The Impact of High-Skilled Immigration on the Wages of U.S. Natives

Serena Hsueh-Chin Huang

Department of Economics
University of Kansas
Lawrence, KS 66045
snowsun@ku.edu

December 6, 2009

PRELIMINARY: PLEASE DO NOT CITE WITHOUT PERMISSION

Abstract:

This paper examines the effect of high-skilled immigrants on wages of U.S. natives using the Scientists and Engineers Statistical Data System (SESTAT) and multiple econometric approaches. The first method estimates the elasticity of substitution between immigrants and natives using a general equilibrium model. The second method uses individual-level instrumental variable (IV) regressions to calculate the impact of increased immigration on wages of natives. Empirical evidence cannot reject the hypothesis that immigrants and natives are perfect substitutes within the same skill group. Furthermore, IV estimates suggest that high-skilled immigration in science and engineering (S&E) reduces wages of similarly educated native workers.

Key Words: Immigration, High-skilled, Science and Engineering, Elasticity of Substitution.

JEL Codes: F22, J31, J61.

Acknowledgement: The Alfred P. Sloan Foundation provided research support. I would like to thank my adviser, Donna Ginther, for guidance and many useful suggestions. I am grateful to Joshua Rosenbloom, Madeline Zavodny, Ronald Caldwell, ChangHwan Kim, Meredith Kleykamp, Luojia Hu, Lisa Barrow, and seminar participants at the Chicago Federal Reserve Bank for very helpful discussions and comments. The use of NSF data does not imply NSF endorsement of the research, research methods, or conclusions contained in this report.

I. Introduction

Do immigrants depress wages of U.S. natives? The question has stirred heated debates in the academic and political arenas. The foreign-born share of the U.S. labor force grew from 5.2 percent in 1970 to 15.7 percent in 2007.[1] While political debate typically centers around low-skilled and illegal immigrants, high-skilled immigrants, defined as foreign-born individuals with at least a bachelor's degree, have received considerably less attention. Several world events have contributed to the large influx of high-skilled immigrants to the U.S. in the 1990s, including the fall of the former Soviet Union, the Tiananmen Square protest, and the Internet boom in the mid-90s. Research on the impact of high-skilled immigrants, however, is limited.[2] Nevertheless, policies restricting skilled immigrants persist. On the one hand, information technology (IT) companies lobby the government for more temporary work visas (H-1B) to hire qualified immigrants, arguing that there is a shortage of native born workers. On the other hand, the economic stimulus package signed by President Obama in February 2009 requires banks that receive federal bailout funds to give hiring priority to U.S. workers over H-1B visa holders. This paper is the first to employ multiple approaches to examine the effect of recent high-skilled immigration on wages of similarly skilled native workers. Empirical results cannot reject the hypothesis that high-skilled immigrants and natives are perfect substitutes within the same skill group. Instrumental variable estimates reveal that high-skilled immigrants reduce wages of native workers.

Most papers on the effect of immigration take one of the two approaches: the general equilibrium approach and "area studies". The general equilibrium approach typically relies on a Constant Elasticity of Substitution (CES) production function and estimates the elasticity of

[1] The 1970 figure comes from author's calculation using the 1970 PUMS. The 2007 figure is from the Bureau of Labor Statistics.
[2] With a few exceptions such as Borjas (2005), Borjas (2007), and Peri and Sparber (2008).

substitution between immigrants and natives. Next, the authors use simulation to calculate the wage effect of immigration on different groups of native workers based on this coefficient. Borjas et al. (2008) find foreign-born and native workers are perfect substitutes and their simulations show immigrants lower wages of natives. Some economists argue that immigrants and natives are not close substitutes; therefore immigration does not reduce wages of native workers. Ottaviano and Peri (2008) find evidence of imperfect substitution and conclude that the 1990-2006 immigration increase has only small negative effects on native U.S.-born workers in the short-run and positive effects in the long-run. Peri and Sparber (2009) develop a general equilibrium model of comparative advantage in task performance to evaluate the effects of immigration on less-educated natives. They show that inflows of less-educated immigrants have negative but very small effects on similarly educated natives. Research based on the general equilibrium model thus far has found mixed results.

Rather than looking at the effect of immigration nationwide, the "area studies" approach examines the effect on the local economy. Instead of measuring the degree of substitution, these papers perform reduced-form estimates to study the correlation between the increased number of immigrants in an area and wages in the same area. Some papers use a similar methodology to examine the relationship between immigration and wages in different education and occupation groups. Most studies find no significant negative effect of increased immigration on natives (Altonji and Card 1991; Butcher and Card 1991; Card 1990, 2001, 2005; Card and DiNardo 2000; Grossman 1982). This empirical finding contradicts economic theory, which predicts immigrant inflows will harm labor market outcomes of natives provided immigrants and natives are substitutes in the production function.

As noted by Borjas (2003), the estimated effect of immigration on native wages "cluster around zero". However, a few studies find small effects of immigration. Jaeger (1996) concludes that immigration depresses the wages of native high school dropouts by three percent. Schoeni (1997) shows that the five percentage point increase between 1970 and 1990 in the share of foreign-born workers has led to a decline in the weekly wages of high school dropouts of at most ten percent, but the effect on the overall economy is found to be insignificant. Orrenius and Zavodny (2007) analyze the effects of immigration on natives separately for professionals, service workers, and manual laborers. Using occupation as a proxy for skill, they find negative effects of the increase in foreign-born workers on natives in blue collar occupations after controlling for endogeneity. These results do not hold for professionals or higher-skilled workers. Borjas (2003) shows the impact of immigrant share on native weekly and annual earnings is negative across education groups. More specifically, his results indicate immigration between 1980 and 2000 increased the labor supply of working men by 11 percent, and wages fell by 8.9 percent for high school dropouts, 2.6 percent for high school graduates, 0.3 percent for those with some college education, and 4.9 percent for college graduates. Literature on immigration generally finds very small, if any, negative wage effects among high-skilled workers.

High-skilled immigrants in science and engineering (S&E) have attracted some recent attention. A small number of papers document the contribution of foreign-born scientists and engineers. Lowell et al. (2007) show that foreign students make up roughly four percent of bachelor graduates, 28 percent of master graduates, and 32 percent of doctorate graduates in the fields of science, technology, engineering, and mathematics. Wadhwa et al. (2007) illustrate that non-citizens account for as much as 24 percent of international patent applications from the United States. Levin and Stephan (2001) find that individuals who have been elected to the National Academy of Sciences and the National Academy of Engineering are disproportionally foreign-born, as are authors of most-cited patents for medical devices, and founders of biotechnology companies. Peri (2007) shows that compared to a foreign-born population of 12 percent in 2000, 26 percent of U.S.-based Nobel Prize winners between 1990 and 2000 were immigrants. Hunt and Gauthier-Loiselle (2008) examine the impact of skilled immigrants on innovation and show that a one percentage point increase in immigrant college graduates raises patents per capita by about 15 percent. Although these studies on foreign-born scientists and engineers find positive effects of skilled immigration, they do not investigate the effect on wages of native workers. My study uses data containing a representative sample of scientists and engineers in the U.S. to analyze wage consequences of immigration in S&E.

While the majority of the immigration literature either look at immigrants as a homogeneous group or focus on low-skilled workers, two exceptions in this extensive literature specifically examine the effect of high-skilled immigrants. Borjas (2005) shows that a ten percent immigration-induced increase in the supply of doctorates lowers the wage of similarly-skilled workers by about three percent. Peri and Sparber (2008) find that immigrants with graduate degrees specialize in occupations demanding more quantitative skills and that similarly educated natives respond to immigration by choosing new occupations with less analytical and more communicative content. Although advanced degree holders are an important part of the high-skilled labor market, they constitute less than half of this labor market. This paper is the first to study the wage impact of high-skilled immigrants based on a broad definition.

Policy-makers have actively managed the supply of high-skilled immigrants in the past two decades. Like the economic literature, the policy debate typically focuses on low-skilled immigrants. One of the few policies that target high-skilled immigrants is the American Competitiveness and Workforce Improvement Act of 1998, which temporarily increased the cap on work visas (H-1B) issued. H-1B visas can only be issued to immigrants with at least a college degree. The annual limit on these visas was 65,000 before fiscal year 1999, and it increased to

115,000 in fiscal year 1999 and to 195,000 in fiscal year 2001. Since the late 1990s, approximately 60 percent of the visas are devoted to S&E occupations (Kerr and Lincoln 2008).

