Height and Cognition at Work
Labor market performance in a low income setting

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Abstract

Evidence indicates that taller workers earn more, particularly in lower income settings. It is possible that stature is a marker of strength which is rewarded in the labor market. It is also possible that height is a proxy for other dimensions of health and human capital including cognition, early life human capital investments and other family background characteristics. As such, height may be an informative signal of worker quality to an employer. This paper evaluates the relative importance of each of these potential mechanisms in a unified framework that treats human capital as multidimensional. We draw on 12 waves of a unique longitudinal survey collected in Central Java, Indonesia that includes measured height, multiple markers of cognition, a set of biomarkers of physical health and extremely rich information on labor market outcomes including sectoral choice, occupation, hours, tenure, self-employed profits, and wages. We document a relationship between height and earnings after controlling cognition, other dimensions of health, family background, education, and occupational choice. The findings are robust for both formal wage work and informal self-employment. We conclude that height is rewarded in the labor market and establish that the height premium is not explained by the rich array of observed indicators of human capital. The results suggest height is appropriately treated as one dimension of a multi-dimensional array of human capital.

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1. Introduction – Human Capital and Labor Market Performance

Evidence indicates that taller workers earn more, particularly in lower income settings.[1] Several explanations have been suggested for the height premium in earnings. Height may be a marker of strength that translates into greater productivity in more physically demanding work. Height is also likely to reflect a plethora of investments in human capital that are correlated with other traits that are rewarded in the labor market (e.g. Strauss and Thomas, 2008). Specifically, since adult stature is largely pre-determined by age 2 or 3 (Martorell and Habicht, 1986), it is reasonable to treat height as a marker of early childhood investments including nutrition and investments in health during pregnancy and the first few years of life.

Thinking about height as one dimension of human capital that captures very early investments suggests an alternative interpretation of the height premium in the labor market: height is likely to be correlated with other early childhood, and possibly later life, human capital investments, many of which are difficult to measure. In this framework, height is likely to be correlated with schooling attainment (Case et al., 2009), cognition (Case and Paxson, 2008), non-cognitive traits such as ambition and confidence (Persico et al., 2004) as well as an array of other markers of health and human capital. Moreover, part of height is genetic, so it almost surely captures the role of family background and investments made across multiple generations. It is also possible that height, per se, is not rewarded in the labor market but is used as a signal of the quality of a worker by employers.

This paper explores each of these potential explanations for the association between height and labor market outcomes. Rather than pin our hopes on one of the explanations, we treat height as one measure of human capital investments that are likely to be correlated with many others. By treating height in this unified way, we attempt to measure the relative contributions of the different

[1] See, among others: Behrman et al. (2009), Case and Paxson (2008, 2008b), Gao and Smyth (2010), Lundborg et al. (2009), Persico et al. (2004), Thomas and Strauss (1997), and Vogl (2012).

explanations in a single study setting – rural Central Java. We draw on rich longitudinal survey data that was designed to provide the evidence necessary to address this question. We focus on the role human capital plays in predicting success in the formal and informal labor markets, highlighting height, cognition, education, health and their interactions. Relying on several key features of the survey, this work complements and extends the literature in a number of ways. In addition to contributing to a better understanding of the complex relationships between different indicators of human capital and labor market performance, this research provides important insights into the functioning of labor markets in a low-income setting.

2. The Work and Iron Status Evaluation

The Work and Iron Status Evaluation (WISE), a large-scale longitudinal survey conducted in Central Java, Indonesia, is designed to collect detailed labor and human capital data necessary to examine the relationship between height, cognition, education, health and labor market outcomes. After a listing survey in late 2001, a population-representative sample of households living in Purworejo kabupaten were interviewed every four months beginning in 2002 and continuing through 2005. Longer-term follow-ups were conducted five and seven years after the start of the survey in 2007 and 2009. All waves of the survey are included in this study.

As the analysis relies on following individuals over time, it is imperative that selective attrition does not contaminate inferences. Attrition is extremely low in WISE: ninety-four percent of households from the 2002 baseline were re-interviewed seven years later in the 2009 wave (see Thomas et al., 2011 for a further discussion of tracking and attrition).

We focus on 5,400 men between the ages of 25 and 65, comprising 38,000 person-wave observations.[2] The number of men included in each wave grows over time by the design of the

[2] See Appendix A for a discussion of selection into the sample of those who report earnings and for comparable results for females to those presented in later sections for males. We focus here on the 93% of 25-65 year old men who report earnings data in the survey. Selection into this group does not appear to drive the results.

tracking rule, as every individual interviewed at baseline is eligible to be followed and interviewed throughout the study. When an individual moves out of an original WISE household and forms a new household, the new household and all of its members become part of the study sample thereafter.

Labor market outcomes

The survey collected detailed information from every household member who was working on labor market outcomes including work status, employer and occupation, tenure, nature of work, and earnings in each job. The later is particularly important in the study setting where approximately three quarters of baseline households engage in farming and work at least part of the time in self employment. Hourly earnings from wage work are calculated as total earnings from work in the market sector during the previous four months divided by hours worked during the same time period. Similarly, hourly earnings from self-employment are calculated as net profits from self-employment during the prior four months divided by the number of hours worked during that time. We selected a four month period because the growing season for the primary crop in the area, rice, is four months.[3] Total hourly earnings is the sum of all earnings from all job divided by the number of hours worked in all jobs during the previous four months.

Table 1 reports means and standard errors of variables of interest. The first rows of Table 1 summarize total hourly earnings, hourly earnings from wage work and hourly earnings from self-employment. All values are reported in Rp10,000 per hour (approximately 1 USD at the time of the survey).

