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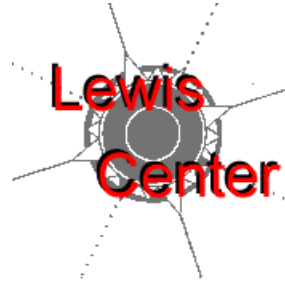
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In Search of the Glass Ceiling: The Career Trajectories of Immigrant and Native – born Engineers

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*** Please note that the figures for this article are missing, our apologies for the inconvenience.**

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INTRODUCTION

Sociological debate over immigrants' progress largely focuses on those less skilled newcomers who enter at the bottom of the labor market. One interpretation emphasizes those economic and social processes that canalize the immigrants and move them into labor market segments where they offer little competitive threat to native workers. In its original, pessimistic variant (Piore 1979), this interpretation saw the newcomers headed for the secondary labor market, which was always in need of extra hands, but at the same time provided few opportunities to get ahead and scant outlets to primary jobs. A later incarnation agreed that some immigrant groups would get funneled into the secondary sector and get stuck there. But it uncovered another mode of incorporation among the less skilled, variously labeled the immigrant enclave or immigrant economy. In this instance, ties among co-ethnic workers, employers, and community institutions provide mechanisms for generating capital and transmitting skills, thereby allowing newcomers to move up from the bottom, even though the immigrant economy remains outside the primary sector (Portes and Bach 1985; Portes and Stepick 1993).

In contrast to these views, an alternative interpretation highlights the forces that promote assimilation. Though classical assimilation theory focused exclusively on changes in such social relationships as intermarriage or neighborhood patterns (Gordon 1964), assimilation as applied to the economy implies a shift away from economic niches or enclaves, with progress occurring as immigrants enter the mainstream (Alba and Nee 1997). In this view, employment in either the secondary sector or the immigrant economy is a transitional phenomenon. Since "markets encourage open social relationships (and) for this reason, function as an integrative institution...firms seek the best qualified and least expensive workers, regardless of ethnicity" (Nee, Sanders, and Sernau 1994).

Controversy between what we shall characterize as segmentation and assimilation approaches swirls over the fate of labor and entrepreneurial immigrants; expert opinion, however, is little divided when considering the employment trajectory of the immigrant professionals, who have played a modest but significant role in immigration to the United States ever since the enactment of the Hart-Celler Act in 1965. For Portes, for example, primary labor market immigrants "are primarily hired according to ability rather than ethnicity," enjoying "mobility chances comparable to those of native workers" and "work conditions and remuneration not...different from those of domestic labor at similar levels" (Portes 1981, 282-3). The sources of parity derive from those characteristics of the open economy identified by Nee and his collaborators: firms "may be predominantly Anglo in character" but "have formal rules and procedure" and "legally...cannot discriminate by race or ethnicity and may be pressured to hire and promote minorities and women" (Nee et al. 1994, 852; see also Alba and Nee 1997, 885). Consequently, professionals "tend to enter at the bottom of their respective occupational ladders and to progress from there according to individual merit," overcoming initial difficulties with "remarkable success" (Portes and Rumbaut 1990, 1990 19), a conclusion with which Alba and Nee, in their recent (1997) review of the relevance of assimilation theory for the new immigration strongly concur.

There is less confidence in the matter, however, in business or policy circles, where the "glass ceiling" provides a byword for concern about the integration of immigrant professionals. The

concept is nowhere clearly defined and the great majority of “glass ceiling” research focuses on women. Nonetheless, the possible existence of an immigrant glass ceiling has become a matter of growing importance, not just to advocacy organizations, or journalists and the newspapers for which they write, but also to Federal Commissions who have devoted considerable attention to this question, and to major industrial and high tech firms where foreign-born professionals are becoming an ever more important presence. The thinking behind the “glass ceiling” notion implies that well-educated immigrants begin by moving ahead, but sooner or later bump into an invisible, but impenetrable, obstacle which prevents their careers from developing along the trajectory followed by comparable native whites. Put somewhat differently, whereas the dual labor market or ethnic enclave/ethnic economy hypotheses emphasize the effects of barriers at the point of immigrant entry into the host labor market -- with immigrants blocked from movement into the structures most conducive to upward mobility -- the glass ceiling hypothesis assumes that immigrants move into the primary sector, concerning itself, instead, with barriers that depress immigrant movement over the course of the career.

