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Health Human Capital, Height and Wages in China

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Abstract:

We estimate the returns to height using data from 12 Chinese cities. We present both ordinary least squares (OLS) and two-stage least squares (TSLS) estimates. In the latter height is instrumented using proxies for health human capital accumulated in childhood and adolescence, which influence adult height. The OLS estimates suggest that an additional centimetre of adult height is associated with wages being 1.1 per cent higher for males and 0.9 per cent higher for females. The TSLS estimates suggest each additional centimetre of adult height is associated with wages being 4.8 per cent higher for males and 10.8 per cent for females. The difference reflects the fact that the OLS estimates are predominantly determined by the random genetic factors influencing height, while the TSLS estimates also take into account returns from investment in health human capital during childhood and adolescence. These results imply considerable returns to investment in health human capital.

JEL Codes: I10, J15, J31, J71

Keywords: China, health, height, wages

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1. Introduction

Several studies exist which examine economic returns to non-economic characteristics. For example, some studies have examined the effects of beauty on wage earnings (Hamermesh & Biddle, 1994; Biddle & Hamermesh, 1998; Hamermesh & Parker, 2003). Other studies have examined the relationship between weight and wages (Cawley, 2004; Cawley *et al.*, 2005; Brunello & D'Hombres, 2007). The relationship between height and wages has also attracted the interest of researchers. Much anecdotal evidence exists which suggests that height is a determinant of economic success. In the early part of the twentieth century, Gowin (1915) documented that business executives were taller than "average men" in the United States. More recently, Gladwell (2005) conducted a survey of about one-half of the CEOs of Fortune 500 companies. He found that the average CEO is approximately three inches taller than the average American male. Persico *et al.* (2004) pointed out that United States Presidents tend to be taller than the American population and that in 10 of the 13 United States Presidential elections up to, and including, the election of George W. Bush, the taller candidate has won.

Several studies exist which examine the relationship between height and wages. Most of these studies document the existence of a wage-height premium. Most studies have examined the wage-height premium in developed countries using data from the United Kingdom, United States or Germany (see eg. Case & Paxson, 2008; Case *et al.*, 2009; Heineck, 2005, 2008; Hubler, 2006). There are relatively few studies of the wage-height premium in developing countries. There are studies for Brazil, Ghana, India and the Ivory Coast (Schultz, 2002, 2003; Dinda *et al.*, 2006). There are, however, no studies which have examined the relationship between height and wages

in China. Related studies for China are Morgan (2000, 2004) which examined the relationship between height and living standards in China in the market reform period (1979-1995) and the late nineteenth and early twentieth centuries respectively. Both studies found evidence of at least a modest positive correlation between height and living standards. In this study, we examine the effect of height on wages in China using data from the China Urban Labour Survey, which was collected in 2005.

A limitation of some of extant literature is that it uses ordinary least squares (OLS) to estimate the effect of height on wages (see eg. Dinda et al., 2006; Heineck, 2008). As such, little attention has been given to the role of investment in health human capital during childhood and adolescence on influencing height and productivity in adulthood. Silventoinen (2003) concluded that in developed countries, approximately 80 per cent of the variation in body height is genetic and 20 per cent is due to environmental factors. In developing countries in which environmental conditions are not as good, the returns to investment in health and nutrition can be expected to be higher, increasing the relative importance of environmental factors. In a study of the wage-height premium in Brazil, Ghana and the United States, Schultz (2002) found that OLS estimates underestimate the effect of height on wages because OLS accounts for the effects of genetic variation in height on wages, but does not capture the human capital returns of differences in health and nutritional intake during childhood. Schultz (2002) found that returns from health human capital in the United States was about one-third the comparable figure in Brazil and Ghana, reflecting diminishing returns to health human capital in developed countries, relative to low-income countries.

In addition to presenting OLS estimates, we present two-stage least squares (TSLS) estimates in which instrumental variables (IV) are used to proxy environmental

factors influencing height during childhood and the availability of health care at the onset of the adolescent growth phase. Consistent with Schultz's (2002) findings for Brazil and Ghana, we conclude that the human capital productivity effect of height estimated using TSLS implies a substantially larger human capital wages effect of height than the OLS estimates. Our results suggest that the OLS estimates of height effects on wages are dominated by genetic variation in height and, as such, appear to understate substantially the human capital returns of good health care and nutritional input in childhood, both of which increase stature later in life.