As the distinction between formal sector wage work and informal self-employment is an important component of the analysis, Table 1 further divides the respondents into those who work in one or both sectors. Column 1 includes all workers. Those who only ever work in the formal

[3] We find that self-reported profits for the prior four months matches very closely to profits calculated from information collected at the business enterprise level on income and expenditure.

sector are included in Column 2, those who only ever work in self-employment are in Column 3 and those who we observe working in both sectors at some time during the study period are included in Column 4. The latter make up over half the respondents. As farm plots are quite small on average, it is common for individuals to supplement self-employed farm earnings with off-farm labor.

Height

In addition to detailed information about labor market behaviors, the measurement of height is central for this research. Although adult stature is fixed until older ages when individuals begin to shrink, we measured height in every survey wave to assures we are able to mitigate problems that arise with measurement error. We use a trimmed mean of all measures of height, excluding those measures that deviate from the trimmed mean by more than 0.5 cm. The average individual in the sample is 161cm, with those who only work for wages slightly taller than those who are self-employed or work in both sectors. This suggests that height is correlated with sectoral choice.

Measures of cognition

WISE assesses cognitive achievement using four different instruments. Each assessment was repeated to mitigate the impact of measurement error and is designed to measure a different axis of cognition.

The first is the Raven's Colored Progressive Matrices pattern recognition test. These matrices were administered three times to individuals over the age of 15. The pattern recognition test is commonly used as a marker of abstract reasoning and intelligence (Raven, 2000), and has been increasingly adopted in household surveys in developing settings (e.g. Barham et al., 2013).

Along with the Raven's Test, WISE included an adaptation of the Philippines National Intelligence Test developed by Guthrie et al. (1977). The test is similar to the Columbia Mental Maturity Scale, and designed to assess fluid intelligence. Respondents are shown a series of 5 images

per question and asked to discriminate between the differences, see Figure 1 for a sample question. A similar test is included in the Cebu Longitudinal Health and Nutrition Survey (e.g. Mendez and Adair, 1999; Glewwe and King, 2001; Daniels and Adair, 2005). The test was originally designed to be culturally appropriate to an area similar to the WISE study site. As such, it uses images of local objects and activities of daily life and is more reflective of experience, logical thinking, and the ability to recognize real world patterns than the abstract Raven's matrices. Several population-based surveys have included the Raven's assessments while a smaller number have sought to measure fluid intelligence. The combination of both assessments is an important advantage of the WISE data.

Respondent memory was assessed using immediate and delayed word recall tests. Respondents are read a list of 10 common nouns and asked to immediately repeat back those that they remember in any order. The survey then continues with questions on physical and mental health conditions, before the respondent is asked to repeat the same words back after a period of approximately five minutes. These two tests provide a measure of both immediate and delayed memory. The same types of questions are administered in the Health and Retirement Survey and other HRS-style surveys (Shih et al., 2011). Unlike other work that averages the two recall scores into a single memory measure (e.g. McArdle et al., 2011; Lei et al., 2012), we choose to examine immediate and delayed memory independently to allow for differential effects of the two markers.

As the unit of measurement of each test score is not directly meaningful, all of the scores have been standardized to z-scores using the sample mean and standard deviation. As a result, the coefficient estimates in the regression models can be interpreted as measuring the impact of a standard deviation change in the test score.

Additional health assessments

In addition to measures of the attained height of individuals, the survey includes several health markers that are potentially related to labor market outcomes. First, body mass index (BMI), weight

(in kg) divided by height (in m) squared, is a second indicator of nutritional status that, unlike height, varies throughout the life course. Extreme values of BMI are predictive of mortality and morbidity. In our study sample very few respondents are overweight or obese, implying low BMI is predictive of poor health. Given the ranges observed in these data, at a first approximation, higher BMI can be interpreted as being associated with elevated VO_2 max and work capacity and, therefore, is likely to be associated with strength.

Resting blood pressure is also measured for each respondent. As in many other developing countries, there are high levels of undiagnosed hypertension in the study site. In the models, we include both systolic blood pressure and the difference between systolic and diastolic blood pressure, pulse pressure. Both are measured in millimeters of mercury (mmHg). Whereas systolic blood pressure is indicative of the maximum pressure on the arteries, pulse pressure is a measure of the pressure change that creates the pulse and has been shown to be predictive of cardiovascular disease as it is indicative of the hardening of artery walls (e.g. Blacher et al., 2000; Franklin et al., 1999; Mattance-Raso et al., 2004; Panagiotakos et al., 2005). Pulse pressures above 60 mmHg are considered elevated (Safar et al., 1987), while the mean in our sample is 46 mmHg.

Each respondent also provides information on a battery of self-assessed Activities of Daily Living (ADLs). In this paper, we focus on whether the respondent had difficulty running 1000m.

3. Descriptive Analysis

As WISE is unique in its collection of this specific set of cognition measures, it is useful to note the relationships between the different markers to emphasize that each captures a unique element of cognition. Table 2 reports results from regressions of standardized Raven's scores on the other three test scores for the entire sample of 25-65 year olds, and separately for men and women to show the patterns are consistent across gender. Raven's is chosen as the dependent variable as it is the most commonly used cognitive test of the four we consider.

Each score is predictive of improvements in Raven's scores, with one standard deviation increases in fluid intelligence, immediate, and delayed word recall predictive of improvements in Raven's scores. Moreover, each score is independently predictive conditional on the others, highlighting the ability of the data to measure different components of cognition. While the scores are highly correlated with each other, each adds a particular element to the analysis.

Height is also positively related to each of the cognitive test scores in our data. Panel B of Table 2 reports regression results from standardized test scores on the natural log of height for each of the tests. In all cases, increasing height is related to increasing test scores, with magnitudes between a 0.04 and 0.06 standard deviation increase for a 1 percent increase in height.