This research makes three significant contributions to the immigration literature. First, I focus on high-skilled immigrants, as defined by foreign-born individuals with at least a bachelor’s degree. Second, I disaggregate the sample by occupation rather than by city or state as in the "area studies", given that high-skilled immigrants may not affect wages of natives in an unrelated occupation even if they reside in the same area. Third, I use a new instrument in the individual-level regressions.

This study employs two approaches to examine the effect of immigrants on wages of U.S. natives. First, I estimate the elasticity of substitution between immigrants and natives following Borjas et al. (2008) and Ottaviano and Peri (2008). The estimates indicate immigrant and native workers are perfect substitutes. Next, I use individual-level regressions to calculate the effect of increased immigration on wages of natives. Using a new instrument, the ratio of foreign to native bachelor’s degree holders, individual-level regressions find a significant and negative effect of immigration on native wages, which is consistent with theoretical predictions.

The remainder of the paper is organized as follows: section II describes the data and descriptive statistics. Sections III and IV discuss the methodology and estimates for the substitution elasticity and the effect of immigration on native wages, respectively. The final section concludes.

II. Data and Descriptive Statistics

In order to examine the effect of S&E immigration on U.S.-born workers, I use the Scientists and Engineers Statistical Data System (SESTAT). These National Science Foundation (NSF)-sponsored data contain information on employment, educational, and demographic characteristics of scientists and engineers in the United States. Only high-skilled individuals educated or employed in S&E are included in the data. SESTAT is a longitudinal dataset that consists of three biennial surveys: the National Survey of College Graduates (NSCG), the National Survey of Recent College Graduates (NSRCG), and the Survey of Doctorate Recipients (SDR).[3] These surveys have the advantage of detailed information on educational background, including the fields of major and minor for a respondent's three highest degrees. Furthermore, the surveys ask about an individual's work activity on the job, in addition to his or her occupation. Information of this quality and detail is not available in other data sets.

The NSCG is available in 1993, 1995, 1997, 1999, 2003, and 2006. The 1993 NSCG is a special baseline survey that includes all those who had earned a bachelor's degree or higher prior to April 1, 1990—whether in S&E or not. It covers a target population of over 30 million college graduates. The 1995-1999 NSCG cover a much smaller target population, only 10 to 12 million individuals in S&E. The sample for the 1993 NSCG was drawn from 1990 Census Long Form respondents, including those residing in the United States or residing abroad as U.S. military personnel. Because SESTAT only includes individuals educated or employed in S&E, the 1993 NSCG in SESTAT contains only scientists and engineers. These individuals are included in the 1995, 1997, and 1999 NSCG. Due to a major redesign, the 2001 NSCG was not conducted.

The NSRCG covers those who received a S&E degree from a U.S. institution in the two academic years prior to the survey reference date.[4] Once individuals have entered the SESTAT system through the NSRCG, they are followed as part of the next NSCG. The 2003 NSCG serves as the baseline survey for future survey cycles in the current decade, much as the 1993 NSCG

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[3] I do not use the SDR in the analysis because the labor market for Ph.D. scientists differs from that for other high-skilled workers.

[4] Specifically, the 1993 National Survey of Recent College Graduates (NSRCG) covers the portion of SESTAT's target population that received bachelor's and master's degrees in an S&E field from a U.S. educational institution between April 1, 1990 and June 30, 1992. The 1995 NSRCG covers those who received bachelor's or master's degrees in an S&E field from a U.S. educational institution between July 1, 1992 and June 30, 1994. The same pattern applies to the subsequent NSRCG.

did.[5] The 2003 NSCG was constructed from the 2000 Census Long Form. Individuals in the 2003 NSCG and NSRCG are included in the 2006 NSCG.

In addition to having detailed information on education and work activities, SESTAT has the advantage of a large sample size and repeated observations. Frequently used data sets such as the Census Public Use Micro Samples (PUMS) do not follow individuals over time. Moreover, SESTAT is a more-representative sample of recent immigrants since new graduates are added to the data every survey year. The sample used in the study excludes part-time and self-employed workers and those above age 65. Individuals with missing earning information and those with real weekly salary less than half of the minimum wage are excluded from the sample.[6]

Table 1 provides weighted descriptive statistics for the variables used in the study from the 1993-2006 SESTAT. The third column contains *p*-values for test of significant difference between immigrants and natives. Mean values for immigrants and natives are significantly different at one percent for all the variables. Compared to native workers, foreign-born workers are older, more experienced, more likely to be male, Asian, Hispanic, married, and have a master's or a doctorate. Immigrants are less likely to live in the Midwest and the south. High-skilled immigrants earn a higher salary than natives on average. In terms of employment, immigrants are much more likely to work in natural sciences and engineering. As far as education, immigrants are more likely to have a highest degree in computer and mathematics, physical sciences, engineering, and health sciences. Immigrants are less likely to have a degree or work in social sciences, business, and non-S&E. Evidently, high-skilled immigrants are drastically different from immigrants as a whole, since immigrants as a group are known to be

[5] The redesign makes it impossible to determine if a respondent in the 2003 NSCG was ever in the 1993-1999 NSCG panel.
[6] This restriction on salary eliminates 1.12% of the sample of full-time workers under the age of 65.

less educated and earn less than native workers (Borjas 1995; Bucher and DiNardo 2002; Chiswick 1978).

Figures 1-3 present the distribution of immigrants across occupations, fields, and types of primary work activities. Across occupations, natural sciences and engineering have the highest concentration of foreign-born workers, ranging from 15 to 21 percent. Social sciences, non-S&E, and business occupations have no more than 11 percent of immigrants (Figure 1). The concentration of foreign-born workers also varies significantly across fields of their highest degree. Computer and mathematical, physical sciences, engineering, and health sciences contain 15 to 22 percent immigrants, while other fields have only 8 to 12 percent (Figure 2). These results suggest immigrants and natives sort into different fields of employment and education.

The variation in immigrant concentration is even greater across types of primary work activities, ranging from 7.3 to 27 percent (Figure 3). The share of foreign-born is very high in research and development (R&D), as well as in computer programming. The lowest concentration is seen in teaching, employee relations, and management. Figures 1-3 show immigrants and natives choose rather different work, suggesting the possibility of imperfect substitution between the two groups. This hypothesis will be formally tested in the analysis.

III. Elasticity of Substitution between Immigrants and Natives

I begin the analysis by estimating the elasticity of substitution between immigrants and natives. Given that increased labor supply lowers wages, one would expect to find a negative impact of immigrants on natives if the two groups are perfect substitutes. Below I provide a brief explanation of the theoretical framework used to calculate the elasticity of substitution, which is based on Borjas (2003), Borjas et al. (2008), and Ottaviano and Peri (2008). The model assumes the aggregate technology for a labor market at time t is given by a nested CES production function:

$$(1) \qquad Y_t = [(1-\alpha_{Lt})K_t^{\nu} + \alpha_{Lt}L_t^{\nu}]^{\frac{1}{\nu}}$$

where Y is output, K is aggregate physical capital, and L is aggregate labor. α_{Lt} denotes the share of labor used at time t, and $\nu = 1 - 1/\sigma_{KL}$ where σ_{KL} is the elasticity of substitution between K and L. Let σ_{KL} = 1, which is consistent with empirical evidence, so the aggregate CES production function collapses to a Cobb-Douglas. While there is one type of physical capital, the model allows labor input to differ by education level d and experience level x. Ottaviano and Peri (2008) further allow imperfect substitution between immigrants and natives in the same skill group. The number of workers in education group d and experience group x, L_{dxt}, are described as a CES aggregate of immigrants I_{dxt} and natives N_{dxt} in the same skill group dx at time t.

$$(2) \qquad L_{dxt} = \left[\phi_{dxt}N_{dxt}^{\gamma} + (1-\phi_{dxt})I_{dxt}^{\gamma}\right]^{\frac{1}{\gamma}}$$

where $\gamma = 1 - 1/\sigma_{IN}$, with σ_{IN} being the elasticity of substitution between natives and immigrants within the same skill cell dx at time t and is the parameter of interest. ϕ_{dxt} measures the productivity levels of natives in a skill group dx at time t. Profit maximization ensures an allocation for which relative marginal products of labor for immigrants and natives equal their relative wages. Setting relative average wages to relative marginal products of labor and taking logs yield equation (3).

