(1) standard[1]	0.0372**	0.01662
(2) parents attend to children	0.0415**	0.0174
(3) schooling mother	0.0284	0.0193
(4) conflicts with father	0.0392**	0.0175
(5) sports activities as adolescent	0.0395*	0.0240
(6) music activities as adolescent	0.0333*	0.0170
(7) grade in subject German	0.0457**	0.0211
(8) grade in subject maths	0.0342*	0.0181
(9) self-confidence	0.0392**	0.0163
(10) = (2)+(3)+(4)	0.0313	0.0211
(11) = (5)+(6)+(7)	0.0477	0.0293
(12) = (2)+(5)+IA_((2),(5))	0.0436	0.0356
(13) = (3)+IA_(city,(3))	0.0242	0.0223
(14) = (4)+(5)+IA_((3),(5))	0.0366	0.0353
(15) = (4)+(5)+IA_(norel,(3))	0.0546	0.0375
(16) = (4)+(5)+IA_(othrel,(6))	0.0616	0.0589
(17) = (4)+(5)+IA_(city,(7))	0.0512	0.0360
(18) = (5)+(6)+IA_(city,(5))	0.0446	0.0393

Notes: N=5,743; * significance at the 0.10 level; ** significance at the 0.05 level; *** significance at the 0.01 level. Control variables are the same as in Table A.2. IA_() means interaction effect between the variables in parentheses.

[1] Assumption: city size in early life (city), no religion (norel), other religion than Christianity (othrel) correlate with the individual effect. In supplement to the assumption in (1) we hypothesize in (2)-(18) that the mentioned variables also correlate with the individual effect μ. E.g., this means in line (9) that we assume that self-confidence correlates with μ.

5. Conclusion

Descriptive results and pooled estimations support the hypothesis that tall people are relatively risk tolerant. Several indirect associations are excluded, e.g., health status and characteristics such as income, managerial activities and self-employment. Moreover, outliers are not responsible. Here is another hypothesis: Tall adolescents tend to think of themselves as leaders, and their peers tend to agree. As a result, they are obliged to make difficult decisions -- that is, to deal with risk -- earlier than their peers of average or below-average height. Consequently, risk appeals to them; self-confident, they tend to downplay the negative aspects of risk-taking, instead of being chiefly concerned with maintaining their status quo. This hypothesis is supported by empirical investigation. The behaviour of their parents and their own successes as reflected in school grades and group activities (sports and music, chiefly) affect the risk attribute in the same way. The height coefficient decreases if traits and skills are incorporated into the risk function. This phenomenon is better revealed by the Hausman-Taylor panel estimates than by pooled estimates. In the former case significant height effects on risk disappear if mother’s educational attainment is accounted for, and especially when several elements of the parents' behaviour and personal traits prevail simultaneously. Interaction effects between environmental conditions and individual abilities strengthen this result.

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Table A.1: Summary statistics (N=5,743)

Variable	Mean	Std. Dev.	Min	Max
risk (=0 risk averse)	4.9475	2.1074	0	10
height (in cm)	173.62	9.2567	139	204
parents attend to children (=1,very strong)	2.2527	0.7923	1	4
schooling mother (=0,no graduation)	1.5210	1.1387	0	5
conflicts with father (=1,very often)	3.6585	1.1617	1	6
sports activities as adolescent	0.6227	0.4848	0	1
music activities as adolescent	0.3183	0.4659	0	1
grade in subject German (=1,very good)	2.5490	0.9011	1	6
self-confidence (=1,low)	2.0642	0.6793	1	3
city - size in early life (=1,large)	2.7061	1.1662	1	4
eastern Germany	0.1880	0.3908	0	1
male	0.5295	0.4991	0	1
schooling (in years)	13.318	2.8601	7	18
age (in years)	42.052	8.3024	25	55
native	0.9711	0.1676	0	1
no religion	0.1297	0.3360	0	1
religion other than Christianity	0.0129	0.1128	0	1
health status (=1,very good)	2.3737	0.8273	1	5
manufacturing	0.3373	0.4728	0	1
trade sector	0.1077	0.3101	0	1
service sector	0.1716	0.3771	0	1
banking and insurance sector	0.0546	0.2273	0	1
public sector	0.3184	0.4659	0	1
farmer	0.0101	0.1000	0	1
self-employed	0.1012	0.3016	0	1
manager	0.2594	0.4382	0	1
tenure (in years)	10.683	9.1423	1	40
real monthly income (in Euro)	2523.1	2241.6	173	45000