Figure 2 displays similar nonparametric regressions of test scores on height. The results show that the relationship between height and cognition is largely consistent over the entire height distribution and for each cognition measure.

4. Human Capital and Earnings

We turn next to documenting returns to height, cognition, education, and health. Table 3 reports results from the pooled sample examining how different markers of human capital are related to log earnings. We focus primarily on hourly earnings, the combination of wages and self-employed net profits, and consider formal wage work versus self employment in later tables. The primary specification is the following:

$$\ln(earn_{it}) = \beta_0 + \beta_1 height_i + \beta_2 cog_i + \beta_3 X_{it} + \beta_4 \theta_{it} + \eta_t + \varepsilon_{it} \quad (1)$$

where *earn* is the hourly earning rate of individual *i* caluclated over the last four months, *height* is the log of attained height of individual *i* and *cog* are the within person mean values of the four cognitive test scores standardized within the sample.[4] Additional control variables include indicators for five

[4] This aids in controlling for possible measurement error in a single test. Alternative cognition specifications such as the score from the first time an individual takes the test or their maximum score are consistent with the within person means reported here.

year age brackets to flexibly control for age and years of education. Health, θ, includes the log of BMI, an indicator for difficulty running 1km from the ADL module, and blood pressure measures. Time fixed effects are included to capture common aggregate conditions including seasonality and prices in the survey area. All standard errors throughout are clustered at the person level.

Table 3 begins by establishing a return to height and cognition in earnings conditional on age and time effects. Column 1 shows that taller individuals do in fact earn more, with a 1% increase in height relating to a 3.6% increase in hourly earnings. Clearly height is strongly related to earnings.

Column 2 then documents returns to cognition independent of height. One standard deviation increases in tests scores are related to 16% higher earnings for the Raven's and fluid intelligence tests. Returns to memory are also quite high at 12% and 5% for immediate and delayed recall. The additional return to each of the cognitive assessments emphasizes the importance of separately considering the four measures.

These findings are consistent with past work in the field – taller individuals and those with higher cognitive function reap rewards in terms of earnings. Column 3 then documents that the returns to height and cognition simultaneously exist in the same model. Conditional on cognitive scores, a 1% increase in height is related to a 2.3% increase in hourly earnings. This is a substantial reduction from the 3.6% correlation in Column 1, and the difference between the two height returns is statistically significant (p-value of 0.00001), reflecting that height and cognition are positively related. However, the return to height is still quite large and statistically significant, suggesting that there is more to height than only a marker for cognition.

In contrast, the coefficients on cognition measures remain remarkably similar when controlling for height. While Raven's and fluid intelligence scores decrease marginally, the word recall coefficients are statistically indistinguishable between the models that include height. While height is more than just cognition, clearly cognition is more than just height.

Column 4 adds years of attained education in the model, as attained years of education is

likely closely related to cognition.[5] An additional year of education is related to a 8.3% increase in hourly earnings. Including education diminishes the returns to both height and cognition, but does not sweep either away, with the exception of delayed word recall which is no longer distinguishable from immediate word recall. The results clearly point to returns to height and cognition on top of education. Cognition may be measuring on the job skills or life experiences accumulated since completing education. These traits may be particularly valuable in the self employed sector.

Thus far the results establish that there are returns to height, cognition, and education that exist independently of each other. In line with the "Brain vs. Brawn" literature (e.g. Pitt et al., 2012), it is also possible that health may play a major role in this setting and that height or cognition is simply reflecting improved heealth. While acknowledging the potential that health and earnings may be simulatanerously determined, Column 5 includes measures of health in the model. The estimated BMI elasticity suggests positive returns to increasing BMI, evidence that strength and work capacity is valued. Those reporting ADL difficulties are limited in their returns. The positive return to systolic blood pressure (SBP) of a 2.5% imcrease in earnings for a 10 mmHg increase in SBP may be due to high wage workers who have both sedentary jobs and can afford diets higher in animal fats. Consistent with the literature on pulse pressure, increasing pulse pressure by 10 mmHg is associated with a 4.5% reduction in earnings.

The results in column 5 shed new light on the relationship between height, cognition and multiple measures of human capital. The estimates not only suggest that health markers have intuitive returns in our earnings models, they do not substantially influence the returns to height, cognition, or education established in Column 4. Of the six coefficients in each column, only the return to education is statistically different between Columns 4 and 5 at the 5% level (*p*-value 0.0001).

While illustratative, interpreting these results is a challenge given that they include both

[5] Specifying a more flexible form for education to allow for nonlinearities produces results consistent with those shown here.

formal wage work and self employed net profits averaged to calculate earnings. Columns 6 and 7 repeat the analysis in Column 5, but limited to only wage earnings in 6 and self employed net profits in 7.[6] Comparing across the columns, the premium to height exists in both sectors although it is larger for self employment. Returns to cognition also persist, although the return to fluid intellgence is restricted to the informal sector. This is further evidence that this test measures a different axis of cognition than the traditional Raven's measure. Specific skill sets and experiences likely translate to the fluid intelligence test and are valuable while operating one's own farm or small business. The health returns are also reflective of slight sectoral differences with BMI more highly valued in self employment.

Sectoral Choice

Along with examining results by sector, one should acknowledge that individuals choose in which sector to work. Table 3 abstracts from this choice, which we incorporate in Table 4. As in the summary statistics, we divide the sample into three distinct groups: those who only ever work in wage work (19% of the sample), those who only ever work as self employed (27%), and those who do both (54%). A particular advantage of the longitudinal structure of the survey is that we observe many of the respondents working in each sector at different times during the study period, and some respondents working in both sectors at the same time. This substantially contributes to identifying the differential effect of height and cognition on labor market performance in each sector.