2. Relationship between height and wages

Several theories have been proposed to explain why taller people are paid more. In developing countries the wage-height premium has been attributed to taller people being more productive than shorter people (Haddad & Bouis, 1995; Steckel, 1995; Strauss & Thomas, 1998). Komlos and Bauer (2003) emphasized that height is positively correlated with income in that children from higher income households consume better nutrients and have better access to health care in childhood and adolescence, which has a positive effect on height in adulthood. If taller people are healthier and stronger, their productivity should be higher than shorter people, in particular in physically demanding jobs, which are prevalent in developing countries.

For developed countries, researchers have explained the wage-height premium on the basis that taller people have higher self esteem (Wilson, 1968; Young & French, 1996) or shorter people face labour-market discrimination (Loh, 1993; Magnusson *et al.*, 2006). According to interpersonal dominance theory in social psychology, short people are stigmatized by others, perceived less positively and, thus, placed at a disadvantage in negotiating with others (Martel & Biller, 1987). Self-fulfilling

prophecies can reinforce these effects. Hubler (2006) argued that short children who believe that they will confront disadvantages in the future will invest less in human capital because subjectively their returns are lower. Evolutionary selection might also be important in explaining the advantages of being taller. As the human species evolved, to the extent that size provided an advantage in competing for resources, a preference for associating with taller people may have evolved (Persico *et al.*, 2004). Along the same lines, Nettle (2002) argued that taller men find it easier to attract mates, while Harper (2000) found that marriage rates are lower among shorter people.

Persico *et al.* (2004) argued that boys who are taller during adolescence are more apt to participate in social activities that build productive human capital. Thus, their premise is that adolescent experiences are responsible for the higher earnings observed for taller men during adulthood, so that those who are shorter as teenagers have lower earnings, even if their heights "catch up" by adulthood. Case and Paxson (2008) took a different tack and argued that height is positively correlated with cognitive ability. Using data from the United Kingdom and United States, these authors found that taller children have higher average cognitive test scores and these test scores explain a large portion of the wage-height premium later in life.

3. Existing empirical studies

Several studies have examined the wage-height premium in the United Kingdom using data from Britain's National Child Development Survey (NCDS). Sargent and Blanchflower (1994) estimated the effect on wages at age 23 of height measures at various ages, for the NCDS cohort born in 1958. Their findings were that an additional 10 centimetres in height at age 16 was associated with a 2.7 per cent increase in wages at age 23. Persico *et al.* (2004) found that among white British men,

every additional inch of adult height is associated with a 2.2 per cent increase in wages, also employing NCDS data. Case and Paxson (2008) found that for females each additional inch of height was associated with a 2.3 per cent increase in wages and for males the comparable figure was 1.9 per cent with NCDS data. Heineck (2008) examined the wage-height premium in the United Kingdom using data from Wave 14 of the British Household Panel Survey (BHPS) collected in 2004. In contrast to other studies for the United Kingdom, Heineck (2008) did not find evidence of a wage-height premium. Heineck's (2008) results are criticized by Case *et al.* (2009) who re-examined the wage-height premium using data from nine waves of BHPS data – Wave 7 (1997) to Wave 15 (2005). These authors do find support for a wage-height premium, which they argue can be explained by taller people having higher educational attainment and sorting into industries with higher wages.

Persico *et al.* (2004) examined the wage-height premium in the United States using data from the National Longitudinal Survey of Youth (NLSY) and found that among adult white men in the United States, each additional inch of height as an adult is associated with a 1.8 per cent increase in wages. Case and Paxson (2008) considered the wage-height premium in the United States using the Panel Study of Income Dynamics. Their finding was that each additional inch of adult height for males results in a 1.9 per cent increase in wages, while each additional inch of adult height for females generates a 1.2 per cent increase in height. Behrman and Rosenzweig (2001) used data on the variation in height between female monozygotic twins from the Minnesota Twin Registry, assembled between 1983 and 1990 and found that each additional inch of height is associated with a 3.5-5.5 per cent increase in wages.