Table A.2: OLS and Hausman-Taylor (H-T) estimates of height effects on risk attitudes (N=5,743)

Standard model	(1) OLS Coef.	(2) H-T_1 Coef.	(3) H-T_11 Coef.	(4) H-T_18 Coef.
height	0.0128***	0.0372**	0.0477	0.0446
parents attend to children	0.0533	-0.1223	-0.0458	-0.2543
schooling mother	0.0192	0.2977**	0.5274*	0.5698*
conflicts with father	-0.0594	-0.0078	0.0930	0.1102
sports activities as adolescent	0.3480***	0.5136***	7.7381**	37.4075**
music activities as adolescent	0.1221*	-0.0018	-2.9092	-8.0322
grade in subject German	-0.0501	-0.2203**	-1.3895	-0.3768
self-confidence	0.0926**	0.0736	0.0461	0.0413
city size in early life	-0.0545**	1.2113*	2.7862**	7.8751**
eastern Germany	0.2430***	0.2383	0.2416	0.2352
male	0.5899***	0.3550	-0.7881	-2.4139
schooling	-0.0135	0.0313	0.0114	0.1121
age	-0.0873**	-0.0392	-0.0494	-0.0716
age squared	0.0011	0.0007	0.0013	0.0017
native	-0.1108	2.2312***	2.2927***	2.1989**
no religion	0.0145	-0.1286	-1.7115	-2.0606
religion other than Christianity	0.2755	11.9460***	20.6049***	23.2217***
health status	-0.1372***	-0.1349***	-0.1264***	-0.1303***
trade sector	0.2094*	0.6095***	0.8191***	0.9850***
service sector	0.1001	0.2743	0.2724	0.2546
banking and insurance sector	0.1406	0.4488	0.1944	0.3816
public sector	-0.0936	0.1605	0.2166	0.4300
self-employed	0.8504***	0.6613***	0.4910**	0.4337*
farmer	-0.1356	-1.8093***	-2.3997***	-2.6154***
manager	0.1584*	0.0920	0.0644	0.0113
tenure	-0.0314**	-0.0041	0.0062	0.0109
real monthly income	0.1000***	0.0733***	0.0311	0.0212
interaction(city, sport)				-9.0381*
constant	4.067***	-7.5622	-14.8436*	-32.5221**

Table A.3: Height estimates (N=5,743)

Height	Coef.	Std. Err.	t	P>|t|
schooling mother	0.2973	0.0797	3.73	0.000
health status	-0.2323	0.1058	-2.20	0.028
eastern Germany	-1.3568	0.2471	-5.49	0.000
native	1.4572	0.5554	2.62	0.009
no religion	0.1127	0.2856	0.39	0.693
religion other than Christianity	-2.5017	0.8256	-3.03	0.002
self-confidence	0.3799	0.1297	2.93	0.003
city size in early life	-0.1359	0.0749	-1.81	0.070
grade in subject German	-0.0790	0.1031	-0.77	0.444
music activities as adolescent	0.4982	0.1902	2.62	0.009
sports activities as adolescent	0.6699	0.1819	3.68	0.000
parents attend to children	-0.1858	0.1112	-1.67	0.095
conflicts with father	-0.2100	0.0738	-2.84	0.004
male	13.0684	0.1791	72.96	0.000
constant	166.0618	0.8785	189.02	0.000
R^2	0.516			