$$(3) \qquad \ln\left(\frac{\overline{w}_{dxt}^{I}}{\overline{w}_{dxt}^{N}}\right) = -\frac{1}{\sigma_{IN}}\ln\left(\frac{I_{dxt}}{N_{dxt}}\right) + \ln\left(\frac{1-\phi_{dxt}}{\phi_{dxt}}\right)$$

where $\overline{w}_{dxt}^{I}$ and $\overline{w}_{dxt}^{N}$ denote the average wage of full-time, full year (FTFY) immigrants and natives in skill cell dx at time t. d subscripts highest degree and takes on the following values: bachelor's, master's, and professional or doctorate degrees. Workers in each education group d

are then classified into seven groups that differ by their amount of work experience: 0-4, 5-9,…, 25-29, and 30+ years. The levels of experience is subscripted by *x*. I_{dxt} and N_{dxt} are, respectively, the total number of hours worked by immigrants and natives in skill cell *dx* at time *t*. The inverse substitution elasticity between immigrants and natives, $-\frac{1}{\sigma_{IN}}$, can be estimated by regressing log relative average wages on log relative hours worked and fixed effects, including education, experience, year fixed effects, and their interactions to proxy the last term in equation (3). The hypothesis that immigrants and natives are perfect substitutes is tested by examining whether the coefficient on log relative hours equals zero, which implies infinite elasticity of substitution.

For completeness, I estimate equation (3) using specifications and weighting methods in both Borjas et al. (2008) and Ottaviano and Peri (2008). As in their papers, each specification is estimated for the pooled sample and by gender. In calculating the relative wages, Borjas et al. (2008) include the entire sample, while Ottaviano and Peri (2008) restricts the sample to be the same as that for calculating the relative supplies. In addition, Borjas et al. (2008) take the average of logarithmic individual wages of native and immigrants in each cell and then subtract one from the other. Ottaviano and Peri (2008) first take the average of cell wages and then apply the logarithm. The weighting methods differ as well. Borjas et al. (2008) use the inverse of the variance of the dependent variable,[7] whereas Ottaviano and Peri (2008) use simple cell-size as the analytic weights. In this study, both methodologies are employed to check for robustness of the estimates. To correct for potential endogeneity in relative foreign-native hours worked, an instrument variable (IV) regression approach is used. Following Borjas et al. (2008) and Ottaviano and Peri (2008), I instrument relative hours worked with relative employment, or

[7] See equation (11) in Borjas et al. (2008).

relative number of workers, in the relevant population. The two variables are expected to be positively correlated.

Relative to Borjas et al. (2008) and Ottaviano and Peri (2008), the definition of skill groups in this study is more precise, since I further disaggregate high-skilled workers into three education groups, which are bachelor's, master's, and professional or doctorate degree recipients. In addition, the measurement error in years of experience in their studies is likely larger because the actual time of labor market entry is not known. In this research, work experience is defined as the difference between the survey year and the year when an individual's highest degree was obtained.

I estimate the elasticity of substitution using the pooled 1995, 1997, 1999, 2003, and 2006 SESTAT.[8] Table 2.A contains estimates of $-\frac{1}{\sigma_{IN}}$ in equation (3) following methods in Borjas et al. (2008). The equation is estimated using five specifications for the entire sample as well as for each gender. In the baseline specification, I regress log relative foreign-native average wages on log relative hours and a constant term (column 1). Then fixed effects are gradually added to the specification (columns 2 to 5). In the pooled sample, the coefficient is only significant in the third WLS specification, but the coefficient is not significant once endogeneity is taken into account (column 3, rows 1 and 2). These estimates imply the elasticity of substitution σ_{IN} is infinite or that immigrants and natives are perfect substitutes within the same education and experience skill group.

In the male only sample, the results are robust across specifications. The coefficient on $-\frac{1}{\sigma_{IN}}$ is not significantly different from zero in any specification, which suggests skilled male

[8] Information on hours and weeks worked is not available in 1993; therefore the 1993 SESTAT is excluded from this analysis.

immigrants are perfect substitutes for natives (rows 3 and 4). In the sample of female workers, the inverse elasticity of substitution is significant in the baseline specification. These results point to imperfect substitution between female immigrants and natives. However, the coefficient is no longer significant once fixed effects are added, suggesting perfect substitution. These estimates are largely consistent with those in Borjas et al. (2008).

Using the same set of data, Table 2.B displays estimates of $-\frac{1}{\sigma_{IN}}$ following the Ottaviano and Peri (2008) method. The only significant coefficient is in the female sample (row 5, column 5), but the significance disappears when endogeneity is corrected for. The estimates in this table cannot reject the hypothesis that high-skilled immigrants and natives are perfect substitutes.

Following the methods in Borjas et al. (2008) and Ottaviano and Peri (2008), I find consistent estimates of substitution elasticity between foreign-born and native workers. Given perfect substitution, increased labor supply induced by immigration is expected to have negative impact on wages of native workers. The next section uses a reduced-form approach to examine wage consequences of immigration.

IV. Individual-Level Estimation of Effect of Immigration on Natives

Group-level regressions such as equation (3) cannot control for individual characteristics and may produce misleading results because of changes in the composition of workers within occupations over time. An alternative approach is a reduced-form regression of equation (3). Estimates using pooled individual-level data with controls for individual characteristics and time-varying returns can correct for omitted variable bias in the unconditional group-level regressions, caused by a correlation between immigration and other factors that affect wages.

Friedberg (2001) estimates the effect of Russian immigrants on native Israeli population using individual-level regressions. Based on her methodology, I estimate the following equation to gauge the effect of high-skilled immigrants on U.S. native wages.

(4) $\ln w_{iot} = \alpha_t + \varphi R_{ot} + X_{it}\theta_t + \varepsilon_{iot}$

where w_{iot} denotes real earnings of a native worker *i* in occupation *o* in year *t*. α_t captures year fixed effects. R_{ot} measures the ratio of immigrants to natives in an individual's occupation in year *t*. Occupations in this study include computer and mathematical, life, physical, social, health sciences, engineering, business, and other non-S&E. The NSF uses a similar categorization in its research on U.S. scientists and engineers. X_{it} are individual characteristics, including race, gender, marital status, type of highest degree, age groups, experience, experience-squared, and geographic region. Here φ measures the effect of increase in the ratio of immigrants to natives in an occupation over time on wages of natives in the same occupation over the same time period. This equation is comparable to a changes regression rather than to a levels regression.

Since R_{ot} is potentially endogenous, φ can only be regarded as correlation between immigration and native wages unless endogeneity is corrected. If immigrants are drawn to higher paying occupations, the estimated φ will be biased upward. Thus the impact of immigration on natives, if negative, will be under-estimated.

1. The Instrument

To address the endogeneity of the ratio of immigrants to natives in an occupation, I estimate IV regressions. A valid instrument must be correlated with the inflow of immigrants into an occupation but uncorrelated with the unobserved component of wage growth in that occupation. The most frequently used instrument in the literature is the stock of immigrants in the previous period, which is likely to be correlated with the immigrants in the current period.[9] However, this instrument may be weak in the sense that the stock of immigrants last period is likely to be correlated with wages this period.

A source of exogenous variation in the entry of high-skilled immigrants into an occupation may come from immigrants educated in a field relevant to that occupation. I use the number of immigrants with a bachelor's degree in a field as an instrument for the number of immigrants in the relevant occupation. I map eight broadly defined majors, including computer and mathematical, life, physical, social, health sciences, engineering, business, and other non-S&E, onto the same eight occupations. Because the endogenous variable is in the form of a ratio, the instrument should also be a ratio. I instrument the ratio of immigrants to natives in occupation *o* in year *t*, R_{ot} , with the ratio of foreign- to U.S.-born bachelor’s degree holders in field *o* in the same year. For instance, the ratio of immigrant to native engineers in 1995 will be instrumented by the ratio of immigrant to native engineering bachelor’s degree holders that year. The correlation between the IV and R_{ot} is expected to be positive because graduates in field *o* are more likely to find employment in the corresponding occupation *o*. An engineering graduate is much more likely to find a job in engineering than in business. The correlation will not be a perfect one since not all individuals work in the field of their undergraduate studies. Furthermore, individuals may obtain graduate education in a different field and work in a field of their graduate education rather than their major in undergraduate studies. For example, many economists have a bachelor’s degree in mathematics or engineering.

