Statistical Discrimination, Productivity, and the Height of Immigrants

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Abstract

Building on the economic research that demonstrates a positive relationship between height and worker ability, this paper compares the wage returns to height for immigrants and natives to explore possible explanations for the positive wage-height gradient. Using multiple data sets, the paper presents a robust empirical finding that the wage gains associated with height are almost twice as large for immigrants than for native-born individuals. This wage relationship occurs because the productivity gap between tall and short immigrants is greater than the productivity gap between tall and short native-born workers. The paper next tests for the possibility that in the relative absence of other sources of information about immigrants, employers place more weight on height for immigrants than for native-born individuals. The evidence does not support the hypothesis of statistical discrimination based on height.

A large amount of empirical evidence demonstrates a positive correlation between height and earnings throughout the world. In the context of developing countries, the focus of this analysis has been on the relationship between health and nutrition inputs and height (Bozzoli, Deaton and Quintana-Domeque 2009; Deaton 2008; Steckel 1995; Strauss and Thomas 1997; Strauss and Thomas 1998). The positive relationship between height and earnings is not surprising given that physical size and strength may be important for manual labor in developing countries (Glick and Sahn 1998). However, sizable wage gains associated with height persist in rich countries such as the United States and Britain where the importance of physical strength is likely to play a smaller role in the labor market. Taste-based discrimination against short people is a possible explanation (Kuhn and Shen 2009).[1] More convincing explanations are that the returns to height in developed countries are explained by the relationship between height and cognitive ability (Case and Paxson 2008; Case, Paxson and Islam 2009; Beauchamp et al 2010; Schick and Steckel 2010), and non-cognitive ability such as social skills (Persico, Postlewaite and Silverman 2004; Schick and Steckel 2010).

This paper contributes to the existing literature on the economic literature on height by presenting a new empirical finding on the relationship between height and wages. I show that the wage returns to height are much larger for immigrants than for native-born men in both the U.S. and the U.K. Next, the paper shows that the mapping between height and productivity is different for immigrants and for natives. Finally, the paper considers the idea of the statistical use of the information in height by employers.

The comparison between immigrants and natives offers a new way of examining whether the positive relationship between height and wages is driven by variation in early life inputs. This work builds on the paper of Case and Paxson (2008), in which they present evidence to suggest that the *main* driver of the relationship between height and wages is the positive correlation between height and cognitive ability. Their paper presents evidence that taller children score higher on cognitive exams and that including test scores explains a substantial portion of the estimated height premium in wages. In this paper, I consider whether a steeper wage-height gradient for immigrants as compared to natives is explained by a stronger correlation between cognitive ability and height among immigrants than among natives. We may expect the correlation between height and the unobserved components of productivity to vary across countries given the substantial variation in the nutrition and disease environment across countries. For example, Bozzoli, Deaton and Quintana-Domeque (2009) show that the relationship between childhood disease and nutrition and adult height varies across countries.

I use measures of cognitive ability and health that are available in the data but not observed by employers to test whether height is more correlated with these measures of productivity for immigrants than

[1] This hypothesis is consistent with the findings on the returns to beauty (Hamermesh and Biddle 1994) and weight (Averett and Korenman 1996).

for native-born individuals. I also exploit variation in the average quality of early life inputs by immigrants' countries of origin. These results contribute to an understanding of the underlying explanation for the positive correlation between height and wages.

Given the correlations between height and ability, employers may use height to infer differences in productivity across workers. The comparison of immigrants to native-born individuals is particularly useful for this exercise because it is plausible that employers face substantial differences in the quality of information signals as they are comparing the expected productivity of immigrants and native-born individuals. Employers may have uncertainty about the academic degree system, the curriculum or the quality of schools in other countries. Furthermore, language barriers may generate or exacerbate noise in employers' assessment of productivity signals from immigrants. This paper considers the idea that employers rely on the information associated with height more for immigrants than for native-born individuals given the relative absence of other information about worker productivity for immigrants.

In models of statistical discrimination, employers use a characteristic that is both easy to observe and correlated with unobservable ability to make decisions on hiring, task assignment and promotion of workers. The existing empirical literature on statistical discrimination has focused on employers' use of race and gender (Altonji and Pierret 2001; Coate and Loury 1993; Farber and Gibbons 1996). My paper is the first to consider the possibility of statistical discrimination on the basis of height in the labor market.[2] The statistical use of the information associated with height by employers is plausible given that height, like race and gender, is easy to observe and strongly correlated with unobservable components of worker productivity.

This paper builds on theories of statistical discrimination that focus on the amount of *uncertainty* around the information available to employers (Aigner and Cain 1977; Phelps 1972; Lundberg and Startz 1983; Oettinger 1996). In these models, employers have an observable, continuous signal of productivity, but the quality of this information is different across groups. Phelps (1972) and Aigner and Cain (1977) show that expected productivity (and hence wages) will be flatter for the group for which there is greater uncertainty in the signal.

To empirically analyze the hypothesis of statistical discrimination, I examine the idea that as uncertainty about immigrant signals is reduced, the returns to height and education of immigrants should move to be more similar to those of native-born individuals. I use years since immigration and whether the immigrant had any education in the host country to capture variation in the quality of the signals. Furthermore, I take advantage of newly available data that offers information about an immigrant's labor

[2] The statistical use of height has been considered by Mankiw and Weinzierl (2009). Their theoretical paper argues that government taxation of height, which is correlated with productivity but not affected by effort, would maximize welfare in a model where worker effort is not observable by the government.

market experiences in his country of origin prior to migration as well as in the United States. Assuming that the noise of signals is lower for employers in the the country of origin than in the U.S., I can use this new data to test the model of statistical discrimination as well as evaluate other measures of information quality.

The results of this paper contribute to our understanding of the process of economic assimilation of immigrants and the individual's decision regarding whether to stay in the host country. Borjas (1994), Borjas (1999) and Card (2005) provide overviews of the literature on the process of economic assimilation of immigrants in the U.S. One area of this literature examines the performance of immigrants in the host country and the speed at which they converge towards the labor market outcomes of natives over time. To my knowledge, my paper is the first that attempts to empirically examine the role of statistical discrimination on immigrant outcomes.

The results suggest that the productivity gap between tall and short immigrants is greater than the productivity gap between tall and short native-born workers. The differences in the mapping between height and productivity are consistent with the idea that health and nutrition inputs and environmental factors vary considerably in developing countries and have long-run consequences for both adult height and productivity. The evidence suggests that taller immigrants have higher levels of work productivity and are rewarded accordingly in the labor market. The results of the paper do not support the hypothesis that employers use height to statistically discriminate against immigrants in the relative absence of other good signals about their productivity.

Data

This section provides a short overview of the data sets used in the paper. Additional details on the data sets and the construction of variables are provided in online Appendix A. The four main data sets used in this analysis are the National Health Interview Survey (NHIS), the Health Survey of England (HSE), the Health and Retirement Survey (HRS) and the New Immigrant Survey (NIS). These four household-level data sets contain the necessary information on height, immigrant status and labor market outcomes, and include a substantial number of immigrants.

The NHIS is a repeated cross-sectional survey conducted by the U.S. National Center for Health Statistics and the Centers for Disease Control Prevention. It is the principal source of data on the health of the civilian population in the U.S. In this paper, I pool together data from the waves from 2000 to 2007. While the annual survey began in 1989, only the waves starting after 2000 contain information on the area of birth of survey respondents who were born outside of the U.S.

The HSE is the only British data set used in this analysis. This data set allows us to examine whether the relationship between height and labor market outcomes depends on host country-specific circumstances. It is a representative sample of adults in private households in Britain conducted by the Social Survey

Division of the Office for National Statistics (ONS). The repeated cross-sectional data was collected beginning in 1991. I use the waves from 1999 and 2004 because these rounds contain information about country of birth and year of immigration. Immigrants were over-sampled in these two rounds and comprise over 30% of survey respondents in those two years.