In addition to the United Kingdom and United States, the wage-height premium has been studied in Germany. Using German Socio-economic Panel (GSOEP) data from 1991 to 2002, Heineck (2005) found that an additional 10 centimetres of adult height for Western German males, generated an additional 4 per cent in wages. Hubler (2006) examined the wage-height premium in Germany using GSEOP data over the period 1985 and 2004 and found a non-linear relationship between height and wages.

In comparison with studies for developed countries, there are relatively few studies for developing countries. Dinda *et al.* (2006) examined the height-wage premium among Indian coal miners. Their findings suggest that workers who are above-average height earn between 9 per cent and 17 per cent more than their shorter counterparts. The most thorough studies for developing countries are by Schultz (2002, 2003) who used a range of IVs to control for the effect on adult height of access to health care and environmental surroundings during childhood and adolescence.

Schultz (2002) examined the wage-height premium in Ghana in 1987-1989 using a Living Standard Survey and the wage-height premium in Brazil in 1989 using a Health and Nutrition Survey. Schultz (2002) found that employing OLS, an additional centimetre of height resulted in a 1.5 per cent increase in wages for males and a 1.7 per cent increase in wages for females in Ghana and a 1.4 per cent increase in wages for males and a 1.7 per cent increase in wages for females in Brazil. However, when Schultz used IVs for height to control for environmental conditions during childhood, the returns to being taller for both males and females were generally five to ten times higher. Schultz (2003) reached similar conclusions using data from Ghana and the Ivory Coast. Schultz (2002, 2003) concluded that the OLS estimates underestimate

the effect of height on wages because OLS accounts for the effects of genetic variation in height on wages, but does not capture the human capital returns of investing in better environmental surroundings and health care during childhood.

4. Data

The data we use in this paper comes from the China Urban Labour Survey, which was administered by the Institute of Population and Labour Economics at the Chinese Academy of Social Sciences in conjunction with provincial and municipal offices of the National Bureau of Statistics of China. The survey was administered in five provincial capital cities (Shanghai, Wuhan, Shenyang, Fuzhou, Xi'an) and seven municipal cities (Wuxi, Yichang, Benxi, Zhuhai, Shenzhen, Baoji and Daqing) in May 2005. Using a proportional population sampling approach, 500 urban local households and 500 migrant households were investigated in each of the five provincial cities, and 400 migrant households were investigated in each of the seven municipal cities. In each household, all family members who were aged 16 or above and who were no longer in school were interviewed individually. In total about 8,000 households and 20,000 individuals participated in the survey. Of these, just over half or 11,512 provided self-reported information on height and wages.

Table 1 Descriptive Statistics

	All	Male	Female
Hourly wage (RMB)	5.82	6.56	4.84
Height in Centimetres	166.40	170.93	160.43
Height Distribution (%)			
Less Than 160 Centimetres	16.01	1.21	35.51
160-164 Centimetres	22.68	6.83	43.53
165-169 Centimetres	19.22	20.89	17.03
170-175 Centimetres	33.21	55.64	3.67
More Than 175 Centimetres	8.89	15.43	0.26
Years of Schooling	9.89	10.12	9.59
Years of Post School Experience	19.45	20.10	18.60
Male (%)	56.86	-	-
Married (%)	83.15	83.65	82.82
Health (%)			