Compared to the stock of immigrants in the previous period, this instrument is less likely to be correlated with U.S. wages. A report published by the NSF shows 37.1 percent of all

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[9] For example, Althonji and Card (1991) use the stock of immigrants in 1970 as an instrument for the change in immigrant share between 1970 and 1980. Other papers include Card (2001), Card and Lewis (2007), and Cortes (2008).

foreign-born scientists and engineers came to the U.S. for family-related reasons (Kannankutty and Burrelli 2007). When examined by education level, the report finds 45.1 percent of immigrants with a bachelor's degree came for family-related reasons, while only 28.7 percent of immigrants with advanced degrees migrated because of their family. For this reason, I do not include immigrants with advanced degrees in the construction of the instrument. This NSF report suggests that the migration of foreign-born individuals with a bachelor's degree is generally not driven by wages in the U.S.

Table 3 presents the correlation between the ratio of graduates in a field and the ratio of workers in the corresponding occupation. As expected, the two variables are positively correlated, which indicates increased ratio of graduates raises the ratio of workers. In addition, the correlation is higher when highest degree is used, suggesting that individuals with advanced degrees are more likely to work in the field of their studies than individuals with a bachelor's degree. This makes intuitive sense, as individuals with advanced degrees such as an M.D. or a Ph.D. are unlikely to work outside of their field of studies due to their specialized trainings. The correlation between the instrument and the potentially endogenous variable is 0.6726. The statistical significance of this correlation will be examined with identification tests in the next section.

2. WLS and IV Estimates

I use the pooled 1993-2006 SESTAT to examine the impact of foreign-born scientists and engineers on their native counterparts. Table 4 presents the coefficients on φ. The least-squares estimates, weighted by SESTAT sampling weights, are positive. These estimates suggest a positive correlation between high-skilled S&E immigration and wages of natives. The covariates in the baseline specification include race, gender, marital status, type of highest degree, age groups, experience, experience-squared, geographic region, year, and occupation dummies. The second specification further includes a set of dummies for primary work activities, with accounting being the omitted category. Occupation interacted with primary work activities are added to the third speciation. The results indicate a ten percent increase in the ratio of high-skilled immigrants to natives is associated with a 1.5 to 1.7 percent increase in native wages. It is not surprising to see that skilled immigrants are drawn to higher paying occupations.

The second row of Table 4 displays coefficients on the instrument in the first-stage. The ratio of immigrant-native bachelor's degree holders is positively correlated with the ratio of immigrants to natives working in the corresponding occupations. The next three rows display results of identification tests. The instrument passes the Kleibergen-Paap under-identification tests with *p*-values less than one percent. In addition, since all the *F*-statistics are much higher than ten, the null of weak instrument is rejected in all specifications.

The IV estimates of φ are negative in all three specifications (Table 4, Row 1). The coefficient is -0.28 in the baseline specification and becomes more negative when additional controls are added. The estimates range from -0.28 to -0.35, implying that a ten percent increase in the ratio of high-skilled immigrants to natives in S&E lowers wages of competing natives by 2.8 to 3.5 percent. The magnitude of the negative impact is similar to that in Borjas (2003) and Borjas (2005).

Individual-level WLS estimates in this section show that immigrant concentration is higher in occupations which experienced faster wage growth. Controlling for endogeneity, IV estimates indicate increased immigration reduces wages of native workers in the same occupation.

3. Robustness Checks

I examine the effect of high-skilled immigrants in more detail by considering different subsamples of U.S.-born workers. Since the magnitude of impact may differ for younger and older natives, I split the sample into age under and over 35 for separate analysis. Friedberg (2001) uses the same classification for young and old workers. The weighted share of foreign-born workers is similar for the two age groups (Table 5, Panel A and B, Row 1). One would expect little difference in the magnitude of impact unless immigrants compete more with natives in one age group. Least-squares estimates show a positive correlation between immigrant concentration and wages in an occupation among only young workers. In other words, young skilled immigrants are drawn to higher paying occupations. The WLS estimates are not significant among older workers. The IV estimates are negative in the two subsamples, though the magnitude differs. A ten percent increase in the ratio of immigrants to natives in S&E lowers wages of older natives by 3.3 to 4.7 percent. The effect on young natives is a little larger, ranging from 5.9 to 7.6 percent. The IV passes all the identification tests. The results suggest that competition is more intense between young natives and immigrants. It is possible that young immigrants and natives are more alike than older immigrants and natives in terms of unobservable characteristics. If younger foreign-born workers migrated to the U.S. at a younger age, they would have better command of English and enhanced understanding of the U.S. system and culture, which would make them more similar to young U.S.-born workers. Table 6 reports average age at initial entry for younger and older immigrants in 2003.[10] It is clear that immigrants under the age of 35 moved to the U.S. at a much younger age than older immigrants. On average, younger immigrants entered the U.S. at 17 years of age, while older immigrants

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[10] The information on age at entry is not available in any other survey years.

entered at 26. The effects of immigration only differ slightly between the two age groups. These results are largely consistent with estimates for the full sample in Table 4.

Another interesting way of dividing the sample is by geographic regions. Because immigrants are more concentrated on the coasts, the negative effect may be more severe in these regions. The IV estimates presented in Table 7 reveal the effect of immigration is negative both on the coasts and in the central part of the United States. The magnitudes differ slightly, ranging from 2.4 to 2.5 on the coasts and 3.7 to 5.1 in the central regions. These estimates indicate the adverse impact of high-skilled immigrants has little geographic differences, which is consistent with the fact that the high-skilled labor market is a national one. Relative to less educated workers, high-skilled workers have more mobility. Low-skilled workers, however, are more confined to the area with specific industries that provide employment opportunities. For instance, most immigrant orange pickers are located in California or Florida, rather than the Midwest. The fact that ethnic enclaves are more likely to exist on the coasts may explain why the effect of immigration is slightly smaller on the coasts than in the central regions.

It is possible that the IT boom relieved some of the downward pressure of immigration on wages, in which case wages of native workers in IT would have increased despite the influx of high-skilled immigrants. On the other hand, the dot com bust could have lowered wages of IT workers even if there was no increase in immigration. I perform another robustness check by removing individuals in engineering, computer and mathematical sciences, and the results remain largely the same.[11] It appears that the increase in demand for IT workers in the 90s and the dot com bust in the early 2000s are not driving the results. Taken together, the results in

[11] Estimates are available upon request.

alternative samples presented in this section are consistent with estimates in the full sample in Table 4 and results on substitutability in Table 2.

V. Conclusion

Despite the large amount of research on immigration, there is no consensus regarding its wage effect on native workers. This study uses new data and methods to examine the consequences of immigration and finds a negative significant impact. The paper contributes to the literature by focusing on high-skilled immigrants, as defined by foreign-born individuals with at least a bachelor's degree. Rather than examining the effect by city or state as in the "area studies", I disaggregate the analysis by occupation. Furthermore, I use a new instrument in the individual-level regressions.

This analysis begin with a widely-accepted general equilibrium model and estimates the elasticity of substitution between immigrants and natives. Assuming a CES production function, empirical results fail to reject the hypothesis that high-skilled immigrants and natives are perfect substitutes. One would expect immigrants to lower wages of natives, given perfect substitution. The second method uses a reduced-form approach to gauge the effect of increased immigration on wages of natives. Using a new instrument, the ratio of foreign- to U.S.-born bachelor's degree holders, individual-level regressions find a significant effect of immigration on native wages. IV estimates indicate that a ten percent increase in employment due to an influx of high-skilled immigrants reduces wages of natives in the same occupation by 2.8 to 3.5 percent. These results are consistent with theoretical predictions that increased labor supply puts downward pressure on wages.

Regarding the implications for the immigration literature, this research shows high-skilled immigrants should be analyzed separately, since the high-skilled market is distinctively different from the low-skilled one. Studies that include workers of all skill levels typically find no effect of immigration. Even papers that distinguish between high- and low-skilled treat all high-skilled individuals as a homogeneous group. I disaggregate high-skilled workers by the type of their highest degree, because advanced degree holders in general command a higher wage than bachelor's degree recipients. This more precise definition of education groups ensures the comparison of "apples to apples" and thus a more accurate impact of immigration.