Controversy over the “glass ceiling” suggests that academic confidence in the open, integrating forces at work in the primary sector may well be misplaced and it is not that difficult to understand why. One can argue that markets function as integrative institutions. But immigrant professionals work mainly in bureaucracies, often of large size, where the forces that lead to the social reproduction of the societally dominant group remain strong. The possibility that highly skilled immigrants encounter obstacles to mobility similar to those confronting their less educated counterparts suggests that the range of inquiry concerning the forces that impede or promote immigrant integration should be extended from the lower- to the higher-skilled sectors of the economy. In which case, studies of the career trajectories of immigrant professionals provide another opportunity for assessing assimilation versus segmented approaches to studying immigrant progress.

This paper reports on an effort designed to search for the glass ceiling, through a study of the career trajectories of native white and Asian immigrant engineers. Immigrants figure prominently among the ranks of the nation’s engineering workforce, accounting for almost 10 percent of all engineers in 1980, 12 percent in 1990, and almost 14 percent of engineers aged 35-54 in the latter census year. The paper reports results from a telephone survey of 423 male, M.S. graduates of the engineering school at “Southern Cal U,” the pseudonym for the large, prestigious university where this research was conducted. As we sought to examine native/immigrant differences over the course of the engineering career, we interviewed 423 respondents, of whom 196 were native-born whites, and 227 were foreign-born persons from Asia.

Though a study of a single case, and thus subject to the usual caveats about the limits of generalizability, the case offers a strategic vantage point for assessing the broader glass ceiling claims. As recipients of at least one, though often more, U.S. degrees, the immigrants in our sample are far *less* likely than foreign-born engineers, who enter the U.S. labor market directly, to suffer disabilities related to foreign training not appropriate to or commensurate with the expectations of U.S. firms. And as the graduates of a major U.S. research university, the immigrants enter the U.S. labor market with an identifiable and prestigious credential that should place them fairly high up the hiring queue.

Immigrant Engineers in the U.S. Economy: The Contours of the Debate

The role of immigrants in the U.S.'s science and engineering complex has changed considerably over the past 40 years. Encouraging the migration of skilled workers goes back to the 1952 Immigration and Naturalization Act, which set aside 50 percent of the quotas for qualified professionals. But these quotas were barely utilized, with persons entering under the (then) first preference accounting for less than 2 percent of all the newcomers who arrived between 1954 and 1964. Behind the under-utilization of skilled preference categories lay the national origins restrictions of the time, which barred the route to the most likely candidates -- namely, immigrants from Asia. For example, from 1954 to 1962, only 410 scientists and engineers emigrated from India, which has since emerged as a major source country of highly educated workers. Consequently, enactment of the 1965 Hart-Celler Act, which opened doors for migration from Asia, eased the arrival of highly skilled engineers and scientists. With the new system in place, the situation rapidly changed: the Asian share of incoming professional, technical and kindred (PTK) worker immigrants moved from just under 20 percent in 1966 to over 50 percent in 1970, a level around which it has fluctuated ever since (Liu 1992).

But the story of immigrant engineers in the U.S. economy is not just a matter of changing composition; it also involves numbers. More than 160,000 foreign engineers and scientists immigrated to the United States as permanent residents between 1966 and 1984, and annual rates of immigration among engineers and scientists have grown in recent years.¹ As intended, the 1990 immigration act appears to have expanded the pool of high-skilled immigrants: almost 23,000 scientists and engineers were admitted to the United States in 1992, the first year of the new law's implementation, in contrast to 14,100 the year before. There is a still larger foreign-born presence in the engineering production pipeline, with American universities housing an ever-growing foreign student population. Between 1954-55 and 1993-94, for example, the foreign-student population grew from 34,232 to 449,749, a good part of which occurred in engineering, where the number of foreign students climbed from 18,084 in 1959-60 to 82,045 in 1993-94. For many, indeed most, foreign students, a stay in American higher education is often a prelude to permanent residence in the United States. Once they are on campus, foreign students make connections to U.S. citizens and employers, which in turn provide the means and the incentives to settle in the U.S. for the long term. In 1982, more than half of the foreign students who had earned a B.S. or an M.S. in engineering during the late 1970s were still residing in the United States (NSF 1986). As of 1987, almost 45 percent of all full-time engineering graduate students were non-U.S. citizens, up from 36 percent in 1977 (NSF 1989).