Columns 1 and 2 of Table 4 examine characteristics associated with individuals in each of the three groups. The coefficients are odds-ratios from a multinomial logit model with the "both" sector group as the base category. The patterns in columns 1 and 2 reveal clear sorting patterns

[6] These results exclude observations that report negative net profits over the past four months, which appears to be driven almost exclusively by seasonality and the timing of the crop cycle. Alternative transformations to earnings preserving these negative values such as square or quartic roots are consistent with those shown here and suggest that restricting to non-negative profits is not driving the results. Logs are maintained for comparability and ease of interpretation.

within the sample. Focusing on the comparison of those who are only wage workers relative to both wage and self employed, the samples are comparable on cognition, but not on education, as an increase in education is related to an increasing odds of being only in wage sector employment. This may be reflective of signaling value in education, or that those with higher education levels are more apt at securing formal jobs. In comparison, those who are only in the profit sector appear worse on cognition, as higher cognition scores are related to decreases in the odds of being only in the self employed sector. The opposite is true for long-term memory, a trait that may be highly valued in self-employment where one is both the manager and employee. The results are suggestive of certain skills that lead to selection in different markets – in particular, attained education for wage work, and memory for self-employment.

Columns 3 through 5 return to documenting the returns to height and cognition, but limited to only those who work within a specific sector. Column 3 examines individuals who work only for formal wages. While a return to height persists, it is now only significant at the 10% level. Abstract reasoning captured by Raven's scores remains the only significant cognitive measure, while years of education shows a strong return. This appears to be a highly selected group focusing on formal wage jobs such as government position that require high years of education to obtain. Those who only work in self-employment, Column 4, see a smaller return to education, but strong returns to height, abstract cognition, and also fluid intelligence and memory.

Column 6 then exploits the variation in the survey from those who work in both sectors. Equation (1) is modified to include individual fixed effects which sweep out time invariant unobserved, and observed characteristics of the individual. While this would make it infeasible to identify the effect of attained height or the person-mean cognitive scores which are assigned as one observation per person, the *difference* of how height and cognition impact earnings in the two sectors is identified by examining earnings when working in the wage vs. self employed sector. Each of the coefficients in Column 6 is an interaction of the characteristic with an indicator for self-employment.

Positive values are indicative of the trait having a higher return in the self-employed sector. This is a novel strategy, as the results rely on detailed data on both formal and informal earnings as well as observing individuals shifting between the two sectors over time.

While there is no difference in the return to height or abstract cognition between the two sectors, increased fluid intelligence and memory have *higher* returns in self-employment for a given individual. This is consistent with the notion that specific entrepreneurial skill sets may be more highly valued in self-employment.

Occupational Choice

Beyond selecting into wage versus self-employment, individuals may choose their occupations as well. Recent evidence from Mexico notes that occupational choice may play a key role in defining the relationship between height, cognition, and earnings if taller and higher ability individuals select into occupations with higher wages (Vogl, 2012).

WISE records detailed descriptions of each individual's tasks that are used to classify jobs into specific set of occupations. Following the literature's discussion of "Brain vs. Brawn," we first examine whether certain characteristics are associated with selecting into strength-oriented occupations where approximately 65% of the sample works. Column 7 of Table 4 reports coefficients from a linear probability model with an indicator for working in agriculture or production work such as masonry or manual transportation operation. Those who are more educated and score higher on Raven's exams are less likely to work in strength oriented positions, as well as those who are taller. It is then a question whether occupational choice can explain a substantial part of the height and cognition premiums.

Columns 8 through 10 of Table 4 show that this is not the case by including twelve occupation category fixed effects in equation (1) to isolate variation within those who work in a

specific occupation.[7] Throughout all specifications, the narrative remains consistent, and we are not able to sweep away the returns to height, cognition, education, or health. While occupational choice may play a role, it is not enough to account for the returns for the various human capital measures.

Family Background

As a next step, the data allows us to specifically examine the role that family background may play as previous work widely acknowledges that human capital and family background are highly correlated. Failure to control family background when examining human capital and labor market performance substantially complicates interpretation of the relationships between height, cognition, and earnings. To overcome this obstacle, we include a set of measures of the human capital of the individual's parents, and exploit variation within families.

Column 1 of Table 5 directly controls for parental height and education, and limits the sample to individuals who we can identify their parents in the WISE sample. The results suggest that family characteristics as captured by these two markers do not explain away the human capital premiums established earlier, although maternal education is positively related to earnings.

An alternative strategy is to examine collections of siblings who share both genetic and environmental background. For our analysis, we isloate siblings with the use of mother fixed effects. Under this strategy, identification comes from comparing children of the same mother to control for common genetic and environmental components. Examining returns to height, cognition, education and health in this way is a novel approach as it relies on the extensive data in WISE, but also the longitudinal nature and tracking rule that follows siblings as they split-off from their primary residences.

The results in Column 2 show that even after sweeping away family background characteristics, a relationship between height and earnings remains, as well as returns to cognition,

[7] Columns 2 through 4 of Appendix Table A1 repeat this analysis excluding health variables showing the results are not driven by the potential joint determination of occupation and health.

education, and health. As height is largely determined by a young age, this may reflect variation in the environment for children born at different time periods. Similarly, changing investments and experiences between siblings may drive differences in cognition and education which relate to differences in earnings. Even when controlling for family background, both observed and unobserved, the data still show a clear relationship between multiple dimensions of human capital and labor market performance.

5. Discussion

Our results suggest a rich interpretation of how multiple markers of human capital relate to labor market returns. Ongoing work looks to delve deeper into these patterns, exploring the potential endogeneity of our markers of human capital, as well as novel measures of non-cognitive skills included in the WISE study. As they stand, the results contribute to literatures aiming to understand labor marker performance in a low-income setting and policies designed at improving these returns.