The findings in this study generate significant immigration policy implications. Until today, little is known about wage consequences of the 1998 H-1B visa increase. IT companies continue to request for more H-1B visas, yet the government has very limited information on how high-skilled immigrants affect wages of U.S.-born workers. Though some studies suggest high-skilled immigrants have important contributions in terms of innovation and entrepreneurship, they do not examine the impact on native wages. This research reveals that the increase in the supply of immigrant scientists and engineers between 1993 and 2006 has negative wage impact on their native counterparts. Policy makers should be more cautious about admitting high-skilled immigrants in the future. In addition, it might be helpful to consider educational policies that would encourage domestic students to enter S&E fields.

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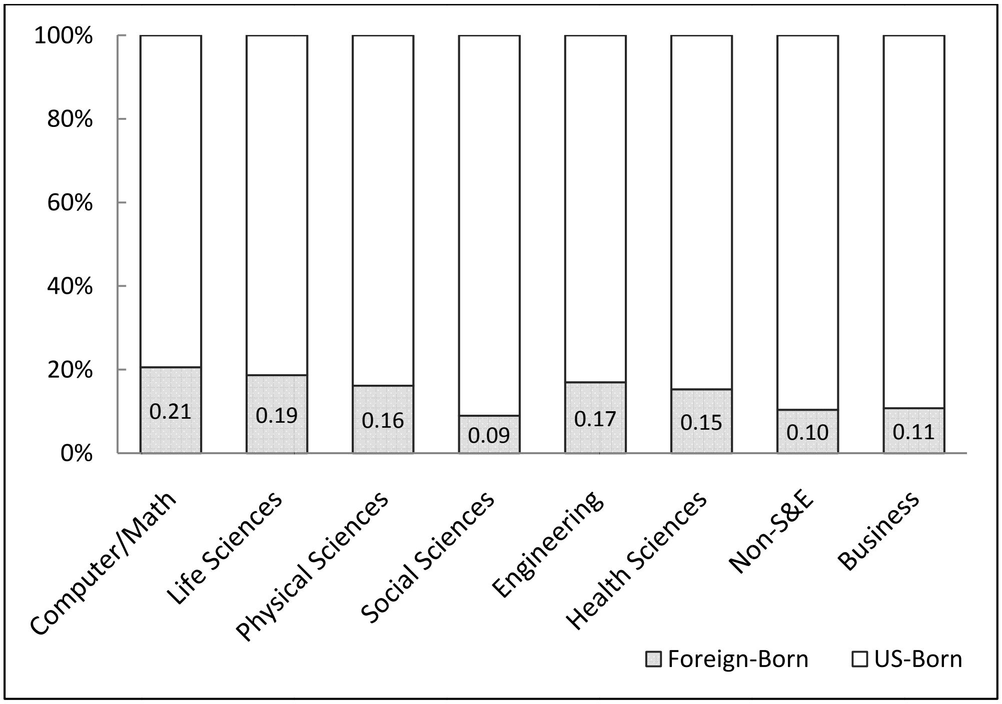
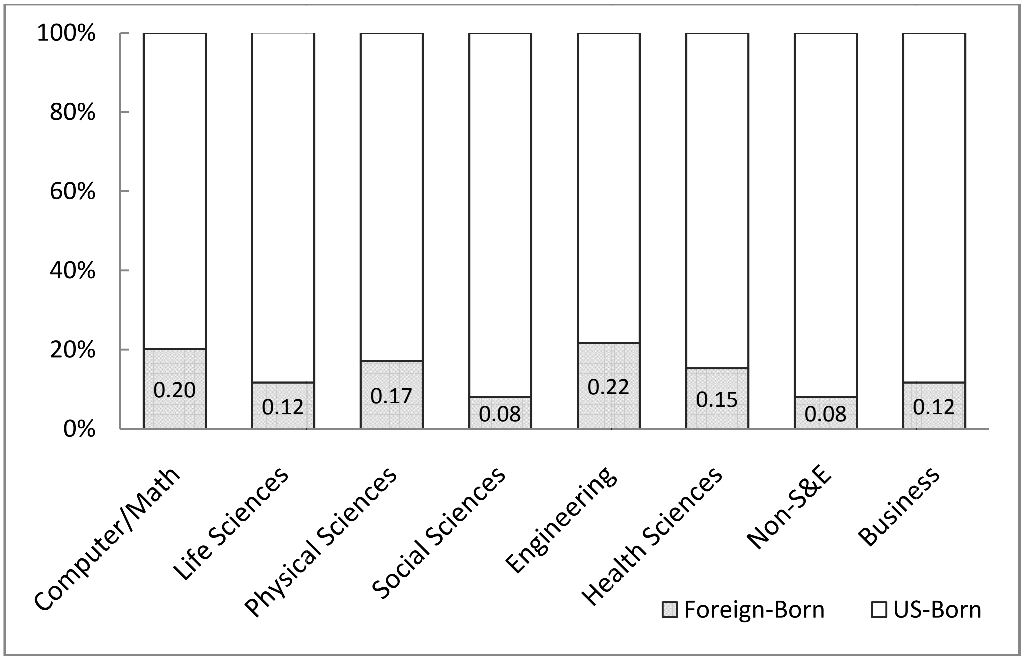
Figure 1— Distribution of Foreign-Born across Occupations



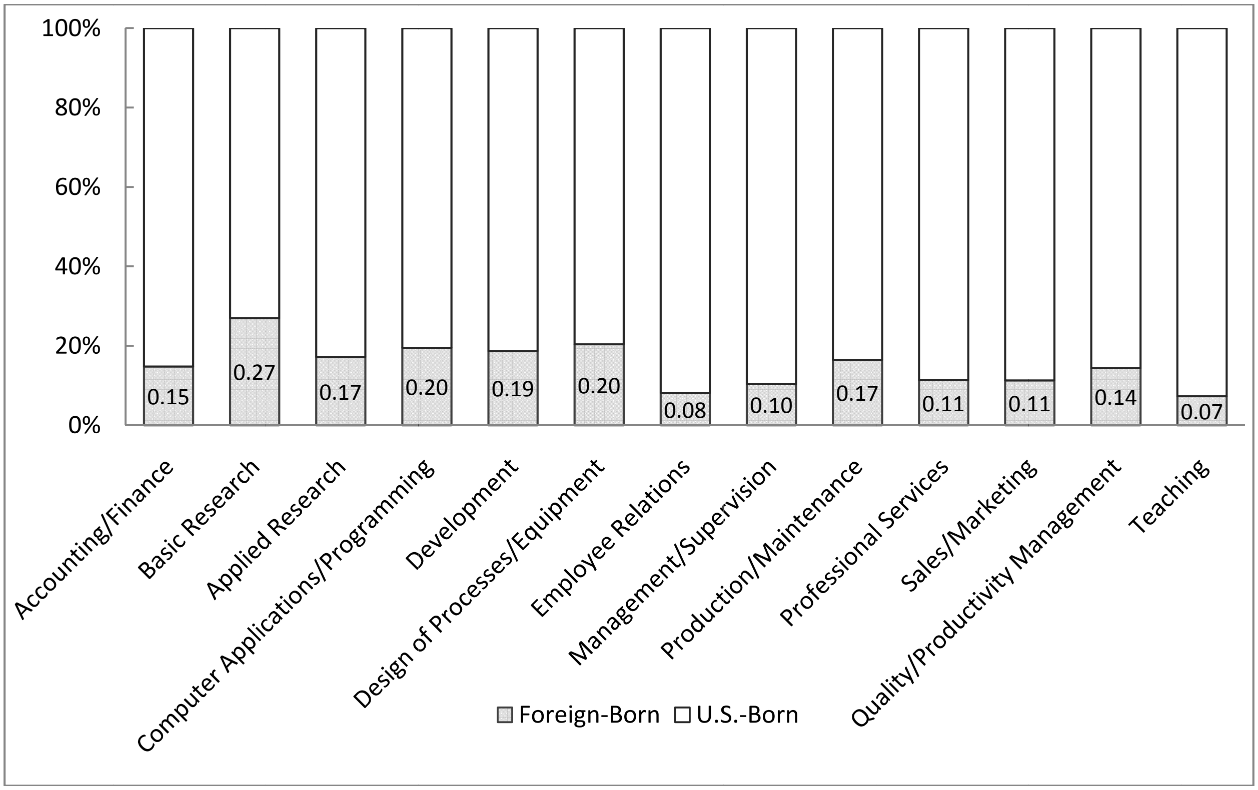
Source: 1993-2006 Science and Engineering Statistical Data System