Conducted by the University of Michigan, the HRS is a panel of Americans that occurs every two years beginning in 1992. The HRS sampled individuals born between 1931 and 1941, and their spouses or partners. Given that the focus of this paper is on labor market experiences rather than the transition into retirement, I use only the 1992 wave. In addition to their current labor market experiences, the HRS also asks retrospective questions about past labor market experiences.[3] These retrospective questions allow for the construction of a pseudo-panel for the analyses using wage information.

The adult sample of the 2003 wave of the NIS is a nationally representative sample of legal immigrants drawn from U.S. government records on admission to legal permanent residence in 2003. This includes new arrivals to the U.S. as well as immigrants who are adjusting their visas.[4] In this paper, I combine the adult and spouse samples of the 2003 wave.[5] While the NIS does not allow for a comparison of immigrants with native-born Americans because the sample almost entirely excludes native-born Americans, the data set offers the advantage of rich retrospective information about the pre-immigration characteristics and experiences of survey respondents. Some native-born Americans enter the sample through marriage with an immigrant but I exclude these observations from the analysis. The sample size of individuals born in the U.S. in the NIS is not large and the American-born individuals that marry immigrants are likely to be different from the general population. This data set differs from the NHIS and HRS in that the immigrants are relatively recent arrivals and legally admitted into the U.S.

In all data sets, I restrict the sample to adult men between the ages of 20 and 60. The samples are further limited to the set of observations that provide all of the information needed for the various analyses. Immigrant status is defined by country of birth. Thus, individuals born in the U.S. who lived in another country before returning to the U.S. would not be classified as immigrants. Specific country of birth is only available in the HSE and NIS; the NHIS has information on region of birth while the HRS only identifies whether the individual was born in the U.S. or not.

[Table 1 about here]

Panel A of Table 1 displays summary statistics for the four data sets, broken down by whether the individual was an immigrant or native-born. On average, native-born men are taller than immigrants by

[3] The survey covers job information immediately before retirement for retired respondents and work prior to the most recent job for all respondents. For each of these jobs, the survey asks for both the starting and ending (or most recent) wage information.

[4] Complete details about the NIS can be found in Jasso et al (2004).

[5] Immigrant spouses of the adult sample are not necessarily changing their immigration status in 2003.

about two inches. The average age of the individuals in the samples ranges from the late thirties to the early forties. The exception is the HRS sample where the average age of individuals is about five years older; given the age frame that is sampled, the age distribution between 20 and 60 associated with the pseudo-panel constructed from the HRS data is skewed towards an older population than the other data sets.

The table presents real yearly earnings for all data sets and real hourly earnings for the NHIS, HRS and the NIS. For the regression results that use individual real earnings, the hourly earnings measures are used for the NHIS, HRS and the NIS, and annual earnings is used for the HSE.[6] With the exception of HRS men, immigrants tend to earn less than native-born individuals and this gap varies across samples. Immigrants are also less likely than native-born individuals to be employed in a white collar job.

Conditional on employment, American immigrants in the NHIS are quite similar to American immigrants in the NIS along most observable characteristics. NIS immigrants earn slightly less than NHIS immigrants. HRS immigrants have substantially lower earnings than immigrants in the NIS and NHIS. This is likely explained by the older cohorts from which the HRS samples.

Panel A of Table 1 also shows characteristics of immigrants in the four main data sets. The average NHIS immigrant in my analysis entered the U.S. at age 19 and has lived in the U.S. for over 18 years.[7] The numbers are fairly similar for HSE immigrants; on average, they entered after age 18 and have lived in the U.K. for over 21 years. The average characteristics for NIS and HRS immigrants are quite different from the NHIS and the HSE. This reflects the unique sampling approaches of the NIS, which includes recent, legal immigrants, and the HRS, which includes older adults. The average NIS immigrant entered in their late twenties and has resided in the U.S. for 6 to 7 years. The average HRS immigrant entered in their late twenties and has resided in the the U.S. for about 19 years. Host country education refers to whether the individual completed any education in the host country.[8] This is constructed from direct information on post-immigration education in the NIS. However, the other data sets lack specific information about the location of a respondent’s schooling; the variable is constructed to equal one if the number of years of schooling plus five is greater than the age of immigration. The share of immigrants that have any schooling in the host country varies substantially across the samples. This variation corresponds with differences in the average age of immigration.

The distribution of region of birth of immigrants is in Panel B of Table 1. The majority of immigrants in the NHIS are from Mexico or other areas of Central or South America (67%). In contrast, in the NIS sample of recent legal immigrants, more immigrants are from Asia than from Central and South America.

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[6] More details about the earnings variables are available in Online Appendix A.

[7] The NHIS does not collect information on the precise time of arrival of the immigrant. The averages are constructed from the categories for time of arrival that are less than 1 year ago, from 1 to less than 5 years, 5 to less than 10 years, 10 to less than 15 years and over 15 years.

[8] The host country is the U.K. for the HSE sample and the U.S. for the other samples.

The majority of immigrants in the U.K. were born in South Asia. Specific country or area of origin is not available for immigrants in the HRS.

Immigrant and Native-Born Returns to Height

Baseline Results

The basic framework to examine the relationship between height and earnings is estimated using the following equation:

$$logw_i = \alpha_0 + \alpha_1 H_i + \beta X_i + \epsilon_i \tag{1}$$

where w_i is the wage of individual i, H is height, X is a vector of covariates and ϵ is an error term. The errors are clustered at the household level.[9] The covariates included in X vary by specifications. In the most parsimonious specification, X includes a quadratic in age, indicators for region of residence in the U.S. or the U.K. and for year. The specification provides a benchmark of comparison with parsimonious estimates of the returns to height presented in other papers.

[Table 2 about here]

The parsimonious results for the sample of native-born individuals are presented in column 1 of Table 2. The corresponding results over a sample of immigrants are in column 4. Among natives, the coefficients suggest that an additional inch of height translates to a 1.7 to 2.6% increase in wages. The corresponding estimates for immigrant men range between 4.0 to 4.3%. The coefficient estimates on height are significant at the 1% level. The regressions in columns 2 and 5 also control for years of education. For men, while the returns to height decrease slightly with the inclusion of the additional control, the height premium for male immigrants relative to male natives is not eliminated. The gap remains such that each additional inch of height yields about twice more wage gains for immigrants than for native-born individuals.

Furthermore, the magnitudes of the returns to education are consistently lower for immigrants than for native-born individuals. Unlike height, the difference in the returns to education for immigrants and natives is not always statistically significant at the standard levels. The magnitudes of the estimates are consistent with the prediction of the model of statistical discrimination where immigrant height is given more weight by employers because the signals of human capital for immigrants are observed by employers with error. The education signal for immigrants may be observed with less reliability for many reasons. The mapping between a foreign degree and the American or British system may be unclear to employers. The quality of the schools may be more difficult to determine for immigrants than for native-born individuals. Finally,

[9] The results for immigrants are robust to clustering the errors by area of origin or by arrival cohort.

these results may be also be consistent with a story in which the mapping between years of education and productivity in other countries is less steep due to lower quality schools.

Finally, columns 3 and 6 of Table 2 include industry and occupation fixed effects. The precision of these fixed effects range from the one-digit level in the HRS to the two and three-digit levels in the other data sets.[10] By looking within job categories, we can evaluate the hypothesis that the height premium for immigrants is due to sorting into different types of jobs with differences in the average level of height and wages. While the coefficient estimates of height decline, the estimates for immigrant men remain much larger than the corresponding estimates for native-born men. Thus, the results indicate that occupational sorting does not explain the higher returns to height for immigrant men over native-born men.

Overall, the results provide strong evidence that the wage returns to height are substantially larger for immigrant men than for native-born men. The similarity in the results for men across the four samples suggests that the results are quite general and not driven by a particular cohort or country.

Occupational Sorting and Physical Labor

To further investigate the possibility that the patterns in the returns to height are driven by a specific type of sorting of immigrants into jobs where the returns to height are higher, this section examines whether the returns to height vary by the physical demands of the work. I divide jobs by how physically demanding they are using a measure of the physical strength associated with occupations in the Dictionary of Occupational Titles (DOT). I am able to merge the DOT data with the NIS, the HRS and several waves of the NHIS. Online Appendix A.5 provides more details on the data merging and the construction of the indicator for a physically demanding job. If the greater returns to height for male immigrants are driven by their sorting into jobs that require physical strength, then we would expect that the returns to height are larger for workers in physically demanding jobs.