With numbers like these, immigrant engineers have become an important presence in American industry. In 1980, when immigrants made up just under seven percent of the total employment, the foreign-born accounted for nearly one of out of every ten engineers (Orr 1988). In 1982, foreign citizens accounted for 10 percent of all the new B.S./M.S. entrants to the U.S. engineering work force, and 36 percent of the new Ph.D. entrants among engineering and computer scientists (NSF 1986), shares that would certainly be augmented were naturalized citizens taken into account. A 1985 NSF survey of 305 companies found that foreign and naturalized U.S. citizens accounted for one fifth of their scientific and engineering employees.

¹ Calculated from NSF, 1986, p. 42.

Ong and Blumenberg's (1994) tabulations from the 1990 Census of Population show that Asians, a largely foreign-born population, comprise 7 percent of all engineers, but comprise 14 percent of those engineers with Masters degrees and 22 percent of those with doctorates.

With the emergence of a large, mainly Asian, immigrant workforce in engineering, earlier optimism about the prospects for these highly skilled, highly motivated newcomers has been thrown into question. Today the "glass ceiling" provides a byword for concern about the integration of immigrant professionals, implying that well-educated newcomers start out in favorable positions, but gradually find themselves on a second-class career track. For example, the 1995 report of the Federal Glass Ceiling Commission described the situation faced by Asian and Pacific Islanders, a heavily foreign-born population, as an "impenetrable glass ceiling." The Commission also called attention to the divergence in perceptions between industry, on the one hand, and immigrant professionals, on the other. The CEOs interviewed by the Commission's staff thought of the glass ceiling as an issue pertaining to women, and, when asked about minorities, responded exclusively in terms of blacks and Hispanics. By contrast, Asian Americans voiced frustration over their difficulties in moving to top management levels (U.S. Federal Glass Ceiling Commission 1995, 102). A 1992 report by the U.S. Commission on Civil Rights found that

The perception that there is a "glass ceiling" barring most Asian Americans from attaining top management positions (especially upper level management positions) for which they are qualified was perhaps the concern most frequently voiced by Asian American...individuals and advocacy groups... (U.S. Commission on Civil Rights 1992, 131)

Though resource constraints prevented a full investigation of the issue, the Commission was "convinced that the problem [of the glass ceiling] is a serious one and that it pervades both private corporations and government agencies" (U.S. Civil Rights Commission 1992, 135). Anecdotal evidence certainly supports this point of view. A 1990 Korn/Ferry survey of highly successful executives in Fortune 500 companies found that only 0.3 percent of senior executives were of Asian descent, indicating severe under-representation (cited in U.S. Civil Rights Commission 1992, 133). In 1992, not a single Asian or Pacific Islander was to be found among executives in the Silicon Valley, notwithstanding the very high Asian professional presence in the areas. And from what we know about rank and file perspectives, above and beyond the views of advocacy organizations, it does appear that perceptions of impediments to progress are widespread: one survey of several hundred Asian American professionals and managers in the San Francisco Bay Area reports that a large proportion felt that racism significantly limited upward mobility, with respondents mentioning difficulties in networking, a lack of mentors, management insensitivity, and an inhospitable corporate culture as the chief obstacles to getting ahead (Cabezas, et al. 1989). Waldinger's case study of engineers in the New York City public sector uncovered not simply widespread belief in a glass ceiling among immigrant engineers, but also growing conflict between immigrants and natives over promotion into the top ranks (Waldinger 1994).