Figure 2— Distribution of Foreign-Born across Field of Studies



Source: 1993-2006 Science and Engineering Statistical Data System

Figure 3—Distribution of Foreign-Born across Work Activities



Source: 1993-2006 Science and Engineering Statistical Data System

Table 1—Descriptive Statistics for Natives and Immigrants
(Pooled 1993-2006 Scientists and Engineers Statistical Data System)

Variable	US-Born	Foreign-Born	*p*-value for two-sided *t*-test
bachelor's degree	0.624	0.527	0.000
	(0.001)	(0.003)	
master's degree	0.282	0.348	0.000
	(0.001)	(0.003)	
doctorate	0.011	0.054	0.000
	(0.000)	(0.001)	
professional degree	0.083	0.071	0.000
	(0.001)	(0.002)	
experience	15.447	15.035	0.000
	(0.028)	(0.057)	
age	41.422	41.553	0.000
	(0.029)	(0.058)	
female	0.356	0.341	0.000
	(0.001)	(0.003)	
married	0.707	0.770	0.000
	(0.001)	(0.003)	
white	0.873	0.307	0.000
	(0.001)	(0.003)	
Asian	0.019	0.508	0.000
	(0.000)	(0.003)	
black	0.061	0.057	0.000
	(0.001)	(0.002)	
Hispanic	0.035	0.116	0.000
	(0.000)	(0.002)	
region: east	0.219	0.267	0.000
	(0.001)	(0.003)	
region: south	0.326	0.267	0.000
	(0.001)	(0.003)	
region: west	0.227	0.321	0.000
	(0.001)	(0.003)	
region: Midwest	0.228	0.145	0.000
	(0.001)	(0.002)	
Occupation: computer/math	0.110	0.185	0.000
	(0.001)	(0.002)	
Occupation: life sciences	0.022	0.032	0.000
	(0.000)	(0.001)	
Occupation: physical sciences	0.019	0.023	0.013
	(0.000)	(0.001)	
Occupation: social sciences	0.019	0.012	0.000
	(0.000)	(0.001)	
Occupation: engineering	0.119	0.158	0.000
	(0.001)	(0.002)	
Occupation: health sciences	0.118	0.138	0.000
	(0.001)	(0.003)	

Table 1 (Continued)

Occupation: non-S&E	0.401	0.002	0.000
	(0.300)	(0.003)	
Occupation: business	0.193	0.151	0.000
	(0.001)	(0.002)	
degree: comp and math	0.090	0.148	0.000
	(0.001)	(0.002)	
degree: life sciences	0.092	0.078	0.000
	(0.001)	(0.002)	
degree: physical sciences	0.041	0.055	0.000
	(0.001)	(0.001)	
degree: social sciences	0.245	0.138	0.000
	(0.001)	(0.002)	
degree: engineering	0.153	0.274	0.000
	(0.001)	(0.003)	
degree: health sciences	0.108	0.126	0.000
	(0.001)	(0.002)	
degree: non-S&E	0.181	0.104	0.000
	(0.001)	(0.002)	
degree: business	0.090	0.077	0.000
	(0.001)	(0.002)	
real annual salary	64707.3	67408.0	0.000
	(159.901)	(332.84)	
Observations	241,625	53,678	

Notes: Standard deviations are reported in parenthesis. Means are weighted by SESTAT sampling weights. Degree refers to an individual's highest degree.

Table 2—Test of Perfect Substitution between Skilled Immigrants and Natives (Pooled 1995-2006 Scientists and Engineers Statistical Data System)

A. Negative Inverse Elasticity of Substitution between Skilled Immigrants and Natives

		Difference between mean log wages of natives and immigrants				
Explanatory Variable	*Sample*	(1)	(2)	(3)	(4)	(5)
Log relative hours worked by immigrants and natives	*Pooled (OLS)*	-0.016	-0.028	-0.121*	-0.068	-0.122
		[0.063]	[0.038]	[0.068]	[0.088]	[0.098]
Log relative hours worked by immigrants and natives	*Pooled (IV)*	-0.021	-0.030	-0.120	-0.060	-0.098
		[0.046]	[0.052]	[0.139]	[0.142]	[0.252]
Log relative hours worked by male immigrants and natives	*Male only (OLS)*	0.022	-0.017	-0.084	-0.048	-0.108
		[0.051]	[0.037]	[0.056]	[0.071]	[0.097]
Log relative hours worked by male immigrants and natives	*Male only (IV)*	0.023	-0.017	-0.074	-0.027	-0.067
		[0.032]	[0.045]	[0.117]	[0.133]	[0.186]
Log relative hours worked by female immigrants and natives	*Female only (OLS)*	-0.127***	-0.027	-0.056	-0.029	-0.028
		[0.039]	[0.034]	[0.043]	[0.041]	[0.043]
Log relative hours worked by female immigrants and natives	*Female only (IV)*	-0.135***	-0.028	-0.058	-0.024	-0.024
		[0.039]	[0.046]	[0.140]	[0.065]	[0.129]
Education × Experience FE		No	Yes	Yes	Yes	Yes
Year FE		No	No	Yes	Yes	Yes
Year × Experience FE		No	No	No	Yes	Yes
Year × Education FE		No	No	No	No	Yes

Notes: Each cell contains estimates of the parameter $-1/\sigma_{IN}$ from separate equations following Borjas et al (2008). The dependent variable is the difference between mean logarithmic individual wages of native and immigrants in each cell. Analytic-weighted standard errors are reported in brackets and adjusted for clustering within education-experience cells. Relative employment is used to instrument for relative hours worked. Each regression has 105 observations. The sample excludes part-time and self-employed workers and those above age 65. Workers with missing salary and those with real weekly salary less than half of the minimum wage are excluded. * significant at 10%; ** significant at 5%; *** significant at 1%.

B. Negative Inverse Elasticity of Substitution between Skilled Immigrants and Natives

		Log relative immigrant-native mean wages				
Explanatory Variable	*Sample*	(1)	(2)	(3)	(4)	(5)
Log relative hours worked by immigrants and natives	*Pooled (OLS)*	0.005	0.003	-0.042	-0.028	-0.020
		[0.048]	[0.042]	[0.063]	[0.099]	[0.075]
Log relative hours worked by immigrants and natives	*Pooled (IV)*	-0.004	0.002	-0.037	-0.023	-0.012
		[0.057]	[0.047]	[0.097]	[0.189]	[0.111]
Log relative hours worked by male immigrants and natives	*Male only (OLS)*	0.003	-0.011	-0.002	0.012	-0.050
		[0.031]	[0.044]	[0.065]	[0.108]	[0.120]
Log relative hours worked by male immigrants and natives	*Male only (IV)*	0.001	-0.010	0.008	0.024	-0.035
		[0.040]	[0.061]	[0.124]	[0.229]	[0.185]
Log relative hours worked by female immigrants and natives	*Female only (OLS)*	-0.075	0.076	0.118	0.196	0.270**
		[0.046]	[0.061]	[0.111]	[0.143]	[0.114]
Log relative hours worked by female immigrants and natives	*Female only (IV)*	-0.092	0.063	0.093	0.168	0.247
		[0.153]	[0.184]	[0.595]	[0.591]	[0.464]
Education × Experience FE		No	Yes	Yes	Yes	Yes
Year FE		No	No	Yes	Yes	Yes
Year × Experience FE		No	No	No	Yes	Yes
Year × Education FE		No	No	No	No	Yes

Notes: Each cell contains estimates of the parameter $-1/\sigma_{IN}$ from separate equations following Ottaviano and Peri (2008). See text for detailed discussion on how the method differs from Borjas et al (2008). The dependent variable is the logarithm of the relative immigrant-native average wage in the cell. Analytic-weighted standard errors are reported in brackets and adjusted for clustering within education-experience cells. Relative employment is used to instrument for relative hours worked. Each regression has 105 observations. Relative employment is used to instrument for relative hours worked. The sample excludes part-time and self-employed workers and those above age 65. Workers with missing salary and those with real weekly salary less than half of the minimum wage are excluded. * significant at 10%; ** significant at 5%; *** significant at 1%.