We show the claim that height is only a marker of cognition is unfounded in this sample. Returns to height persist across models incorporating sectoral choice, occupation, and family background. Taller individuals maintain an earnings premium.

The claim that cognition can be captured by height is also unfounded. Moreover, we document the importance of considering a broad array of cognitive measures, as different aspects of cognition are valued differently in certain sectors and markets. Incorporating these different axes of cognition helps in understanding sorting patterns across sectors. Those individuals who are particularly strong on fluid intelligence and memory may do particularly well running their own businesses.

We also do not support results suggesting that sorting across employment sectors or occupations drives the relationship between height, cognition, and earnings. While different markers of human capital are certainly related to working in a specific sector or occupation, returns within

these occupations are still influenced by human capital.

Height, cognition, education and health are related markers of human capital. However, one dimension does not completely capture the other components. Understanding the combined relationships provides evidence on the complex inter-linkages between multiple dimensions of human capital and labor market performance.

References

Barham, T., K. Macours, and J. A. Maluccio. More schooling and more learning? effects of a 3-year conditional cash transfer program in Nicaragua after 10 years. Working Paper, October 2012.

Behrman, J. R., J. Hoddinott, J. A. Maluccio, and R. Martorell. "Brains versus brawn: Labor market returns to intellectual and health human capital in a poor developing country." Working Paper, September 2009.

Blacher, J., J. A. Staessen, X. Girerd, J. Gasowski, L. Thijs, L. Liu, J. G. Wang, R. H. Fagard, and M. E. Safar. Pulse pressure not mean pressure determines cardiovascular risk in older hypertensive patients. *Archives of Internal Medicine*, 160(8): 1085, 2000.

Safar, ME, S. St Laurent, A. Safavian, B. Pannier, G. London, "Pulse pressure in sustained essential hypertension: a haemodynamic study," 1987, *Journal of Hypertension:* 5(2): 213-8.

Case, A. and C. Paxson. "Height, health, and cognitive function at older ages." *American Economic Review: Papers and Proceedings*, 98(2): 463–467, 2008.

Case, A. and C. Paxson. "Stature and status: Height, ability, and labor market outcomes." *The Journal of Political Economy*, 116(3): 499, 2008.

Case, A., C. Paxson, and M. Islam. "Making sense of the labor market height premium: Evidence from the British household panel survey." *Economics Letters*, 102(3):174–176, 2009.

Daniels, M. and L. Adair. "Breast-feeding influences cognitive development in Filipino children." *The Journal of Nutrition*, 135(11): 2589–2595, 2005.

Franklin, S., S. Khan, N. Wong, M. Larson, and D. Levy. "Is pulse pressure useful in predicting risk for coronary heart disease? The Framingham Heart Study." *Circulation*, 100(354–360), 1999.

Gao, W. and R. Smyth. "Health human capital, height and wages in China." *Journal of Development Studies*, 46(3):466–484, 2010.

Glewwe, P. and E. King. "The impact of early childhood nutritional status on cognitive development: Does the timing of malnutrition matter?" *The World Bank Economic Review*, 15(1): 81–113, 2001.

Guthrie, G. M., A. H. Tayag, and P. J. Jacobs. "The Philippine nonverbal intelligence test." *The Journal of Social Psychology*, 102(1):3–11, 1977.

Huang, W., X. Lei, G. Ridder, J. Strauss, and Y. Zhao. "Health, height, height shrinkage and SES at older ages: Evidence from China." Working Paper, April 2012.

Lei, X., Y. Hu, J. J. McArdle, J. P. Smith, and Y. Zhao. "Gender differences in cognition among older adults in China." *Journal of Human Resources*, 47(4): 951–971, 2012.

Lindqvist, E. and R. Vestman. "The labor market returns to cognitive and noncognitive ability: Evidence from the Swedish enlistment." *American Economic Journal: Applied Economics*, 3(1): 101–28, 2011.

Lundborg, P., P. Nystedt, and D.-O. Rooth. The height premium in earnings: The role of physical capacity and cognitive and non-cognitive skills. IZA Discussion Paper No. 4266, June 2009.

Martorell, R., Habicht, J.-P. "Growth in early childhood in developing countries". In: Falkner, F., Tanner, J.M. (Eds.), Human Growth, vol. 3, Methodology. Ecological, Genetic, and Nutritional Effects on Growth. second ed. Plenum, New York, pp. 241–262, 1986.

Mattace-Raso, F., T. van der Cammen, N. van Popele, D. van der Kuip, M. Schalekamp, A. Hofman, M. Breteler, and J. Witteman. "Blood pressure components and cardiovascular events." *Journal of the American Geriatric Society*, 52:1538–1542, 2004.

McArdle, J. J., J. P. Smith, and R. Willis. "Cognition and economic outcomes in the Health and Retirement Survey." In D. Wise, editor, *Explorations in the Economics of Aging*, pages 209–236. University of Chicago Press, 2011.

Mendez, M. and L. Adair. "Severity and timing of stunting in the first two years of life affect performance on cognitive tests in late childhood." *The Journal of Nutrition*, 129(8): 1555–1562, 1999.

Panagiotakos, D. Kromhout, A. Menotti, C. Chrysohoou, A. Dontas, C. Pitsavos, H. Adachi, H. Black- burn, S. Nedeljkovic, and A. Nissinen. "The relation between pulse pressure and cardiovascular mortality in 12,763 middle-aged men from various parts of the world: A 25-year follow-up of the seven countries study." *Archives of Internal Medicine*, 165: 2142–2147, 2005.