Scholarly efforts to assess claims of an immigrant glass ceiling yield answers, however, that are at best equivocal. One of the earlier studies, Michael Finn's analysis of data on 13,000 engineers, found no earnings gap between native and foreign engineers, after controlling for years of work

experience, type of employer, degree field, degree level, and several other relevant factors (Finn 1985). While a more recent study, using 1990 Census data to look at scientists and engineers, found that Asian and Pacific Islanders earn less than whites at all educational levels, quite different results emerged after controlling for background characteristics and distinguishing natives from the foreign born. U.S.-born Asian Pacific Islander scientists made more than their white counterparts, with no gap remaining among the engineers! The foreign-born did worse than the whites, but that disparity declined with years of residence in the United States, falling to zero after twenty to twenty-five years (Ong and Blumenberg 1994). These findings suggest that the widespread belief in a pervasive glass ceiling may be the result, not of systematic discrimination, but of the sudden immigrant influx into science and engineering, with the newcomers concentrated, naturally, at the bottom of the pyramid. Indeed, a recent study of Asians in the federal civil service suggests exactly this pattern. On average, the gap between those whites and Asians in federal grade levels and those assigned to supervisory posts widened between 1978 and 1992. Most of the disparity, however, was due to differences in seniority and changes in the distribution of seniority, with the result that, after controlling for background characteristics, Asians were actually doing better in 1992 than in 1978 (Kim and Lewis 1994).

The results from other research, however, lean in the direction of the glass-ceiling hypothesis. A study of the aerospace industry, conducted for Congress by the General Accounting Office, found that Asian Americans have difficulties moving from professional to managerial jobs; though Asians in aerospace were considerably more likely to work as professionals than either blacks or Hispanics, the latter were more likely to be employed in managerial positions (U.S. General Accounting Office 1989). Duleep and Sanders (1992), who used 1980 census data and restricted their analysis to U.S.-born persons, found that lower educated Asian Americans do better than comparable whites, after controlling for other background characteristics, but that Asian Americans with 16 or 20 years of schooling do worse than their white counterparts. According to Duleep and Sanders, Asians were also less likely to be employed as managers. The most compelling evidence in favor of the glass ceiling hypothesis, however, comes from the work of Joyce Tang, who has written several papers using the Survey of Natural and Social Scientists and Engineers (SSE), a longitudinal survey compiled by the Bureau of the Census for NSF. One article, focusing on career attainment, found little evidence of white/Asian earnings inequality, with only the most recently arrived immigrants lagging behind whites. Foreign-born Asians, however, were far less likely to hold managerial jobs than their white counterparts, and less likely to be promoted, with time of arrival having little effect on either outcome (Tang 1993). In a second article, focusing on career changes, Tang (1994) found that Asians were far more likely to remain in engineering or engineering-related positions than their white counterparts, with zero-order effects for the foreign-born essentially unchanged after statistical controls. While the implication of greater career stability is uncertainly related to the glass ceiling hypothesis, it does suggest that Asians, and the foreign-born among them, in particular, confront a more restricted environment than do their white counterparts.

Sources of Disadvantage

Thus, the empirical literature on immigrant professionals yields the classic opposition between segmentation and assimilation approaches to immigrant economic adaptation briefly outlined in the introduction.

Assimilation approach: In this view, immigrant disadvantage is a matter of adjustment. Such adjustment difficulties are likely to be less severe for technically trained specialists than for college-educated generalists since, as Liu (1994) notes, the standardization of math and science makes the proficiencies of scientists and engineers highly transferable. Moreover, university training often goes along Western or American lines, as many Asian universities have adopted U.S. curricula, and their faculties themselves include a large component of professors with Western or U.S. degrees.² Nonetheless, there are clearly adjustment difficulties, as evidenced in reports of underemployment or of initial sojourns in the ethnic economy that are only gradually succeeded by a return to the original field of training. Difficulties of this sort are most likely to be experienced by engineers who move directly into the U.S. labor market, and least likely to be experienced by those who gain at least some formal U.S. training. This yields the null hypothesis:

H0: Immigrant/native disparities diminish over time, as immigrants gain relevant human capital and improve language skills. Net of education, experience, and language ability, and citizenship status, immigrant and native engineers should enjoy comparable earnings.

Segmentation approach: An alternative hypothesis, consistent with a segmentation view that sees immigrants filling the least desirable jobs, would imply that immigrants arrive with the technical skills needed to start out at the bottom, but lack the competencies required to get ahead over the course of the career. In contrast to the assimilation perspective, which sees language skills most deficient at the outset and improving thereafter, the opposite scenario holds that rough competence in English and strong technical skills may serve immigrants well in getting a job, but do not suffice for moving ahead, when other qualities are wanted.