[Table 3 about here]

Table 3 presents the results that include interactions of height with the indicator that equals one if the individual's occupation is physically demanding. In most cases, the estimates of the interaction term are negative. This suggests that the returns to height are actually larger for jobs that are not physically strenuous. The magnitude of the difference in the returns to height for jobs that are physically demanding and jobs that are physically undemanding is very small. The results of Table 3 confirm that the patterns in the relationship between height and wages among immigrants and natives are not driven by sorting of immigrants into physically strenuous jobs.

[10] See Online Appendix A for more details.

Specification and Robustness Checks

Nonlinearities in the Returns to Height

The results presented in Section 3 assume that the relationship between height and the logarithm of wages is linear. This specification follows the standard in the bulk of the literature on the wage returns to height. Nonparametric estimates of the returns to height provide support for the linearity assumption (Strauss and Thomas 1998). However, given that immigrants are on average several inches shorter than native-born individuals, this assumption could be problematic for the analysis of this paper if the actual relationship between height and earnings is concave. This section demonstrates that the estimated differences in the relationship between height and wages for immigrants and for natives is not driven by the functional form of the estimating equation.

[Table 4 about here]

I examine two alternative specifications of the relationship between height and wages. First, I estimate the relationship with a quadratic in the height of the individual. Second, I include the logarithm of height rather than the level of height in inches. The results are presented in Table 4 and are comparable to the results in columns 3 and 6 of Table 2. Columns 1-6 of Table 4 demonstrate that the returns to height are still at least twice as large for immigrant men as for native-born men. This is true both under the quadratic specification (Panel A) and under the logarithmic specification (Panel B). This holds in both the NHIS and the HRS data for Americans as well as in the HSE data for Britons.

Selection of Immigrants

This section considers the idea that the observed relationship between height and wages of immigrants is explained by heterogeneity in the selection process across immigrants. It is possible that only tall individuals succeed in immigrating to the U.S. or the U.K., but this would not introduce a bias in the estimated returns to height among immigrants given the assumption of linearity in the relationship between height and wages. The kind of selection that is necessary to generate an upward bias in the returns to height for immigrants is more complicated. One possibility is negative selection of illegal immigrants from Central America, where the average height is relatively low, combined with positive selection of immigrants from areas where people are taller due to immigration policies.[11] Given that the returns to height are similar in samples where the distribution of originating countries and the time of arrival are very different (as shown in Table 2), this concern is unlikely to be driving the results. For additional confidence, I implement two other

[11] For analysis on the determinants of negative or positive selection of immigrants, see Borjas (1987) and Jasso and Rosenzweig (1990).

specifications, one that includes country fixed effects and one that includes fixed effects for country interacted with arrival cohort. Under the assumption that selection effects vary across countries rather than within countries, the specification with country fixed effects removes the effects of selection. Furthermore, this specification will also address other possible explanations that depend on differences in characteristics across countries of origin. Under the assumption that selection effects vary across time as well as across countries, the specification that includes fixed effects for country interacted with arrival cohort will provide the within country-cohort returns to height for immigrants.

The NIS and HSE include information on country or region of birth of immigrants, but the NHIS only has region of birth of immigrants.[12] The HRS does not share any information about the place of origin of immigrants, and is excluded from the analysis in this section. Immigrants' arrival cohorts are defined by the decade of arrival into the United States or the United Kingdom.

[Table 5 about here]

The results are presented in Table 5. The results correspond with the specification presented in column 6 in Table 2 with the addition of country or region fixed effects (odd columns) or country-cohort fixed effects (even columns). For American immigrants in the NHIS and NIS, the inclusion of country fixed effects and country-cohort fixed effects does not have much effect on the estimates of the returns to height and to education. For British immigrants, the inclusion of country fixed effects in column 3 and of country-cohort fixed effects in column 4 slightly decreases the returns to height. Overall, though, the returns to height remain substantially higher than those of native-born Britons. Thus, the results suggest that the returns to height are not solely driven by differences in selection across countries or time, but also hold when comparing tall and short immigrants from the same country and from the same country and cohort.

Measurement Error in Height

Another potential concern is that systematic differences in reporting error for height between immigrants and natives could bias the coefficient estimates and generate the observed, larger returns to height for immigrants.[13] While height in the NHIS and NIS is self-reported, height is measured by trained interviewers in the HSE. Given that the ratio of the returns to height for immigrants and native-born individuals are similar for the HSE and the NHIS, it is unlikely that the larger returns to height for immigrants are explained by measurement error in height. Height is self-reported in the 1992 wave of the HRS used in this analysis. Height is also self-reported in all subsequent waves of the HRS, but in 2006

[12] More details about the regions and countries of origin are provided in Online Appendix A.4.

[13] Another possible concern is that measurement error in education is greater among immigrants than among natives. However, this is unlikely to be driving the estimates of the wage returns to height as columns 1 and 4 in Table 2 do not include education.

height was also measured by trained staff and the average reporting error was very low at around 1-2% with no significant differences by racial or ethnic subgroups (Meng, He and Dixon 2010).

A method for addressing systematic reporting error in height was suggested by Lee and Sepanski (1995) and Bound, Brown and Mathiowetz (2002). They use an independent source of data that contains both the true and the reported values of the variable. By estimating the true value of the variable as a function of its noisy reported value and other observable characteristics, one can derive a relationship between the reported and the true values. Assuming that the relationship between the reported and the measured values are the same in both data sets, the estimated relationship from the validation data can be used to calculate the true value of height from the reported value in the primary data set.

Respondents in the Third National Health and Nutrition Examination Survey (NHANES III) from the U.S. Department of Health and Human Services reported their own estimates of height and were professionally measured four weeks later. Using this data set to implement the correction for reporting error in height separately for immigrants and native-born individuals does not remove the large gap in the returns to height for immigrants and for native-born individuals in the NHIS and NIS.[14]

Productivity Differences in the Height Signal

The previous literature has demonstrated evidence for the linkage between height and health (Strauss and Thomas 1998, Steckel 1995), cognitive skills (Case and Paxson 2008) and non-cognitive skills (Persico, Postelwaite and Silverman 2004). It is possible that the larger impact that each additional unit of height has on immigrant wages over native-born wages results from non-linearities in the mapping between nutritional inputs and health and cognitive development. For example, the returns to increasing investment in health and nutrition can have higher returns in both height and productivity at low levels of investment. I test this hypothesis in three ways. First, I examine whether the higher returns to height for immigrants are driven by immigrants from poorer regions of the world. Second, I directly test whether height is more correlated with measures of productivity for immigrants than for native-born individuals. Finally, I examine whether the returns to height are larger in jobs that use cognitive reasoning.

Returns to Height by Income of Country of Origin

First, I examine whether the returns to height for immigrants vary by the average income of their country of origin. The following wage regression is implemented over a sample of immigrants:

[14] I use the NHANES III rather than the HRS for this exercise because the age distribution of the NHANES III sample is more similar to the age distributions of the NHIS and NIS data. These results are available from the author upon request.

$$logw_{ij} = \alpha_0 + \alpha_1 H_{ij} + \sum_{k=2}^{4} \alpha_k \, GDPN_{j\in k} * H_{ij} + \beta X_{ij} + \gamma_j + \epsilon_{ij} \quad (2)$$

where $GDPN_{j\in k}$ is an indicator variable for whether the real per capita GDP of the individual's country of origin j is in quartile k in the year of immigration across all immigrants in the sample.[15] The specification includes country fixed effects, γ_j. The estimate of α_1 yields the within-country returns to height for immigrants from countries in poorest quartile of the immigrant sample. The estimate of α_k indicates whether the within-country returns to height for immigrants from countries in the kth poorest quartile are different from those in the poorest quartile.