Ordinary Health	1.36	1.24	1.53
Good Health	13.26	12.63	14.09
Very Good Health	85.37	86.13	84.38
Urban Registration (%)	43.57	43.91	43.08
Communist Party Member (%)	6.76	8.74	4.13
Occupation (%)			
Professional/Technician	13.08	12.59	13.72
Producer/Transporter	7.10	7.22	6.94
Service Worker	60.80	55.48	67.68
Equipment Operators	19.02	24.71	11.66
Ownership Form of Employer (%)			
Government Agency	9.07	8.59	9.67
State-Owned Enterprise	23.80	16.11	12.90
Private Enterprise	16.99	17.52	16.30
Foreign/Taiwan/HK JV	3.06	3.05	3.08
Small Business	53.90	52.61	55.65
Others	2.24	2.13	2.40
Industry (%)			
Manufacturing Industry	11.58	12.57	10.27
Construction Industry	4.19	6.03	1.78
Transportation/Communication	4.84	7.36	1.52
Wholesale/Retail/Catering	37.16	33.29	42.28
Social Service	21.65	19.35	24.71
Government/Institution	2.56	2.67	2.41
Others	18.02	18.73	17.04
City (%)			
Shanghai	13.38	13.20	13.62
Wuhan	12.56	12.42	12.73
Shenyang	11.21	11.35	11.00
Fuzhou	13.34	12.91	13.90
Xi’an	11.82	11.81	11.85
Daqing	4.90	5.20	4.51
Wuxi	5.41	5.72	5.02
Yingchang	5.00	4.72	5.38
Benxi	5.33	5.97	4.49
Zhuhai	4.82	4.72	4.96
Baoji	5.53	5.06	6.16
Shenzhen	6.68	6.91	6.39
Number of Observations	11512	6546	4966

Table 2 Hourly Wages and Height (RMB)

	All	Male	Female
Less Than 160 Centimetres	4.41	4.74	4.40
160-164 Centimetres	4.99	5.09	4.97
165-169 Centimetres	5.62	5.93	5.13
170-175 Centimetres	6.59	6.61	6.09
More Than 175 Centimetres	8.02	8.03	7.44
Total	5.82	6.56	4.84

Table 1 provides descriptive statistics for the full sample as well as for males and females. For the full sample, the hourly wage rate was 5.82 RMB and the average height was 166.4 centimetres. The hourly wage rate and average height of males was higher than females. In total, 56.86 per cent of the population was male, 83.15 per cent were married, 43.57 per cent had an urban household registration and 6.76 per cent were members of the Communist Party. The majority of the sample worked as service workers in wholesale/retail/catering or social services. Similarly, a majority of respondents were employed in small business. Table 2 shows the hourly wage rate according to height. For the sample as a whole and for males and females considered separately, there is a positive relationship between height and hourly wage rates.

5. Empirical specification

We employ a Mincer (1974) earnings function in which the log of hourly wage earnings (measured in RMB) is regressed on years of schooling, post-school experience, post-school experience squared, height in centimetres and a series of control variables. The specific control variables that we employ are gender, marital status, self-reported health, household registration status, whether the individual is a member of the Communist Party and dummy variables for the individual's occupation, the industry in which the individual works, ownership form of the firm for which the individual works and the city in which the individual lives.

We expect a positive relationship between height and wages. Based on human capital theory, wages are determined by investment in human capital. Schooling and on-the-job training are major types of investment. We expect a positive relationship between years of schooling and wages. Post-school experience is a proxy for job-training investment. We expect the wage-experience profile to follow a parabolic shape in

experience. Wages will initially increase, reach their peak when human capital is at a maximum and eventually fall as human capital depreciation dominates accumulation.

Of the control variables we expect that individuals with better self-reported health will have higher productivity and earn higher wages. We expect that individuals with urban household registration will earn more, given that previous studies report evidence of labour market discrimination against migrants, who typically have a non-urban household registration (see eg. Liu, 2005). Finally, we expect that being a member of the Communist Party will command a wage premium. Previous studies have found that Communist Party members earn more than non-Communist Party members in the Chinese urban labour market (see eg. Appleton *et al.*, 2002; Li, 2003; Bishop & Liu, 2005). There are two possible explanations. One is that a wage premium for Communist Party members could simply be economic rents for a privileged group. A second explanation is that the Party can be viewed in much the same fashion as a college in Western countries, as a screen for talent, motivation and other personal characteristics correlated with productivity (Bishop & Liu, 2005). The expected sign on marital status is *ex ante* unclear. Individuals who are married might, in a time allocation sense, have less time available for work tasks because of family commitments. However, marriage can also generate efficiencies through specialisation and the division of labour where tasks are divided between spouses, freeing up time (Baker & Jacobsen, 2007). There are also several studies showing that individuals who are married tend to be healthier (see eg. Gardner & Oswald, 2004; Gerdtham & Johanneson, 2004; Frijters *et al.*, 2005). Thus, married individuals might have better health and more energy and, as such, have higher productivity.