Table 3—Correlation between the Ratio of Workers and the Ratio of Graduates
(Pooled 1993-2006 Scientists and Engineers Statistical Data System)

	Ratio of Foreign- to US-born with Only a Bachelor's in Field *o*	Ratio of All Foreign- to US-born with a Bachelor's or higher in Field *o*
Ratio of Foreign- to US-born Workers in Occupation *o*	0.6726	0.8723

Notes: Occupation/Field *o* takes on 8 possible values: Computer and Mathematical, Life, Physical, Social Sciences, Engineering, Health Sciences, Business and Finance, and Non-Science & Engineering.

Table 4—WLS and IV Estimates of Effect of Immigration on Native Wages

(Pooled 1993-2006 Scientists and Engineers Statistical Data System)

	Log Real Annual Salary					
	WLS	IV	WLS	IV	WLS	IV
Ratio of Foreign-born to Natives in Occupation *o*	0.148**	-0.281**	0.172***	-0.328***	0.164***	-0.345***
	[0.059]	[0.114]	[0.059]	[0.115]	[0.061]	[0.120]
First Stage						
Ratio of Foreign-born to Native B.A./B.S. in Field *o*		0.551***		0.542***		0.519***
		[0.003]		[0.003]		[0.003]
Identification Tests						
F-Stat		29524.4		29932.1		26467.3
		(0.000)		(0.000)		(0.000)
Kleibergen-Paap rk LM stat		9365.9		9104.8		8016.3
		(0.000)		(0.000)		(0.000)
Kleibergen-Paap rk Wald stat		24042.1		23754.6		20453.9
		(0.000)		(0.000)		(0.000)
Observations	241,625	241,625	241,625	241,625	241,625	241,625
Occupation Dummies	Yes	Yes	Yes	Yes	Yes	Yes
Primary Work Activity Dummies	No	No	Yes	Yes	Yes	Yes
Primary Work Activities x Occupations	No	No	No	No	Yes	Yes

Notes: The dependent variable is the log real annual wage of native workers. The regressions are weighted by SESTAT sampling weights and control for education, age group, experience, experience-squared, female, married, race, year, and region fixed effects. Robust standard errors are in brackets, clustered on individuals. * significant at 10%; ** significant at 5%; *** significant at 1%. The sample excludes part-time and self-employed workers and those above age 65. Workers with missing earning information and those with real weekly earnings less than half of the minimum wage are excluded. *p*-values in parentheses.

Table 5—WLS and IV Estimates of Effect of Immigration on Native Wages by Age
(Pooled 1993-2006 Scientists and Engineers Statistical Data System)

	Log Real Annual Salary					
	WLS	IV	WLS	IV	WLS	IV
A. Sample: Natives under Age 35						
Weighted Percentage Foreign-Born	12.66%					
Ratio of Young Foreign-born to Natives in Occupation *o*	0.206***	-0.764***	0.228***	-0.661***	0.201***	-0.592***
	[0.058]	[0.155]	[0.057]	[0.150]	[0.060]	[0.143]
First Stage						
Ratio of Young Foreign-born to Native B.A./B.S. in Field *o*		0.408***		0.408***		0.426***
		[0.005]		[0.005]		[0.005]
Identification Tests						
F-Stat		6998.39		6977.27		7400.13
		(0.000)		(0.000)		(0.000)
Kleibergen-Paap rk LM stat		3087.15		3076.84		3345.53
		(0.000)		(0.000)		(0.000)
Kleibergen-Paap rk Wald stat		3251.26		3227.77		3468.38
		(0.000)		(0.000)		(0.000)
Observations	96,882	96,882	96,882	96,882	96,882	96,882
B. Sample: Natives Age 35 or Older						
Weighted Percentage Foreign-Born	13.66%					
Ratio of Older Foreign-born to Natives in Occupation *o*	-0.091	-0.327**	-0.110	-0.407***	-0.102	-0.474***
	[0.076]	[0.146]	[0.076]	[0.146]	[0.077]	[0.153]
First Stage						
Ratio of Older Foreign-born to Native B.A./B.S. in Field *o*		0.604***		0.597***		0.574***
		[0.006]		[0.006]		[0.006]
Identification Tests						
F-Stat		9438.31		9489.95		8148.24
		(0.000)		(0.000)		(0.000)
Kleibergen-Paap rk LM stat		5970.50		5828.99		5055.41
		(0.000)		(0.000)		(0.000)
Kleibergen-Paap rk Wald stat		9491.04		9376.90		8063.50
		(0.000)		(0.000)		(0.000)
Observations	144,743	144,743	144,743	144,743	144,743	144,743
Occupation Dummies	Yes	Yes	Yes	Yes	Yes	Yes
Primary Work Activity Dummies	No	No	Yes	Yes	Yes	Yes
Primary Work Activities x Occupations	No	No	No	No	Yes	Yes

Notes: The dependent variable is the log real annual wage of native workers. The regressions are weighted by SESTAT sampling weights and control for education, age group, experience, experience-squared, female, married, race, year, and region fixed effects. Robust standard errors are in brackets, clustered on individuals. * significant at 10%; ** significant at 5%; *** significant at 1%. The sample excludes part-time and self-employed workers and those above age 65. Workers with missing earning information and those with real weekly earnings less than half of the minimum wage are excluded. *p*-values in parentheses.

Table 6—Immigrant's Age at Initial Entry
(2003 Scientists and Engineers Statistical Data System)

	Younger Foreign-born (Age < 35)	Older Foreign-born (Age >= 35)	Significant Difference (*p*-value)
Age at Initial Entrance to the U.S.	17.495 (0.245)	25.619 (0.169)	0.000
Observations	3,129	8,070	

Notes: Weighted by SESTAT sampling weights. Standard errors are in parenthesis. The information is only available in 2003.

Table 7—WLS and IV Estimates of Effect of Immigration on Native Wages by Region
(Pooled 1993-2006 Scientists and Engineers Statistical Data System)

	Log Real Annual Salary					
	WLS	IV	WLS	IV	WLS	IV
A. Sample: Native Workers Located on the Coasts						
Weighted Percentage Foreign-Born 16.91%						
Ratio of Foreign-born to Natives in Occupation *o* Located on the Coasts	0.115	-0.235**	0.149*	-0.248**	0.161**	-0.239**
	[0.080]	[0.115]	[0.079]	[0.115]	[0.082]	[0.119]
First Stage						
Ratio of Foreign-born to Native B.A./B.S. in Field *o*		0.820***		0.811***		0.783***
		[0.006]		[0.006]		[0.006]
Identification Tests						
F-Stat		20207.81		20538.96		18358.45
		(0.000)		(0.000)		(0.000)
Kleibergen-Paap rk LM stat		5304.64		5166.54		4606.62
		(0.000)		(0.000)		(0.000)
Kleibergen-Paap rk Wald stat		14728.07		14561.32		12872.13
		(0.000)		(0.000)		(0.000)
Observations	107,756	107,756	107,756	107,756	107,756	107,756
B. Sample: Native Workers Located in the South or the Midwest						
Weighted Percentage Foreign-Born 10.30%						
Ratio of Female Foreign-born to Natives in Occupation *o* Located in the South or the Midwest	0.134	-0.369*	0.149*	-0.471**	0.115	-0.512**
	[0.082]	[0.198]	[0.082]	[0.201]	[0.084]	[0.210]
First Stage						
Ratio of Foreign-born to Native B.A./B.S. in Field *o*		0.422***		0.414***		0.394***
		[0.004]		[0.004]		[0.004]
Identification Tests						
F-Stat		12022.12		12099.19		10486.82
		(0.000)		(0.000)		(0.000)
Kleibergen-Paap rk LM stat		4226.10		4100.31		3586.21
		(0.000)		(0.000)		(0.000)
Kleibergen-Paap rk Wald stat		10422.01		10266.91		8684.77
		(0.000)		(0.000)		(0.000)
Observations	133,862	133,862	133,862	133,862	133,862	133,862
Occupation Dummies	Yes	Yes	Yes	Yes	Yes	Yes
Primary Work Activity Dummies	No	No	Yes	Yes	Yes	Yes
Primary Work Activities x Occupations	No	No	No	No	Yes	Yes

Notes: The dependent variable is the log real annual wage of native workers. The regressions are weighted by SESTAT sampling weights and control for education, age group, experience, experience-squared, female, married, race, year, and region fixed effects. Robust standard errors are in brackets, clustered on individuals. * significant at 10%; ** significant at 5%; *** significant at 1%. The sample excludes part-time and self-employed workers and those above age 65. Workers with missing earning information and those with real weekly earnings less than half of the minimum wage are excluded. *p*-values in parentheses.