Persico, N., A. Postlewaite, and D. Silverman. "The effect of adolescent experience on labor market outcomes: The case of height." *Journal of Political Economy,* 112(5): 1019–1053, 2004.

Pitt, M., M. Rosenzweig, and N. Hassan. "Human capital investment and the gender division of labor in a brawn-based economy." *American Economic Review*, 2012.

Raven, J. "The Raven's progressive matrices: Change and stability over culture and time." *Cognitive Psychology*, 41:1–48, 2000.

Safar, ME, S. St Laurent, A. Safavian, B. Pannier, G. London, "Pulse pressure in sustained essential hypertension: a haemodynamic study," 1987, *Journal of Hypertension:* 5(2): 213-8.

Shih, R. A., J. Lee, and L. Das. "Harmonization of cross-national studies of aging to the Health and Retirement Study." RAND Labor and Population Working Paper 94-08, July 2011.

Spears, D. "Height and cognitive achievement among Indian children." *Economics and Human Biology,* 10: 210–219, 2012.

Thomas, D. and J. Strauss. "Health and wages: Evidence on men and women in urban Brazil." *Journal of Econometrics*, 77(1):159–185, 1997.

Vogl, T. "Height, skills, and labor market outcomes in Mexico." Working Paper, July 2012.

Appendix

Selection into the Sample

The results in the body of the paper utilize a sample of men between the ages of 25-65 who ever report earnings during the study period. This is 93% of all 25-65 year old men. Column 1 of Appendix Table A1 compares this sample to the subset of individuals who do not report earnings using a linear probability model.

The results suggest there are slight differences in terms of Raven's scores and years of education for those who are omitted from the analysis. Physical limitation is also predictive of not reporting earnings.

Ongoing work looks to examine the sensitivity of our analysis to examining only the subset of wage and self-employed earners. Results from Table A1 suggest that selection into the sample is not a driving force behind our findings.

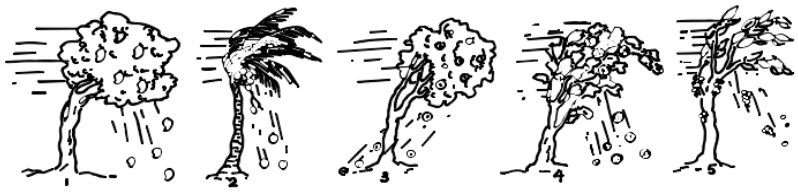
Human Capital and Labor Market Returns for Women

The design of WISE, and the detailed earnings measures for those who are self-employed in particular, makes it an ideal dataset to examine the relationship between labor market returns and markers of human capital for women. Work in progress examines these returns, acknowledging the potential endogeneity of labor force participation.

Table A2 repeats the baseline earnings analysis shown for men in Table 3. Results show strong returns for height and abstract and fluid intelligence across specifications. Word recall scores are insignificant once controlling for education. Perhaps the most striking difference is for self-employed earnings, which show no return to cognition in the parsimonious model in Column 7. These patterns are indicative of the importance of continuing to examine the returns to human capital for women.

Figures

Figure 1: Sample Fluid Intelligence Question.



Respondents are asked to pick which one of the pictures does not belong

Figure 2: Nonparametric Relationship between Cognitive Assessments and Height

Table 1: Summary Statistics

		Individual Works in […]		
	All	**Wage Sector Only**	**Self-employed Sector Only**	**Both Sectors**
	(1)	**(2)**	**(3)**	**(4)**
Hourly earnings				
All work	0.35	0.50	0.40	0.29
	(0.03)	(0.02)	(0.10)	(0.01)
From work in wage sector	0.40	0.50		0.37
	(0.03)	(0.02)		(0.03)
From self-employment	0.44		0.40	0.48
	(0.05)		(0.10)	(0.06)
Height (cm)	161.63	163.70	160.59	161.47
	(0.09)	(0.21)	(0.17)	(0.12)
Age	41.36	31.93	48.17	41.26
	(0.17)	(0.30)	(0.35)	(0.21)
Years of Education	8.25	10.63	7.23	7.93
	(0.06)	(0.12)	(0.11)	(0.08)
Body Mass Index	20.87	20.99	20.68	20.92
	(0.04)	(0.09)	(0.08)	(0.05)
Difficulty Running 1k (%)	16.89	9.00	26.80	14.71
	(0.51)	(0.91)	(1.17)	(0.66)
Systolic Bp (mm Hg)	125.18	123.59	127.88	124.36
	(0.25)	(0.51)	(0.55)	(0.33)
Pulse Pressure (mm Hg)	46.91	45.22	49.04	46.40
	(0.18)	(0.40)	(0.39)	(0.24)
Raven's Test (%)	53.56	65.28	46.52	52.99
	(0.36)	(0.87)	(0.69)	(0.46)
Fluid Intelligence (%)	61.26	68.53	55.04	61.98
	(0.34)	(0.90)	(0.66)	(0.42)
Word Recall - Immediate	4.62	5.26	4.26	4.62
(out of 10)	(0.02)	(0.05)	(0.04)	(0.03)
Word Recall - Delayed	3.56	4.27	3.20	3.53
(out of 10)	(0.02)	(0.06)	(0.04)	(0.03)
N. Individual-Wave Obs.	38,430	4,521	8,576	34,274
N. Individuals	5304	1000	1429	2875

Table 2

Panel A: Relationship Between Cognition Measures
Dep. Var: Raven's Score

	Sample		
	All	**Male**	**Female**
	(1)	**(2)**	**(3)**
Fluid Intell. Score	0.477***	0.480***	0.469***
	(0.010)	(0.014)	(0.015)
Immediate Word Recall	0.154***	0.124***	0.195***
	(0.013)	(0.018)	(0.020)
Delayed Word Recall	0.109***	0.123***	0.091***
	(0.013)	(0.018)	(0.019)
N. Individuals	9,857	5,304	4,553
R-squared	0.393	0.367	0.425