If the difference in the relationship between height and productivity for immigrants and native-born Americans and Britons is driven by higher productivity returns to nutritional and health inputs at low levels of investment, then we expect the wage returns to height to be largest for immigrants from poor countries relative to others from the same country. In other words, the productivity hypothesis suggests the coefficient estimate of α_1 to be positive and large, and the coefficient estimates of α_k to be negative and decreasing in k. This is a weak test of the productivity hypothesis. If the described pattern in the coefficients is not observed, then this is evidence against the productivity hypothesis; however, if the pattern in the coefficients is observed, the results are consistent with the productivity story but also consistent with other stories such as a model of statistical discrimination if the reliability of the signal of height is decreasing in the per capita GDP of the immigrants' country of origin.[16]

These equations are estimated using the NIS and HSE samples that contain information on the specific country of origin of immigrants. The distribution of the immigrants' origins are quite different across these samples (see Panel C of Table 1); thus, it is not surprising that the distribution of GDP per capita is very different across the samples. The quartiles are constructed within the NIS and HSE so the categories refer to different levels of GDP per capita for the samples.[17] The sample for this analysis is further limited to immigrants for which there is a specific country of origin; immigrant observations that are only provide a region of origin are not included.[18]

[Table 6 about here]

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[15] Data on real GDP per capita in the country of origin across years is the Laspeyres series from the Penn World Tables with a reference year of 1996.

[16] A pattern of an inverse relationship between the magnitude of the returns to height and the level of development of the country of origin is necessary but not sufficient support for the productivity hypothesis. While the pattern is consistent with a particular type of statistical discrimination, it is neither necessary nor sufficient.

[17] The cutoffs for the quartiles for the HSE are USD$1386, $1641 and $2505. In the NIS, they are $2741, $4707 and $8256.

[18] Detailed information on country and region of origin is available in Online Appendix A.4.

Table 6 displays the results. The estimated coefficient on height is positive and statistically different from zero at the 5% level. The coefficient estimates on the interactions are all negative in the sample of male immigrants. The returns to height decrease with the quartile of the GDP per capita of the country of origin. Furthermore, the magnitude of the coefficients on the interactions for both NIS and HSE males are consistent with the hypothesis that immigrant returns to height reflect productivity. The gap in wages associated with a ten-inch difference in height for two male immigrants in the U.S. who are from a poor country like Ethiopia will be 12% but the corresponding gap would only be around 5% for two male immigrants from a rich country like the U.K. Thus, the returns to height for American immigrants from wealthy countries is very similar to the estimated height premium for native-born Americans.

These results demonstrate that the within-country slope of the relationship between height and productivity is decreasing in the level of development of immigrants' country of origin. Thus, the empirical results are consistent with the hypothesis that the larger wage returns to height for immigrants are explained by a different relationship between height and productivity for immigrants than for native-born individuals. However, as previously mentioned, these results are necessary but not sufficient evidence for the productivity hypothesis because they can also be explained by the mechanism of statistical discrimination under some assumptions. The next section presents a stronger test of the productivity hypothesis.

Height and Direct Measures of Ability

In the second test, I directly examine whether height is more correlated with measures of productivity for immigrants than for native-born individuals. This hypothesis is tested with the following regression over a sample that includes both immigrants and native-born individuals :

$$P_i = \beta_0 + \beta_1 H_i + \beta_2 H_i * I_i + \beta_3 I_i + \beta_4 X_i + \epsilon_i \tag{3}$$

where I_i is an indicator that equals 1 if individual *i* is an immigrant. The dependent variable, P, is health status or cognitive ability.[19] If the gap in the returns to height reflect differences in the relationship between height and productivity for immigrants and for native-born individuals, then we expect the coefficients β_1 and β_2 to have the same sign and the magnitude of β_2 relative to β_1 to be similar to the gap in the returns to height for immigrants relative to native-born individuals displayed in Table 2.

[Table 7 about here]

[19] Ideally, the analysis would also have measures of non-cognitive ability as a dependent variable, but such measures are not available in the four data sets used in the paper.

The OLS results are presented in Table 7.[20] In the first three columns, the dependent variable is individuals' self-reported health status where 1 refers to excellent health and 5 to poor health.[21] In all three samples, taller individuals are also healthier, and these estimates are significant at the 1% level. Furthermore, the evidence in the NHIS and HSE suggests that each additional inch of height corresponds to a larger improvement in health for immigrants than for native-born individuals. The gap is largest in the HSE sample where a ten-inch change in height corresponds with one-fifth of a standard deviation of better health for native-born men and with over one-half of a standard deviation of better health for immigrant men. The gap is also significant in the NHIS sample where a ten-inch change in height corresponds with one-quarter of a standard deviation of better health for native men and over one-third of a standard deviation for immigrant men. In contrast, the results of the HRS show the opposite result; the impact of height on health is smaller for immigrants than for natives but this is not statistically significant.[22]

The last three columns of Table 7 correspond to equation 3 with the dependent variable as a measure of cognitive ability. Of the main data sets used in this analysis, only the HRS has a direct measure of the cognitive ability of adults. HRS adults are administered the Wechsler Adult Intelligence Scale (WAIS) test, which is the primary instrument used to measure the intelligence quotient (IQ) of adults and adolescents. The WAIS covers verbal comprehension, memory, perceptual organization and processing speed. A higher score of the test corresponds to higher IQ.

I supplement the analysis with data from the Third National Health and Nutrition Examination Survey (NHANES III), which contains information on immigration status, height and several measures of cognitive ability.[23] The symbol-digit substitution test (SDST) is one of the tests included in the WAIS and measures coding speed. Individuals are presented with pairings of digits and symbols and are asked to enter the corresponding digit for a series of the symbols as quickly as possible. Five trials were conducted and the score used is the error-corrected speed. A lower value corresponds to faster responses and higher cognition. In addition, the NHANES includes a serial digit learning test (SDLT), which measures learning and recall. Individuals are presented with a sequence of digits. Afterwards, the individual is asked to enter the entire sequence of numbers in the order presented. A smaller number represents fewer mistakes and higher cognition.

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[20] Online Appendix B considers the impact of the inclusion of health and cognition on the estimated relationship between earnings and height.

[21] The results in Table 7 assume that the measure of health status can be treated as an interval variable. The results are robust to relaxing this assumption by allowing the dependent variable to be ordinal in an ordered probit specification. These results are available from the author upon request.

[22] The HRS does not ask about past health status, so the HRS sample for Table 7 is limited to 1992.

[23] The NHANES III spans 1988-1994 and was designed to obtain nationally representative information on health and nutrition of individuals in the U.S. This data isn't used in the other analyses of the paper because it lacks information on the income of respondents.

The results demonstrate that for all three measures, taller men also have higher cognitive ability. This is consistent with the results of Case and Paxson (2008). This analysis also indicates that the correlation between height and cognition is stronger for immigrants than for native-born individuals. This holds for the three measures of cognitive ability. The difference is statistically large in magnitude and significant for the NHANES sample but not statistically significant at the 10% level for the HRS sample. The NHANES results suggest that each additional inch of height corresponds to more than twice as large an increase in cognition for immigrants as for native-born individuals. Overall, the results provide evidence in support of the hypothesis that the greater wage returns to height experienced by immigrants reflect a higher slope in the mapping between height and productivity.

Returns to Height in Job Requiring Cognitive Skills

Building on the evidence in the previous section that showed that height is more strongly correlated with health and cognitive ability for immigrants than for natives, I examine whether the height premium in earnings varies by the cognitive demands associated with jobs. The cognitive reasoning associated with occupations is quantified by the DOT, and is described in more detail in Online Appendix A.5. If the gap in the returns to height for immigrant and native men reflects differences in the correlation between height and cognitive ability, we would expect both a larger height premium for individuals working in jobs that require cognitive reasoning and a steeper slope for immigrants in these jobs than for natives.

[Table 8 about here]

The results that include interactions between height and whether the job requires cognitive reasoning are in Table 8. For both natives and immigrants, the height premium in earnings is significantly larger in jobs that require reasoning skills. Furthermore, the additional gains associated with height in jobs using cognitive ability is larger for immigrant men than for native men; this gap is the largest in the HRS data where the additional wage gains associated with height in cognitively demanding jobs is more than twice as large for immigrants as for natives. The results confirm previous findings that variation in the conditions and inputs of early life have long-run effects on both adult height and cognitive ability (Case and Paxson 2008).