Appendix Table A.1

Covariate Coefficients for Table 4 Individual-Level WLS and IV Estimates

	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	WLS	IV	WLS	IV	WLS	IV
Master's	0.171***	0.170***	0.186***	0.186***	0.187***	0.187***
	[0.005]	[0.003]	[0.005]	[0.003]	[0.005]	[0.003]
Doctorate	0.265***	0.265***	0.317***	0.318***	0.330***	0.330***
	[0.018]	[0.011]	[0.018]	[0.011]	[0.018]	[0.011]
Professional degree	0.702***	0.701***	0.697***	0.696***	0.695***	0.693***
	[0.011]	[0.005]	[0.011]	[0.006]	[0.011]	[0.006]
Experience	0.036***	0.036***	0.035***	0.035***	0.035***	0.035***
	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]
Experience-Squared	-0.001***	-0.001***	-0.001***	-0.001***	-0.001***	-0.001***
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
Age < 30	0.130***	0.130***	0.126***	0.126***	0.125***	0.124***
	[0.006]	[0.004]	[0.006]	[0.004]	[0.006]	[0.004]
Age 30-39	0.101***	0.101***	0.100***	0.100***	0.100***	0.100***
	[0.007]	[0.005]	[0.007]	[0.005]	[0.007]	[0.005]
Age 40-49	0.047***	0.047***	0.049***	0.049***	0.051***	0.051***
	[0.009]	[0.006]	[0.009]	[0.006]	[0.009]	[0.006]
Age 40+	-0.018	-0.017**	-0.014	-0.013	-0.011	-0.010
	[0.016]	[0.009]	[0.015]	[0.009]	[0.015]	[0.009]
Female	-0.201***	-0.201***	-0.186***	-0.186***	-0.186***	-0.186***
	[0.005]	[0.003]	[0.005]	[0.003]	[0.005]	[0.003]
Married	0.094***	0.094***	0.094***	0.094***	0.092***	0.092***
	[0.004]	[0.003]	[0.004]	[0.003]	[0.004]	[0.002]
Asian	0.004	0.005	0.002	0.003	0.001	0.002
	[0.010]	[0.011]	[0.009]	[0.011]	[0.009]	[0.011]
Black	-0.072***	-0.072***	-0.068***	-0.068***	-0.067***	-0.067***
	[0.006]	[0.005]	[0.006]	[0.005]	[0.006]	[0.005]
Hispanic	-0.078***	-0.078***	-0.072***	-0.073***	-0.072***	-0.072***
	[0.008]	[0.008]	[0.008]	[0.008]	[0.008]	[0.008]
Year = 1995	-0.005*	-0.008**	-0.008**	-0.011***	-0.007**	-0.010***
	[0.003]	[0.003]	[0.003]	[0.003]	[0.003]	[0.003]
Year = 1997	0.039***	0.037***	0.033***	0.031***	0.034***	0.032***
	[0.003]	[0.003]	[0.003]	[0.003]	[0.003]	[0.003]
Year = 1999	0.099***	0.097***	0.090***	0.087***	0.091***	0.088***
	[0.004]	[0.003]	[0.004]	[0.003]	[0.004]	[0.003]
Year = 2003	0.154***	0.183***	0.145***	0.180***	0.146***	0.181***
	[0.007]	[0.009]	[0.007]	[0.009]	[0.007]	[0.009]
Year = 2006	0.143***	0.162***	0.136***	0.157***	0.136***	0.157***
	[0.006]	[0.006]	[0.006]	[0.006]	[0.006]	[0.006]
Region: east	0.097***	0.097***	0.096***	0.096***	0.096***	0.096***
	[0.006]	[0.003]	[0.006]	[0.003]	[0.006]	[0.003]
Region: south	0.018***	0.018***	0.019***	0.019***	0.018***	0.018***
	[0.005]	[0.003]	[0.005]	[0.003]	[0.005]	[0.003]
Region: west	0.074***	0.074***	0.075***	0.075***	0.075***	0.075***
	[0.006]	[0.003]	[0.006]	[0.003]	[0.006]	[0.003]
Occupation: computer/math	0.280***	0.364***	0.219***	0.317***	0.182***	0.278***
	[0.012]	[0.023]	[0.012]	[0.023]	[0.033]	[0.031]
Occupation: life sciences	-0.047***	0.028	-0.040***	0.048**	-0.074	0.022
	[0.013]	[0.022]	[0.013]	[0.022]	[0.069]	[0.051]
Occupation: physical sciences	0.092***	0.126***	0.087***	0.127***	0.217***	0.258***
	[0.010]	[0.015]	[0.010]	[0.014]	[0.068]	[0.096]

Appendix A.1 (Continued)

Occupation: social sciences	0.324***	0.359***	0.276***	0.315***	0.265***	0.307***
	[0.006]	[0.010]	[0.007]	[0.010]	[0.025]	[0.021]
Occupation: engineering	0.040***	0.033***	0.029**	0.021**	0.236***	0.228***
	[0.013]	[0.009]	[0.013]	[0.009]	[0.063]	[0.048]
Occupation: health sciences	0.177***	0.221***	0.155***	0.207***	0.043	0.094***
	[0.009]	[0.013]	[0.009]	[0.013]	[0.054]	[0.032]
Occupation: business	0.376***	0.387***	0.311***	0.324***	0.242***	0.255***
	[0.006]	[0.004]	[0.006]	[0.004]	[0.020]	[0.010]
Primary Work Activity: Basic Research			-0.166***	-0.164***	-0.081***	-0.081***
			[0.014]	[0.012]	[0.026]	[0.016]
Primary Work Activity: Applied Research			0.011	0.011	-0.020	-0.019
			[0.011]	[0.007]	[0.023]	[0.013]
Primary Work Activity: Computer Applications			0.062***	0.059***	0.060***	0.062***
			[0.010]	[0.006]	[0.020]	[0.010]
Primary Work Activity: Development			0.079***	0.081***	0.051**	0.051***
			[0.011]	[0.006]	[0.024]	[0.013]
Primary Work Activity: Design of Process/Equipment			0.048***	0.054***	0.077***	0.075***
			[0.010]	[0.006]	[0.024]	[0.013]
Primary Work Activity: Employee Relations			-0.022*	-0.021***	-0.056**	-0.054***
			[0.013]	[0.007]	[0.022]	[0.012]
Primary Work Activity: Management/Supervision			0.104***	0.104***	0.052***	0.050***
			[0.010]	[0.005]	[0.019]	[0.009]
Primary Work Activity: Production/Maintenance			-0.148***	-0.148***	-0.258***	-0.258***
			[0.014]	[0.007]	[0.023]	[0.012]
Primary Work Activity: Professional services			0.010	0.010*	-0.042**	-0.041***
			[0.011]	[0.005]	[0.019]	[0.009]
Primary Work Activity: Sales/Marketing			0.068***	0.068***	0.038**	0.038***
			[0.012]	[0.005]	[0.019]	[0.009]
Primary Work Activity: Quality Management			-0.020*	-0.020***	-0.118***	-0.118***
			[0.012]	[0.007]	[0.025]	[0.013]
Primary Work Activity: Teaching			-0.168***	-0.168***	-0.202***	-0.203***
			[0.011]	[0.005]	[0.018]	[0.009]
Primary Work Activity: Other			-0.101***	-0.100***	-0.184***	-0.183***
			[0.012]	[0.006]	[0.020]	[0.010]
Constant	10.037***	10.098***	10.049***	10.120***	10.092***	10.165***
	[0.011]	[0.017]	[0.014]	[0.018]	[0.020]	[0.019]
Observations	241625	241625	241625	241625	241625	241625
R-squared	0.382	0.382	0.402	0.401	0.407	0.406
Additional Controls						
Primary Work Activity x Occupation					X	X