Panel B: Height and Cognition

	Dependent Variable			
	Raven's Test	**Fluid Intelligence**	**Immediate Recall**	**Delayed Recall**
	(1)	**(2)**	**(3)**	**(4)**
Log Height	6.175***	5.890***	5.183***	4.744***
	(0.339)	(0.351)	(0.393)	(0.392)
N. Individuals	5,304	4,824	4,674	4,674
R-squared	0.060	0.068	0.043	0.035

Robust standard errors in parentheses

Table 3 - Returns to Human Capital

	Dependent Variable: Log of Hourly […]						
			Earnings			**Wages**	**Profits**
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**
Log Height	3.636***		2.354***	1.874***	1.942***	1.554***	2.239***
	(0.345)		(0.324)	(0.304)	(0.299)	(0.285)	(0.385)
Raven's Score		0.166***	0.160***	0.077***	0.073***	0.056***	0.058***
		(0.017)	(0.017)	(0.015)	(0.015)	(0.015)	(0.020)
Fluid Intelligence Score		0.164***	0.156***	0.056***	0.049***	0.008	0.082***
		(0.017)	(0.017)	(0.016)	(0.016)	(0.016)	(0.021)
Immediate Recall		0.127***	0.124***	0.052***	0.045**	0.038**	0.049**
		(0.021)	(0.021)	(0.019)	(0.019)	(0.020)	(0.025)
Delayed Recall		0.045**	0.045**	0.028	0.026	0.016	0.023
		(0.020)	(0.020)	(0.018)	(0.018)	(0.019)	(0.024)
Years of Education				0.083***	0.075***	0.070***	0.057***
				(0.003)	(0.003)	(0.003)	(0.004)
Log BMI					1.016***	0.791***	1.128***
					(0.096)	(0.101)	(0.124)
I(Running 1k Difficult)					-0.049**	-0.035	-0.022
					(0.024)	(0.026)	(0.028)
Systolic Bp					0.025***	0.024***	0.011
					(0.009)	(0.009)	(0.011)
Pulse Pressure					-0.045***	-0.043***	-0.021
					(0.011)	(0.010)	(0.014)
Age Controls	y	y	y	y	y	y	y
Wave FE	y	y	y	y	y	y	y
Observations	38,430	38,430	38,430	38,430	38,430	21,119	26,190

S.E. clustered at the individual level. See text for notes.

*** p<0.01, ** p<0.05, * p<0.1

Table 4 - Sectoral and Occupational Choice

	Sectoral Choice						Occupational Choice			
	Multinomial Logit OR Base Category: Both		Returns to Human Capital							
			Pooled			Individual FE	LPM Strength	Returns to Human Capital		
	Only Formal	Only Informal	Only Formal	Only Informal	Both	Both	Occupation	Earnings	Wages	Profits
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Log Height	1.017**	1.012**	1.023*	2.290***	1.875***	0.331	-0.528***	1.730***	1.494***	1.961***
	(0.008)	(0.006)	(0.590)	(0.732)	(0.312)	(0.539)	(0.159)	(0.276)	(0.267)	(0.364)
Raven's Score	1.059	0.909*	0.067**	0.108***	0.042**	-0.002	-0.016**	0.057***	0.053***	0.052***
	(0.059)	(0.044)	(0.030)	(0.036)	(0.017)	(0.030)	(0.008)	(0.014)	(0.014)	(0.019)
Fluid Intelligence Score	0.964	0.924	0.019	0.067*	0.056***	0.105***	0.003	0.050***	0.009	0.081***
	(0.060)	(0.050)	(0.030)	(0.040)	(0.017)	(0.030)	(0.008)	(0.015)	(0.015)	(0.020)
Immediate Recall	1.014	0.894*	0.046	-0.037	0.069***	0.077**	-0.013	0.029*	0.030	0.032
	(0.078)	(0.056)	(0.035)	(0.043)	(0.021)	(0.036)	(0.009)	(0.018)	(0.018)	(0.024)
Delayed Recall	1.117	1.125*	0.019	0.090**	0.001	-0.030	-0.017*	0.019	0.013	0.018
	(0.080)	(0.070)	(0.037)	(0.046)	(0.019)	(0.034)	(0.009)	(0.017)	(0.018)	(0.022)
Years of Education	1.122***	1.023**	0.084***	0.056***	0.061***	0.009	-0.036***	0.047***	0.045***	0.039***
	(0.015)	(0.011)	(0.006)	(0.008)	(0.004)	(0.006)	(0.002)	(0.003)	(0.003)	(0.004)
Log BMI	0.624	1.191	0.564***	1.115***	0.982***	0.344*	-0.405***	0.758***	0.638***	0.853***
	(0.228)	(0.362)	(0.202)	(0.201)	(0.112)	(0.200)	(0.047)	(0.090)	(0.098)	(0.118)
I(Running 1k Difficult)	1.297*	1.206**	0.063	-0.047	-0.041	0.030	-0.024**	-0.063***	-0.053**	-0.038
	(0.186)	(0.112)	(0.054)	(0.046)	(0.026)	(0.035)	(0.010)	(0.023)	(0.024)	(0.028)
Systolic Bp	1.017***	1.002	-0.005	0.009	0.018*	-0.005	-0.016***	0.010	0.015*	0.002
	(0.004)	(0.003)	(0.017)	(0.018)	(0.009)	(0.014)	(0.004)	(0.008)	(0.008)	(0.010)
Pulse Pressure	0.987**	0.992*	-0.011	-0.024	-0.032***	0.004	0.033***	-0.018*	-0.029***	-0.001
	(0.005)	(0.005)	(0.020)	(0.025)	(0.011)	(0.017)	(0.005)	(0.010)	(0.010)	(0.014)
I(Informal Sector)					-0.377***	-2.893				
					(0.019)	(2.870)				
Wave FE			y	y	y	y	y	y	y	y
Occupation FE								y	y	y
Observations	5,304	5,304	4,381	8,482	34,508	34508	37245	38430	38430	38430