Support for this proposition can be found in the case study literature. For example, Cannon, who interviewed top-level managers in the industrial research and development community, reports that

Almost every survey respondent believed that language differences present difficulties in the operation of their business. Respondents from consumer-oriented businesses said that communication difficulties arising from language differences were real problems. In a later question concerned with the prospects for growth of the foreign engineer into upper management, language difficulties were repeatedly mentioned as factors (Cannon 1988, 110).

Cultural differences may compound the effect of any linguistic inadequacies, as suggested by this New York City public sector manager, interviewed by Waldinger:

There are two negatives [to employing immigrants]. The issue of attitude. A lot of the foreign-born have a dignity issue. I have no problem with telling my

² Ong and Blumenberg report that in 1988, over two-thirds of the S&E faculty at Seoul University, South Korea's premier university, had a foreign doctorate, with nearly three-quarters of this group having received their training in the United States (Ong and Blumenberg 1994, 187).

people "you're stupid, you screwed up"; I have to think twice before I say anything to the foreign-born. Second, technically, the foreign-born are superior, no question about that, but written or spoken communication is a problem." (Waldinger 1994, 26)

Considerations of the same sort were advanced by a top official in a California transportation agency, with a large immigrant component among its engineers, who noted that "in some cultures, the engineer is a technical practitioner and not necessarily involved in determining alternatives and impact, as is expected of the U.S. engineer." (Gray 1990, 22) The Glass Ceiling Commission itself took note of cultural differences and their import, noting that corporate culture is a "white male culture that values aggression and socializing over hard work and merit." The commission's Asian interviewees also conceded the point, agreeing that getting into the top corporate level "requires learning how to work within the dominant white-male culture."

There may be distinctive factors associated with engineering careers that magnify the importance of linguistic or cultural differences. Employers seek to promote skilled technical workers up the corporate hierarchy since some level of technical ability, experience, and know-how is the logical prerequisite for managerial technical workers. But the organization of engineering work also makes the selection process difficult. Individual productivity is difficult to measure since engineers work as teams and output may not be highly correlated with input. As technical workers may not always share management's orientations, gaining greatest satisfaction from tasks that might not necessarily be most profitable, promotion may be influenced, not simply by productivity, but by identification with the firm. Thus, subjective aspects enter heavily into the promotional process, as ethnic preferences or prejudices are more likely to exercise influence when work effort and performance are difficult to measure.

H1: Immigrant and native engineers may begin at comparable starting points, but their careers progressively diverge over time. By mid- to late-career, and net of other background differences, immigrants bump into a glass ceiling, as indicated by a lower rate of return to experience.

Data and Research Design

This study reports on results from a telephone survey of M.S. degree holders who graduated from the engineering school at Southern Cal U between 1970 and 1990. By design, we hold not only years of education constant, but also the quality and the experience of schooling itself and the prestige attached to the identical credential awarded by the same university. Since differences in education usually account for a large portion of explained variance in studies of labor market outcomes, our design diminishes the likelihood that observed differences will be due to random or unobservable factors, making statistically significant findings, therefore, all the more meaningful. By selecting a group of graduates from a highly ranked university, we are also able to avoid a source of bias affecting studies that do not control for the quality of the degree-granting institutions. Since Asians are disproportionately overrepresented among the ranks of students in higher-quality universities, failure to control for the quality of education biases the results for Asians downwards. By surveying the graduates of Southern Cal U, however, we are capturing precisely that academically successful population who may otherwise be submerged in larger studies.

Our project also allows us to assess the experience of foreign-born engineers in the area where they are likely to play their most important role -- California. Demographically, California has the nation's largest concentration of immigrants; it is home to the largest, and most rapidly growing Asian population, whose ranks are increasingly dominated by high-skilled immigrants; and foreign engineers play a very important role in California's high technology sector, with immigrants accounting for more than 25 percent of most engineering specialties in the Southern California region. Moreover, California's educational institutions account for a disproportionate share of graduate engineering production.