Errors in the measurement of height can lead to bias in OLS estimates, which IV estimation methods should correct. Thus, in addition to OLS, we also present TSLS estimates in which we instrument for height. Hubler (2006) instruments for height using self-reported health status during adulthood. However, this is not very satisfactory, given that adult height is determined by health care and nutritional intake in childhood and adolescence (Case & Paxson, 2008; Schultz, 2002). Thus, it is desirable that IVs proxying healthcare and nutritional intake should be measured in the residential location and time period in which health inputs have their strongest effect on adult height. This corresponds to the locale, and the point in time, in which the respondent was a child or adolescent (Schultz, 2002, 2003).

We use two instruments. The first is the number of doctors per capita in the province in which the respondent was born, when the respondent was aged 12. The data source is NBS (2000). Schultz (2002) reported that the adolescent growth spurt begins at age 12. Beard and Blaser (2002) reported that girls tend to reach peak height velocity at 12 and boys at 14. Thus, doctors per capita at age 12 in the province the respondent lived is a proxy for health care at the onset of the adolescent growth phase.

The second instrument we use is an index of the location of the primary school attended by the respondent in which 1=village, 2=small town, 3=county-level town and 4=city. The location of the primary school attended by the respondent is used to proxy whether the respondent lived in a rural village, small town, large town or city as a child. There is much literature suggesting that environmental surroundings in childhood are related to adult height (see Beard & Blaser, 2002 and references cited there in). The most important environmental factors influencing height are thought to

be the quality of the uterine environment and, in childhood, nutritional status and the disease environment (Case & Paxson, 2008). The location index is a good proxy for these environmental factors for three reasons. First, access to health care is lower in villages and rural towns than county-level towns and cities in China (Blumenthal & Hsiao, 2005; Meng *et al.*, 2000; World Bank, 1997). Second, the quality of prenatal care is lower in rural villages and small country towns than in county-level and city hospitals in China (Anson, 2004; Wu *et al.*, 2008). Third, the nutritional intake of children, and their mothers during pregnancy, in rural villages is lower than in county-level towns and cities in China (Chang *et al* 1994; Chen 2000).

6. Results

The OLS and TSLS results for males and females are reported in Table 3. The OLS results suggest that an additional centimetre of adult height is associated with wages being 1.1 per cent higher for males and 0.9 per cent higher for females. These results are similar, although slightly lower, than findings using OLS for other developing countries, such as Schultz's (2002) findings for the wage-height premium in Brazil and Ghana. Turning to the TSLS estimates, each additional centimetre of adult height is associated with wages being, 4.8 per cent higher for males and 10.8 per cent for females. Thus, similar to Schultz (2002, 2003), the TSLS estimates of the wage-height premium are several times larger than the OLS estimates. The TSLS estimates are similar in magnitude to the wage-height premium estimated by Schultz (2002, 2003) for Brazil, Ghana and the Ivory Coast. An explanation for this finding is that the OLS estimates are predominantly determined by the random genetic factors underlying stature, while the TSLS estimates also take into account returns from investment in health human capital during childhood and adolescence (Schultz, 2002).