All columns include flexible age controls, with robust standard errors in parenthese. These are clustered at the person level in Columns 3 through 10. Columns 1 and 2 report odds-ratios from a multinomial logit model examining sector choice. Columns 3 through 5 are pooled earnings regressions as in Table 3. Column 6 reports coefficients from models including individual FE. Coefficients are from interactions of the variable with an indicator for working in the informal sector. Column 7 is a linear probability model for choosing a strength oriented occupation, and columsn 8 through 10 include occupation fixed effects. *** p<0.01, ** p<0.05, * p<0.1

Table 5 - Family Background

	Pooled Earnings (1)	Mother Fixed Effects (2)
Log Height	1.813***	1.190*
	(0.546)	(0.716)
Raven's Score	0.058**	0.114**
	(0.023)	(0.048)
Fluid Intelligence Score	0.046*	-0.010
	(0.024)	(0.062)
Immediate Recall	0.029	0.001
	(0.029)	(0.053)
Delayed Recall	0.049*	0.051
	(0.029)	(0.069)
Years of Education	0.058***	0.019**
	(0.005)	(0.008)
Log BMI	0.509***	0.469
	(0.150)	(0.417)
I(Running 1k Difficult)	0.066	0.109***
	(0.044)	(0.041)
Systolic Bp	0.013	0.022*
	(0.015)	(0.013)
Pulse Pressure	-0.035**	-0.049***
	(0.016)	(0.013)
Parental Characteristics		
Mother's Height	0.365	
	(0.594)	
Father's Height	-0.187	
	(0.652)	
Mother's Years of Education	0.017**	
	(0.007)	
Father's Years of Education	0.009	
	(0.007)	
Age Controls	y	y
Wave FE	y	y
Observations	11,789	11,789
R-squared	0.189	0.094
Number of Mother FE		1,653

Standard errors clustered at the sibling level.

*** p<0.01, ** p<0.05, * p<0.1

Table A1 - Selection and Occupational Choice Excluding Health

	Selection Into the Sample No Earnings Data	Occupational Choice and Returns to Human Capital Excluding Health		
		Earnings	Wages	Net Profits
	(1)	(2)	(3)	(4)
Log Height	-0.022	1.681***	1.428***	1.897***
	(0.087)	(0.277)	(0.266)	(0.366)
Raven's Score	-0.027***	0.058***	0.053***	0.055***
	(0.005)	(0.014)	(0.014)	(0.019)
Fluid Intelligence Score	-0.009*	0.055***	0.013	0.085***
	(0.005)	(0.015)	(0.015)	(0.020)
Immediate Recall	-0.004	0.034*	0.036*	0.035
	(0.005)	(0.018)	(0.019)	(0.024)
Delayed Recall	-0.002	0.020	0.013	0.017
	(0.005)	(0.017)	(0.018)	(0.023)
Years of Education	0.005***	0.051***	0.047***	0.043***
	(0.001)	(0.003)	(0.003)	(0.004)
Log BMI	-0.045			
	(0.030)			
I(Running 1k Difficult)	0.043***			
	(0.010)			
Systolic Bp	0.000			
	(0.003)			
Pulse Pressure	0.007			
	(0.004)			
Occupation FE		Y	Y	Y
Observations	5,741	38,430	21,119	26,190
R-squared	0.218	0.228	0.300	0.159

S.E. clustered at the individual level in Col.

*** p<0.01, ** p<0.05, * p<0.1

Table A2 - Returns to Human Capital for Women

	Dependent Variable						
			Earnings			**Wages**	**Profits**
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**
Log Height	3.600***		2.494***	2.117***	2.062***	1.983***	1.705***
	(0.438)		(0.395)	(0.360)	(0.357)	(0.446)	(0.484)
Raven's Score		0.185***	0.181***	0.068***	0.063***	0.096***	0.029
		(0.022)	(0.022)	(0.020)	(0.020)	(0.023)	(0.029)
Fluid Intelligence Score		0.192***	0.189***	0.051**	0.048**	0.094***	0.003
		(0.023)	(0.022)	(0.021)	(0.021)	(0.025)	(0.030)
Immediate Recall		0.034	0.024	-0.041	-0.049*	-0.036	-0.038
		(0.028)	(0.027)	(0.025)	(0.025)	(0.030)	(0.034)
Delayed Recall		0.076***	0.077***	0.031	0.029	0.037	0.007
		(0.026)	(0.026)	(0.024)	(0.023)	(0.028)	(0.032)
Years of Education				0.092***	0.090***	0.099***	0.062***
				(0.004)	(0.004)	(0.005)	(0.007)
Log BMI					0.611***	0.317***	-0.022
					(0.088)	(0.106)	(0.026)
I(Running 1k Difficult)					-0.020	-0.004	-0.096
					(0.018)	(0.023)	(0.126)
Systolic Bp					-0.126	-0.189	0.040
					(0.091)	(0.115)	(0.167)
Pulse Pressure					-0.023	-0.077	0.141
					(0.117)	(0.148)	(0.128)
Age Controls	y	y	y	y	y	y	y
Wave FE	y	y	y	y	y	y	y
Observations	28,838	28,838	28,838	28,838	28,838	15,812	15,455

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, *