Conceptual Framework for Statistical Discrimination

The model of statistical discrimination examined in this paper is based on an observable, continuous measure of skill (Aigner and Cain 1977; Phelps 1972).[24] This skill measure has been conceptualized as a

[24] Note that the emphasis on this class of models is on signal reliability and is distinct from models of statistical discrimination that focus on employers’ use of (or beliefs about) differences in the average outcomes of groups (Altonji and Pierret 2001; Coate and Loury 1993; Farber and Gibbons 1996; Fryer 2007).

test score such as on a college entrance exam or an employer-administered exam. The economics literature on statistical discrimination of groups in the labor market and the uncertainty in the information provided by a continuous test score has been almost entirely theoretical. This may reflect the reality that very few employers administer exams as part of their hiring practices or ask about standardized test scores. The framework used in this paper builds on these existing theoretical models with height representing the continuous measure of skill. One advantage of the focus on height rather than test scores is that it is plausibly observed by employers.

Consider the case where the true relationship determining marginal productivity, P^*, is given by

$$P_i^* = \alpha + H_i^* \beta + S_i^* \delta + \epsilon_i \tag{4}$$

where height, H^*, is perfectly observable by employers. True human capital, denoted by S^*, is observed by employers with error:

$$S_i = S_i^* + \zeta_i. \tag{5}$$

I assume that ζ_i is uncorrelated with S_i^* and H_i^*.

Assuming that workers are paid their marginal product, the estimated wage returns to H, $\hat{\beta}$, is given by

$$\hat{\beta} = \frac{Cov(H_i^{*}\,\beta + S_i^* \delta, H_i^* - S_i \hat{\pi}_{sh})}{Var(H_i^* - S_i \hat{\pi}_{sh})} \tag{6}$$

where $\hat{\pi}_{sh} = \frac{Cov(S_i, H_i^*)}{Var(S_i)}$.

After a little additional algebra, we get

$$\hat{\beta} = \beta + \frac{\frac{Cov(S_i^*, H_i^*) Var(\zeta_i)}{Var(S_i^*) + Var(\zeta_i)}}{Var(H_i^*)(1 - R_{sh}^2)} \delta \tag{7}$$

where R_{sh}^2 is the R-squared of a regression of S on H^*. The sign of the fraction preceding δ in equation 7 is determined by the direction of the correlation between H^* and S^*. If H^* and S^* are positively correlated and educational attainment increases productivity ($\delta > 0$), then error in the employers' observations of S^*, denoted by $Var(\zeta_i)$, leads to an overestimate of the returns to H.

Consider two groups, immigrants and native-born individuals, denoted by I and N, respectively. If the differences across the two groups are such that S is a more reliable indicator of productivity for natives than for immigrants (in other words, $Var(\zeta_i^I) > Var(\zeta_i^N)$), then all else equal, statistical discrimination by employers implies that $\hat{\beta}^I > \hat{\beta}_N$.

The estimated wage returns to S are given by

$$\hat{\delta} = \delta\left[1 - \frac{Var(\zeta_i)}{(1 - R_{sh}^2)(Var(S_i^*) + Var(\zeta_i))}\right]. \tag{8}$$

Thus, under statistical discrimination, the returns paid by employers for human capital are attenuated by the noise associated with the signal. Greater noise in the signal of human capital leads to a lower estimate of the relationship between wages and observed human capital.

Testing for Statistical Discrimination

The results in the main section of the paper are consistent with statistical discrimination on the basis of height; the wage gains associated with height to be greater for immigrants than for native-born individuals and the wage gains associated with education to be greater for native-born individuals than for immigrants.

The model of statistical discrimination further implies that if uncertainty in immigrants' signals of human capital is reduced, the gaps between the two groups in the wage returns to height and education should close. To test this implication of the model, in addition to standard data on wages, height and education, I need a variable that correlates with the noise in the signal of human capital.

I consider three potential measures of information quality. Two of the measures, years since immigration and any education in the host country, are available in cross-sectional data on immigrants. While the quality of the signal of human capital is likely to increase with immigrants' time in the host country or human capital acquisition in the host country, these measures may also be correlated with unobservable characteristics. To address this issue, I consider an alternative approach that relies on variation in signal reliability before and after immigration. Assuming that employers in the U.S. observe signals of productivity with more noise than employers in the country of origin, I can use pre-immigration labor market experiences to evaluate the hypothesis of statistical discrimination using height. This time-series variation also allows for an examination of the validity of the other two measures of signal quality.

Cross-Sectional Variation in Signal Reliability

Over a sample of immigrants, I estimate the following equation:

$$logw_i = \beta_0 + \beta_1 H_i + \beta_2 H_i * Q_i + \beta_3 S_i + \beta_4 S_i * Q_i + \beta_5 Q_i + \beta_5 X_i + \epsilon_i \quad (9)$$

where S is total years of schooling and Q is a measure of signal quality.[25] If signal quality is increasing in Q and $\beta_1 > 0$ and $\beta_3 > 0$, the model of statistical discrimination predicts that the wage returns to height are decreasing in signal quality ($\beta_2 < 0$) and the wage returns to education are increasing in signal quality ($\beta_4 > 0$). In other words, as the reliability of the signal of S improves, employers place more weight on S and less weight on the perfectly observable characteristic, H. This relies on plausible assumptions that height is observed perfectly by employers for both immigrants and natives but S is observed with more error for immigrants than for native-born individuals.

I consider two potential measures of Q. The first measure of Q is years since immigration. As an immigrant spends more time in the host country, the quality of human capital signal is likely to improve. This may occur because communication becomes easier either through improved language ability or cultural assimilation. The second measure of Q is an indicator for whether the immigrant completed any education in the host country. The quality of the signal of human capital is plausibly improved when an immigrant attends school in the host country. For example, if an individual has a graduate degree from an American university in addition to a foreign degree, the noise in the signal for employers is plausibly lower than if the individual had a similar graduate degree from an unfamiliar foreign university.

One concern is that the measures of Q capture unobserved ability rather than signal quality. The predictions associated with this alternative interpretation of Q would be different. If we assume that education and ability are complements in worker productivity and there are also complementarities between different types of ability, then this alternative model would suggest that $\beta_2 > 0$ and $\beta_4 > 0$.[26] It is possible that the measures of Q may capture variation in worker ability. The cultural assimilation or improved English language abilities associated with years in the host country may increase worker productivity directly in addition to reducing the noise in the signal of productivity. Furthermore, over time some immigrants choose to leave the host country and this selection may generate a correlation between ability and years in the host country. If high ability immigrants remain in the U.S. or if productivity increases directly with the amount of time in the host country due to assimilation, then we would expect $\beta_2 > 0$ and $\beta_4 > 0$. If selection is such that low ability immigrants are more likely to remain in the U.S., then we would expect $\beta_2 < 0$ and $\beta_4 < 0$. As with the other measure of Q, host country education may be correlated with

[25] Q is equivalent to $Var(\zeta_i)$ in the model. Note that while the model of Altonji and Pierret (2001) produces a similar estimating equation, the underlying model is quite different. The estimation here does not require a variable that is observed by the econometrician but not by the employer.

[26] The assumption that education and ability are complementary inputs into worker productivity is common (Lang and Manove 2011; Mwabu and Schultz 1996). Evidence suggests strong complementarities types of ability such as cognitive ability and social skills (Cunha and Heckman 2007; Weinberger forthcoming).

individual ability. If immigrants with host country education tend to have higher ability due to admissions policies and immigration rules, or if productivity directly improves as the result of any education in the host country, then we expect $\beta_2 > 0$ and $\beta_4 > 0$.