Table 3 Estimates of Log Hourly Wage Functions

	Male		Female	
	OLS	TSLS	OLS	TSLS
Height in Centimetres	0.0114***	0.0481**	0.0089***	0.1073***
	(0.0017)	(0.0210)	(0.0019)	(0.0406)
Years of Schooling	0.0435***	0.0392***	0.0389***	0.0332***
	(0.0038)	(0.0045)	(0.0040)	(0.0062)
Post School Experience	0.0020	0.0062	-0.0001	0.0045
	(0.0033)	(0.0043)	(0.0036)	(0.0055)
Experience Squared	-0.0002***	-0.0002***	-0.0001	-0.0002*
	(0.0001)	(0.0001)	(0.0001)	(0.0001)
Married	0.1278***	0.1165***	-0.0216	0.0338
	(0.0311)	(0.0344)	(0.0347)	(0.0504)
Health (Ordinary=1)				
Good Health	0.1719***	0.1215	0.0725	-0.0291
	(0.0757)	(0.0981)	(0.0812)	(0.1128)
Very Good Health	0.2623***	0.2010**	0.1297*	0.0010
	(0.0734)	(0.1006)	(0.0789)	(0.1135)
Urban Registration	0.1737***	0.1367***	0.1790***	0.1067**
	(0.0220)	(0.0388)	(0.0240)	(0.0431)
Communist Party Member	0.0880***	0.0807**	0.0153	0.0169
	(0.0317)	(0.0346)	(0.0483)	(0.0626)
Occupation (Professional/Technician=1)				
Producer/Transporter	-0.4022***	-0.4242***	-0.2643***	-0.2979***
	(0.0386)	(0.0435)	(0.0421)	(0.0568)
Service Worker	-0.4526***	-0.4385***	-0.3871***	-0.3944***
	(0.0285)	(0.0314)	(0.0302)	(0.0406)
Equipment Operators	-0.3658***	-0.3409***	-0.3221***	-0.2508***
	(0.0305)	(0.0329)	(0.0405)	(0.0561)
Ownership Form of Employer (Government Agency=1)				
State-Owned Enterprise	0.0588	0.0413	0.0563	0.0376
	(0.0389)	(0.0415)	(0.0419)	(0.0545)
Private Enterprise	0.0329	0.0170	-0.0224	-0.0333
	(0.0394)	(0.0434)	(0.0419)	(0.0545)
Foreign/Taiwan/HK JV	0.3152***	0.2955***	0.2453***	0.2012**
	(0.0620)	(0.0693)	(0.0657)	(0.0898)
Small Business	-0.0863**	-0.0904**	-0.1123***	-0.0870*
	(0.0383)	(0.0410)	(0.0397)	(0.0541)
Others	-0.2772***	-0.3289***	-0.1852***	-0.1272
	(0.0655)	(0.0713)	(0.0671)	(0.0912)
Industry (Manufacturing Industry=1)				
Construction Industry	0.1434	0.1618***	0.3052***	0.4089***
	(0.0431)	(0.0463)	(0.0748)	(0.1066)
Transportation/Communication	0.1617***	0.1409***	0.1247*	0.1079
	(0.0384)	(0.0471)	(0.0767)	(0.1014)
Wholesale/Retail/Catering	-0.1034***	-0.1159***	-0.0158	-0.0189
	(0.0336)	(0.0364)	(0.0405)	(0.0535)

Social Service	-0.1826***	-0.1775***	-0.1142***	-0.0632
	(0.0339)	(0.0366)	(0.0402)	(0.0550)
Government/Institution	0.0996	0.1254*	0.0817	0.0961
	(0.0647)	(0.0682)	(0.0744)	(0.0956)
Others	0.0451	0.0717**	0.1033**	0.1447***
	(0.0328)	(0.0352)	(0.0413)	(0.0551)
City	Controlled	controlled	controlled	controlled
Constant	-0.4671	-6.7066*	0.1064	-15.6474**
	(0.3002)	(3.5433)	(.3319)	(6.5011)
Number of Observations	5574	5028	4339	3838
F(β=0)	134.78***	116.88***	107.02***	60.80***
R-squared	0.4527	0.4169	0.4581	0.1338
Hausman t test of exogeneity of height (Prob>t)	-	-2.77	-	-5.01
		(0.0060)		(0.0001)

Notes: Figures in parenthesis are standard errors. ***(**)(*) denotes statistical significance at 1%(5%)(10%). In the TSLS regressions an index of the location of the primary school attended by the respondent and the number of doctors per capita in the province in which the respondent was born at age 12 are used as instrumental variables for height.

This result suggests that there are considerable returns to investment in health human capital. In this respect, as part of the Tenth and Eleventh Five Year Plans the Chinese government has committed to universal access to basic health services and a strategy setting forth a vision for "Healthy China 2020" is being developed (World Bank, 2008). Improving maternal and child health care, particularly in poor rural areas, is an important component of this overall strategy. In the Tenth Five-Year Plan the goal of eliminating tetanus among newborns was launched. Important initiatives in the Eleventh Five-Year Plan are a Medical Assistance Program, which aims to assist vulnerable groups in rural areas with medical expenses, and a rural health service delivery system, the aim of which is to improve access to health care in township health centres and village clinics. Free hospital delivery for all pregnant women is being discussed (World Bank, 2008). However, implementation of health care services reform under the Eleventh Five Year Plan is progressing unevenly. Serious challenges to rural water and sanitation and birth defect prevention remain.