[Table 9 about here]

The results are presented in Table 9. The evidence on how the returns to education vary with the amount of time spent in the U.S. or the U.K. is fairly mixed. It is positive and significant in the NHIS data, negative and significant in the NIS data, and statistically and economically not different from zero in the HSE and HRS. Years since immigration generally has a positive effect on the returns to height rather than the negative effect predicted by the model of statistical discrimination. In fact, the effect for each additional decade in the host country is extremely small in magnitude and not statistically different from zero. The results in the even columns where Q is an indicator for education in the host country also are not consistent with the predictions of statistical discrimination. The magnitude and significance of the estimates of the interaction between height and education in the host country suggest that there is no impact of host country education on the returns to height. Overall, the evidence does not support the hypothesis of statistical discrimination by employers against immigrants. The results also do not support the idea that Q captures unobserved ability rather than signal quality.

Variation in Signal Reliability and Panel Data

The NIS asks retrospective information on the labor market experiences of immigrants in the year that they immigrated to the U.S. Assuming that the reliability of the signal of human capital is lower for employers in the host country than for employers in the country of origin, pre-immigration labor market information offers another test of the model of statistical discrimination.

Over a sample that pools pre- and post-immigration labor market experiences of individuals in the NIS, I estimate the following equation:

$$logw_{it} = \gamma_0 + \gamma_1 H_i + \gamma_2 H_i * PreImmig_{it} + \gamma_3 S_{it} + \gamma_4 S_{it} * PreImmig_{it} + \gamma_5 X_{it} + \upsilon_{it} \qquad (10)$$

where $PreImmig$ is an indicator that equals one if the data refer to a period prior to immigration to the U.S., and X includes a quadratic in age, and indicators for country of origin and year. The panel data set includes two observations for every individual, one observation prior to immigration and one observation after immigration.[27] Age and years of education are adjusted appropriately in the pre-immigration data. I

[27] One of the key limitations of the panel results is that the sample in this section only includes a selected group of individuals that worked both before and after immigration. For example, individuals who immigrate to the U.S. for education and never worked in their origin country would not be included in this analysis.

include country of origin fixed effects to address the issue that the returns to height and education may vary in different countries. The key coefficients of interest, γ_2 and γ_4, yield the difference between the pre- and post-immigration wage returns to height and education among individuals originating from the same country.

The key assumption of equation 10 is that employers in the immigrants' country of origin observe signals of productivity that are less noisy than the signals observed by American employers. Statistical discrimination based on height by American employers would yield $\gamma_2 < 0$ and $\gamma_4 > 0$. If employer statistical discrimination on height occurs in the absence of other reliable sources of information, then we expect that employers' reliance on height to be less strong for immigrants in their country of origin than in the U.S. In other words, the wage returns to education are higher prior to immigration when the signal is clearer. The weight placed on height is lower given the availability of other information on productivity.

The NIS pseudo-panel data offers additional predictions in combination with the measures of signal quality, Q, discussed in the previous section. I estimate the following regression:

$$\begin{gathered} logw_{it} = \gamma_0 + \gamma_1 H_i + \gamma_2 PreImmig_{it} * H_i + \gamma_3 S_{it} + \gamma_4 PreImmig_{it} * S_{it} + \\ \gamma_5 PreImmig_{it} + \gamma_6 H_i * Q_i + \gamma_7 S_{it} * Q_i + \gamma_8 PreImmig_{it} * Q_i + \\ \gamma_9 H_i * PreImmig_{it} * Q_i + \gamma_{10} S_{it} * PreImmig_{it} * Q_i + \gamma_{11} Q_i + \gamma_{12} X_{it} + v_{it} \end{gathered} \tag{11}$$

where Q is years since immigration to the U.S. divided by ten or whether the individual has any education in the U.S. The measures of Q are time-invariant in this equation to allow us to determine whether Q reflects time-invariant unobservable ability. Under statistical discrimination, the post-immigration interactions of height and Q would be as previously discussed ($\gamma_6 < 0$ and $\gamma_7 > 0$) because as the signal of education improves less weight is placed on height and more on education. If the effect of Q is driven by a correlation with unobserved ability rather than capturing signal quality, we should see positive returns to Q both before and after immigration as well as positive estimates of the interactions of Q with height and education both before and after immigration ($\gamma_6 > 0$, $\gamma_7 > 0$, $\gamma_6 + \gamma_9 > 0$ and $\gamma_7 + \gamma_{10} > 0$).

[Table 10 about here]

The results of equations 10 and 11 are presented in Table 10. In columns 1 and 3, the signs on the interactions, γ_2 and γ_4, are opposite to the predictions of statistical discrimination. The estimates in column 2, where both coefficients are negative, are also not consistent with statistical discrimination. However, we cannot statistically reject the hypothesis because none of the estimated interactions are significantly different from zero at the 10% level on their own or jointly.

Column 2 presents the results where Q is the amount of time that the immigrant has spent in the U.S. (divided by 10). We see that $\gamma_6 > 0$ and $\gamma_7 < 0$ which is not consistent with either statistical discrimination or Q reflecting ability, but these estimates are not significant at the standard levels. The results on the pre-immigration effects of Q interacted with education, $\gamma_7 + \gamma_{10}$, also indicate that Q is not picking up unobserved ability. The results where Q is a dummy variable for American education is displayed in column 3 of Table 10. The key predictions of the model of statistical discrimination regarding education are again rejected. First, the post-immigration returns to education are decreasing with U.S. education (γ_7) rather than increasing as predicted by statistical discrimination and this estimate is statistically significant. Second, the total pre-immigration interaction between American education and the returns to years of education ($\gamma_7 + \gamma_{10}$) are negative and statistically different from zero at the 5% level.

Overall, the results do not support the model of statistical discrimination using height given variation in signal reliability across groups for men. The pre-immigration effects of both measures of Q are not statistically different from zero. The evidence against the model of statistical discrimination depends on the assumption that the measures of Q capture variation in signal quality. I consider the most plausible alternative interpretation of Q, that the measures reflect unobserved ability, and do not find evidence supporting an ability bias.

Conclusion

Using several different data sets, this paper presents a very robust empirical finding that the returns to height are much larger for immigrant men in the U.S. and the U.K. than they are for native-born men in those countries. This research contributes to our understanding of the economic literature that uses height as an input into an individual-level production function or as an outcome to compare individuals. The empirical evidence in this paper suggests that there is a stronger relationship between height and unobserved components of productivity, including health and cognitive ability, for immigrants than for native-born Americans or Britons. This suggests the possibility of a concave relationship between health and nutritional inputs during early life and long-run outcomes such as adult height and productivity. Future research can exploit the way that height offers information about cognitive development in evaluating the kinds of early life interventions that are important for long-run outcomes.

In addition, this paper contributes to the literature that tests for employer statistical discrimination. The paper is the first to present an empirical analysis that focuses on height. Given that height is as easy to observe as race and gender, this physical characteristic is simple for employers to use. The distinction between immigrants and native-born individuals presents plausible groups for whom there is a discrepancy in the reliability of other signals of productivity, such as education. While the results suggest that height offers information about productivity that is otherwise not directly observed, the empirical evidence indicates that employers do not use height as a tool of statistical discrimination. This finding is similar to previous results that suggest that employers do not use race to statistically discriminate among workers despite the differences in average outcomes by race (Altonji and Pierret 2001).

These results have important implications for our understanding of the immigration decisions of individuals as well as the process of assimilation of immigrants. The empirical findings of this paper do not support the hypothesis that improvements in signal quality over time and statistical discrimination on the basis of height play a role in the convergence over time wages among immigrants in the U.S. or U.K.

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Table 1: Summary Statistics

	NHIS		HSE		HRS		NIS
	Native	Immigr	Native	Immigr	Native	Immigr	Immigr
Panel A: Individual Characteristics							
Height (Inches)	70.35	68.13	69.22	67.50	70.04	67.97	68.12
	(2.65)	(2.83)	(2.68)	(2.66)	(2.77)	(3.27)	(3.39)
Age	39.52	37.87	40.14	40.13	45.18	46.88	37.02
	(10.72)	(9.99)	(10.11)	(9.51)	(11.26)	(9.63)	(8.91)
Yearly Earnings	44849	34669	27463	24010	24376	24494	33934
	(24836)	(23375)	(21979)	(22960)	(26626)	(45918)	(44793)
Hourly Earnings	21.95	16.52			22.67	21.76	15.81
	(39.58)	(23.56)			(32.19)	(74.28)	(20.05)
White Collar	0.34	0.25	0.44	0.38	0.32	0.28	0.30
	(0.48)	(0.43)	(0.49)	(0.50)	(0.47)	(0.45)	(0.46)
Education	13.81	12.45	12.13	12.90	12.32	10.65	13.72
	(2.23)	(3.21)	(2.26)	(2.96)	(3.12)	(5.06)	(4.62)
Health Status	1.94	2.00	1.79	1.93	2.58	2.57	1.87
	(0.89)	(0.92)	(0.79)	(0.83)	(1.19)	(1.20)	(0.91)
Immigration Age		18.8		19.1		29.4	28.0
		(9.04)		(10.0)		(11.8)	(10.5)
Years in U.S./U.K.		18.0		21.0		18.7	8.9
		(11.0)		(13.0)		(12.3)	(8.2)
Host Country Education		0.43		0.41		0.14	0.22
		(0.49)		(0.49)		(0.35)	(0.42)
Observations	41537	9652	3519	1643	9200	903	2958
Panel B: Distribution of Immigrants' Region of Origin							
Central & South America		67.2					25.3
Europe & Central Asia		10.1		7.2			18.9
Africa & Middle East		5.7		20.8			11.3
Asia		14.5		56.1			30.2
Other		2.5		15.8			14.3
Panel C: Immigrant Height by Region of Origin							
Central & South America		67.7					67.2
		(2.69)					(3.29)
Europe & Central Asia		70.3		68.5			70.2
		(2.68)		(2.22)			(3.04)
Africa & Middle East		69.3		67.7			69.0
		(2.75)		(2.59)			(3.75)
Asia		67.8		67.1			67.4
		(2.57)		(2.59)			(2.87)
Other		70.3		68.0			67.7
		(2.76)		(2.87)			(3.42)

Notes: Standard deviations in parentheses. Earnings are in real 2004 US dollars for the US samples and real 2004 British sterling for the HSE sample. Health status ranges from 1 to 5 where 1 equals excellent and 5 poor. In Panels B and C, for the US, “Other" is comprised mainly of Canada and Oceania. For the UK, “Other" is comprised mainly of North America. Host Country Education equals one if the person completed at least a year of schooling in the host country.

Table 2: Baseline Returns to Height for Natives and Immigrants

	Native Born			Immigrant		
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A: U.S. Men (NHIS)						
Height	0.017	0.009	0.006	0.043	0.018	0.013
	[0.001]***	[0.001]***	[0.001]***	[0.002]***	[0.002]***	[0.002]***
Education		0.087	0.058		0.083	0.042
		[0.001]***	[0.002]***		[0.002]***	[0.003]***
Observations	41537	41537	41537	9652	9652	9652
Adjusted R^2	0.14	0.23	0.32	0.13	0.28	0.39
Panel B: U.K. Men (HSE)						
Height	0.026	0.022	0.010	0.043	0.039	0.023
	[0.005]***	[0.005]***	[0.004]**	[0.008]***	[0.008]***	[0.008]***
Education		0.069	0.010		0.048	0.001
		[0.008]***	[0.006]		[0.008]***	[0.008]
Observations	3519	3519	3519	1643	1643	1643
Adjusted R^2	0.09	0.13	0.31	0.05	0.07	0.33
Panel C: U.S. Men (HRS)						
Height	0.025	0.012	0.009	0.040	0.021	0.015
	[0.003]***	[0.003]***	[0.003]***	[0.010]***	[0.009]**	[0.008]*
Education		0.072	0.065		0.057	0.047
		[0.003]***	[0.003]***		[0.006]***	[0.007]***
Observations	9200	9200	9200	904	904	904
Adjusted R^2	0.05	0.13	0.16	0.17	0.26	0.33
Panel C: U.S. Men (NIS)						
Height				0.023	0.015	0.009
				[0.003]***	[0.003]***	[0.003]***
Education					0.080	0.032
					[0.007]***	[0.007]***
Observations				2958	2958	2958
Adjusted R^2				0.08	0.12	0.24
Ind & Occ FE	No	No	Yes	No	No	Yes

Notes: Robust standard errors clustered by household in brackets. ***,**, * denote significance at the 1%, 5% and 10% level, respectively. The dependent variable is the logarithm of current real earnings in the U.S. and pre-immigration real earnings at the time of immigration (in real U.S. dollars). Height is in inches. All regressions include a quadratic in age, indicators for year and for region, and a constant term. Columns 3 and 6 include industry and occupation indicators.

Table 3: Returns to Height by the Physical Demands of the Occupation

	NHIS		HRS		NIS
	Native	Immigrant	Native	Immigrant	Immigrant
	(1)	(2)	(3)	(4)	(5)
Height	0.007	0.015	0.009	0.012	0.009***
	[0.001]***	[0.003]***	[0.003]***	[0.008]	[0.003]
Height*I(Physical Job)	-0.001	-0.003	-0.001	0.001	0.000
	[0.001]	[0.001]**	[0.001]*	[0.002]	[0.001]
Observations	29589	6503	9200	904	2958
Adjusted R^2	0.31	0.38	0.17	0.34	0.23
Mean of I(Physical Job)	0.517	0.668	0.570	0.649	0.622

Notes: Robust standard errors clustered by household in brackets. ***,**, * denote significance at the 1%, 5% and 10% level, respectively. The dependent variable is the logarithm of real earnings. Height is measured in inches. A physical job is an indicator that equals one if the person's occupation is greater than 2 on a 5 point scale where 1 is sedentary and 5 is heavy strength. All regressions include a quadratic in age, education, indicators for year, region, industry and occupation, and a constant term.

Table 4: Nonlinear Estimates of the Returns to Height

	NHIS Data		HSE Data		HRS Data	
	Native	Immigr	Native	Immigr	Native	Immigr
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A: Quadratic Specification						
Height	0.097	0.209	0.121	0.352	0.002	0.115
	[0.045]**	[0.085]**	[0.143]	[0.260]	[0.056]	[0.168]
Height^2	-0.001	-0.001	-0.001	-0.002	0.000	-0.001
	[0.000]**	[0.001]**	[0.001]	[0.002]	[0.000]	[0.001]
F-statistic	18.46***	19.95***	3.05**	4.69***	4.58***	1.45
Observations	41537	9652	3519	1643	9200	904
Adjusted R^2	0.32	0.39	0.31	0.33	0.15	0.30
Panel B: Logarithmic Specification						
Log(Height)	0.446	0.875	0.543	1.436	0.516	0.916
	[0.077]***	[0.151]***	[0.282]*	[0.562]**	[0.198]***	[0.555]*
Observations	41537	9652	3519	1643	9200	904
Adjusted R^2	0.32	0.39	0.33	0.35	0.15	0.30

Notes: Robust standard errors clustered by household in brackets. **, *, + denote significance at the 1%, 5% and 10% level, respectively. The dependent variable is the logarithm of real wages. Height is measured in inches. All regressions include a quadratic in age, education, indicators for year, region, industry and occupation indicators, and a constant term. The F-statistic refers to whether height and height squared are jointly significant.

Table 5: Within-Country and Cohort Estimates of Immigrants' Returns to Height

	U.S. (NHIS)		U.K. (HSE)		U.S. (NIS)	
	(1)	(2)	(3)	(4)	(5)	(6)
Height	0.012	0.012	0.017	0.017	0.007	0.008
	[0.002]***	[0.002]***	[0.009]*	[0.008]**	[0.003]**	[0.003]**
Education	0.038	0.039	0.004	0.008	0.036	0.037
	[0.003]***	[0.003]***	[0.009]	[0.009]	[0.008]***	[0.008]***
Country FE	Yes	Yes	Yes	Yes	Yes	Yes
Country*Arrival Cohort FE	No	Yes	No	Yes	No	Yes
Observations	9652	9652	1643	1643	2958	2958
Adjusted R^2	0.40	0.42	0.34	0.35	0.25	0.26

Notes: Robust standard errors clustered by household in brackets. ***,**, * denote significance at the 1%, 5% and 10% level, respectively. The dependent variable is the logarithm of real earnings. Height is measured in inches. All regressions include a quadratic in age, indicators for year and for region of residence in the U.S. or U.K., and a constant term. The additional controls in the even columns are indicators for industry and occupation. The NIS and HSE both have country of birth of immigrants, but the NHIS only provides information on region of birth.