Similar to Schultz's (2002, 2003) findings the wage-height premium from the TSLS estimates is higher for females than males. Nutritional intake and health care available to girls is lower than boys in China. Sen (1990) considered China one of the Asian countries in which pro-son bias is so strong that it manifests itself in the phenomenon of ''missing women''. Alternatively, lower nutritional intake and healthcare may reflect differences in the perceived productivity of investments in boys and girls. Rosenzweig and Schultz (1982) make this argument with respect to India. Their argument was that as girls were less likely to find employment, poor Indian households may have invested less in their health and nutrition, leading ultimately to excess female mortality. In either case these arguments suggest that for the relatively few girls who do receive more nutrition and health care the returns to height during adulthood are much higher. Note that Schultz (2003) proposes a similar argument to this in explaining why the wage-height premium is stronger in Ghana than the Ivory Coast. He suggests (at p.346) that the reason for this finding is that "malnutrition among children is more of a binding constraint on adult height in Ghana".

The results for the other variables are generally consistent with expectations. We find that based on the TSLS estimates, an additional year of schooling results in a 3.9 percent increase in wages for males and a 3.3 per cent increase in wages for females. This finding is similar to several previous studies for China (Byron & Manaloto, 1990; Maurer-Fazio, 1999; Liu, 1998). As predicted by human capital theory, the wage-experience profile follows a parabolic shape, although the coefficient on experience is statistically insignificant. The wage peak occurs at 16 years of experience for males and 12 years of experience for females. Thus, if an individual starts working at age 22, male wages peak at age 38 and female wages peak at age 34. The estimated peak is lower than that found in previous studies. For example, Li

(2003) found that male wages peak at age 48 and female wages peak at age 43, while Liu (1998) and Johnson and Chow (1997) found the peak in experience to be even later in workers' careers. Males with an urban household registration earn 13.7 per cent higher than males with a non-urban household registration, while the comparable figure for females is 10.7 per cent. This figure is lower than that reported in Liu (2005) who found that having an urban household registration raised an individual's income by 26 per cent. We find that males who are members of the Communist Party receive 8.1 per cent higher wages, while the coefficient on the Party variable is insignificant in the regression for females. This finding is almost identical to that reported in Li (2003) who found that Communist Party membership increased returns for men by 8.5 per cent, but was statistically insignificant for females. Finally, we find that married males warn more, while for females marital status is insignificant.

7. Conclusion

There is an emerging literature that estimates the wage-height premium and offers explanations for its existence. Most of these studies, though, have used data from developed countries and few have considered the role of health human capital. This paper has examined the productive returns to health human capital, which is associated with adult height, when the returns to health human capital are identified from instruments for access to health care and environmental surroundings during childhood. The TSLS estimates of the effect of height on wages are much larger than the OLS estimates. Given that the OLS estimates of the effect of height on wages can be considered to reflect genetic differences in height, the difference between the OLS and TSLS estimates suggests a considerable return to health human capital. The policy implications of the findings are that investment in health human capital in the form of enhanced nutrition and health care during one's childhood and adolescence

has the potential to considerably increase one's productivity during adulthood. This result is consistent with limited evidence for other developing countries.

As Case and Paxson (2008) noted, future research is needed to identify whether there are specific windows of time in which health and nutrition interventions would have the largest impact on adult height, which is rewarded later in life. To conduct such analysis, longitudinal studies that follow cohorts from poor and wealthier settings over time would be an advantage. While such longitudinal studies exist for some developed countries, such data is scant for developing countries. If data collection of this sort is considered too ambitious, large household surveys of workers that collected information on height, as well as other physical characteristics such as weight, plus features of the respondent's childhood home would be helpful. As Schultz (2003) noted, this would facilitate routinely estimating extended wage equations in which height is treated as an endogenous variable, which, in turn, would become a more reliable tool for setting human resource priorities.

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