Table 6: Immigrants' Returns to Height and Per Capita GDP of Country of Origin

	NIS Data	HSE Data
	(1)	(2)
Height	0.012	0.040
	[0.005]**	[0.016]**
Height* $\frac{GDP}{N}$ quartile 2	-0.004	-0.017
	[0.011]	[0.024]
Height* $\frac{GDP}{N}$ quartile 3	-0.004	-0.027
	[0.001]***	[0.031]
Height* $\frac{GDP}{N}$ quartile 4	-0.007	-0.039
	[0.002]***	[0.027]
Observations	1914	1101
Adjusted R^2	0.26	0.38

Notes: Robust standard errors clustered by household in brackets. ***,**, * denote significance at the 1%, 5% and 10% level, respectively. The dependent variable is the logarithm of real wages. Height is measured in inches. All regressions include a quadratic in age, indicators for year, for region, for GDP quartiles and for country of origin, education, industry and occupation controls, and a constant term.

Table 7: Relationship between Height, Health and Cognition

	Health Status			Cognitive Ability		
	NHIS	HSE	HRS	NHANES		HRS
				SDST	SDLT	WAIS
	(1)	(2)	(3)	(4)	(5)	(6)
Height	-0.023	-0.016	-0.039	-0.014	-0.091	0.124
	[0.002]***	[0.005]***	[0.008]***	[0.004]***	[0.017]***	[0.025]***
Immigrant*Height	-0.009	-0.033	0.013	-0.031	-0.161	0.027
	[0.004]**	[0.009]***	[0.021]	[0.007]***	[0.035]***	[0.077]
Immigrant	0.623	2.374	-1.018	5.778	30.103	-2.640
	[0.246]**	[0.430]***	[1.426]	[1.269]***	[5.950]***	[5.204]
Observations	51189	7462	2554	2300	2250	2195
Adjusted R^2	0.03	0.06	0.01	0.12	0.13	0.02
Mean of Dep. Var.				3.02	6.02	6.21
(Standard Deviation)				(1.11)	(5.06)	(2.99)

Notes: Robust standard errors clustered by household in brackets. ***,**, * denotes significance at the 1%, 5% and 10% level, respectively. Height is measured in inches. All regressions include a quadratic in age, indicators for year and a constant term. In columns 1-3, the dependent variable, health, is a self-reported measure where 1 equals excellent health and 5 equals poor health. The measure of cognition is the error-corrected speed for the symbol digit substitution test (SDST), total score in the serial digit learning test (SDLT) in column 5, and the standardized Wechsler Adult Intelligence Scale (WAIS) score in column 6. Cognitive ability is increasing in the WAIS score, but decreasing in the other measures.

Table 8: Returns to Height by the Cognitive Requirements of the Occupation

	NHIS		HRS		NIS
	Native	Immigrant	Native	Immigrant	Immigrant
	(1)	(2)	(3)	(4)	(5)
Height	0.005***	0.012***	0.008***	0.011	0.008**
	[0.001]	[0.003]	[0.003]	[0.008]	[0.003]
Height*I(Cognitive Job)	0.0017***	0.0022**	0.002**	0.005*	0.004***
	[0.000]	[0.001]	[0.001]	[0.002]	[0.001]
Observations	29589	6503	9200	904	2958
Adjusted R-squared	0.308	0.383	0.17	0.35	0.237
Mean of I(Cognitive Job)	0.770	0.654	0.691	0.633	0.570

Notes: Robust standard errors clustered by household in brackets. ***,**, * denote significance at the 1%, 5% and 10% level, respectively. The dependent variable is the logarithm of real earnings. Height is measured in inches. A cognitive is an indicator that equals one if the person's occupation is greater than 3 on a 6 point scale where 6 reflects the greatest level of cognitive reasoning. All regressions include a quadratic in age, education, indicators for year, region, industry and occupation, and a constant term.

Table 9: Information Quality and the Returns to Height and Education of Immigrants

	NHIS Data		HSE Data		HRS Data		NIS Data	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Height	0.012	0.012	0.012	0.028	0.018	0.011	0.008	0.009
	[0.004]***	[0.003]***	[0.016]	[0.011]**	[0.013]	[0.008]	[0.005]*	[0.004]***
Height*Years Since Immigration/10	0.001		0.005		-0.006		0.001	
	[0.002]		[0.006]		[0.006]		[0.004]	
Education	0.039	0.035	-0.006	-0.002	0.039	0.034	0.056	0.030
	[0.004]***	[0.003]***	[0.015]	[0.009]	[0.009]***	[0.007]***	[0.011]***	[0.008]***
Education*Years Since Immigration/10	0.003		0.008		-0.001		-0.016	
	[0.002]*		[0.006]		[0.004]		[0.007]***	
Years Since Immigration/10	0.031		-0.311		0.551		0.276	
	[0.132]		[0.399]		[0.372]		[0.636]	
I(Educated in Host Country)		0.014		1.024		1.658		1.017
		[0.288]		[1.021]		[1.510]		[1.182]
Height*I(Educated in Host Country)		0.002		-0.013		-0.026		-0.005
		[0.004]		[0.015]		[0.020]		[0.007]
Education*I(Educated in Host Country)		0.000		0.005		0.021		0.000
		[0.004]		[0.017]		[0.024]		[0.014]
Observations	9652	9652	1643	1643	844	844	2958	2958
Adjusted R^2	0.41	0.40	0.35	0.34	0.37	0.36	0.25	0.24
P-value of F-test:								
$\beta_1=0$ & $\beta_2=0$	0.16	0.89	0.25	0.67	0.45	0.22	0.05	0.76

Notes: Robust standard errors clustered by household in brackets. ***,**, * denote significance at the 1%, 5% and 10% level, respectively. The dependent variable is the logarithm of real wages. Height is measured in inches. All regressions include a quadratic in age, indicators for year, region, industry and occupation indicators, and a constant term.

Table 10: Comparison of Pre- and Post-Immigration Wages of NIS Immigrants

Q=	(1)	Years in U.S. (2)	U.S. Educated (3)
Height	0.018*	0.009	0.020*
	[0.010]	[0.014]	[0.011]
Pre-Immigration*Height (γ_2)	0.010	-0.015	0.007
	[0.013]	[0.019]	[0.014]
Education	0.101***	0.107***	0.127***
	[0.021]	[0.030]	[0.024]
Pre-Immigration*Education (γ_4)	-0.034	-0.012	-0.023
	[0.031]	[0.039]	[0.031]
Pre-Immigration	-2.339	1.662	-1.872
	[2.131]	[3.153]	[2.318]
Height*Q (γ_6)		0.011	-0.022
		[0.013]	[0.020]
Education*Q (γ_7)		-0.008	-0.110**
		[0.019]	[0.050]
Pre-Immigration*Q		-4.996	-1.511
		[3.227]	[6.127]
Pre-Immigration*Height*Q (γ_9)		0.033*	0.016
		[0.020]	[0.034]
Pre-Immigration*Education*Q (γ_{10})		-0.035	-0.106
		[0.035]	[0.110]
Q		-1.799	5.652
		[2.221]	[3.571]
Observations	1053	1053	1053
Adjusted R^2	0.204	0.217	0.218
P-values of F-test:			
$\gamma_2=0$ & $\gamma_4=0$	0.487		
$\gamma_6=0$ & $\gamma_7=0$		0.594	0.729
$\gamma_6+\gamma_9=0$		0.003	0.807
$\gamma_7+\gamma_{10}=0$		0.160	0.023

Notes: Robust standard errors clustered by household in brackets. ***,**, * denote significance at the 1%, 5% and 10% level, respectively. The dependent variable is the logarithm of pre-immigration real wages at the time of immigration (in real U.S. dollars). Height is measured in inches. Years since immigration and education in host country refer to the individual's post-immigration status. All regressions include a quadratic in age, indicators for country and year of immigration, and a constant term.