Several considerations led us to focus on M.S. graduates. While there is a large immigrant population enrolled at all levels of engineering training, the great majority of students at the Bachelor's level are citizens or permanent residents of the United States, who moved into higher education in the normal fashion. At an institution like Southern Cal U, foreign students account for a relatively small proportion of engineering enrollment at the Bachelor's level. By contrast, immigrants, in general, and foreign students, in particular, are a much larger presence in doctoral education. But here, there is much greater difficulty in assessing any glass ceiling effects, as there are at least two main career tracks for those with a Ph.D. in engineering, with one leading to employment in industry, and another to employment in the academic world. It may well be the case that glass ceiling effects can be found both in academia and industry, but given the very different ways in which academic and industrial careers are structured the underlying processes shaping career paths are likely to be quite different. Since the glass-ceiling problem is usually, though not always, linked to private, corporate employment, and our funds did not allow us to collect large samples of both academic and non-academic engineers, we chose not to focus on those graduates with Ph.D. degrees. Instead we decided to examine those graduates with M.S. degrees, who like those with Ph.D. degrees, comprise a population with a heavy foreign student presence. Unlike Ph.D. programs, M.S. career trajectories are simpler, lacking the complicating factor of the alternative academic track. In addition, far less is known about the Masters degree holders than about the Ph.D. holders, about whom good data are available (e.g., the annual surveys of earned doctorates).

The survey compares native-white male engineers with foreign-born male engineers from Asia, with Asia defined as the entire continent of Asia. We chose males for reasons having to do with simplicity and financial constraints: adding gender would yield a further complication not tractable given the relatively small sample which we targeted. We chose Asians for two reasons: this group is overrepresented among the ranks of foreign-born engineers; and the debate over the progress of engineers is framed in terms that resonate with the broader discussion of Asian mobility.³

³ Our definition of Asia differs from that of the Census, which, using OMB definitions, stops at the Pakistani/Afghani border. This definition seems purely arbitrary, having no cultural, sociological, or linguistic bases. It has the further defect of categorizing members of the same tribe, ethnic group, or linguistic group as either Asian or Caucasian, depending on whether they live in Pakistan or Afghanistan. Including all Asian-born persons adds Middle Eastern immigrants, also an important component in the foreign-born engineering population, to our sample; as Middle Easterners may be perceived as whites, their presence allows us to test for the effects of "race" among our foreign-born respondents. We have run all of the regressions reported in this paper, using both definitions of "Asian," and find no differences

The sample was constructed from a list of roughly 3,000 male, M.S. degree holders who graduated from Southern Cal U between 1970 and 1990, generated for us by the development office at Southern Cal U, and maintained by them for the purposes of alumni relations. Interviewing and sample selection were undertaken by the Survey Research Center at Southern Cal U. We divided the sample into two components: one with Asian surnames and a second consisting of all "others." Names on the lists were randomized; respondents were screened to ensure a match with our eligibility characteristics; and then, if eligible, were interviewed.⁴ Interviewing was conducted over the telephone by an ethnically diverse group from the Center's staff, which included persons from the countries likely to be represented among respondents; on average, the interviews lasted 30 minutes. We experienced a very high acceptance rate, 85 percent for the sample overall, with no difference between the Asian and the white subsamples in this respect.

The survey sampled all M.S. graduates with at least one post-graduation engineering job. By the time of the interview, however, almost one out of every ten respondents was no longer working in engineering. Attrition rates, however, differed little between immigrants and natives, with 92 percent of the U.S.-born respondents and 90 percent of the foreign-born respondents still working in engineering at the time of the interview. A logistic regression to test for the effect of place of birth on attrition found no significant differences between immigrants and natives. Consequently, sample selection bias is unlikely to influence any immigrant/native differences found when analyzing those members of the sample still employed in engineering.

Results

Applied to the case of immigrant engineers, a segmentation approach suggests that immigrants will suffer from a lower return to experience. As the members of our sample begin with a high, common base-line level of education, experience is the most relevant (though not the only) measure of human capital. As the glass ceiling hypothesis implies a difference in the rate of progress, the appropriate test focuses, not on the overall immigrant/native difference (the intercept), but on the disparity in rates of return (the slope), measured as an interaction between foreign-born status and experience.

Table 1 presents results from an OLS regression of the log of annual earnings in the last/current job on a set of human capital variables, including experience, experience squared, and hours of work, to which are added dummies for nativity, and a term interacting place of birth with experience. (*Table 1 not available online*)

of any sort; disaggregations for specific sending areas, e.g., Middle East or China (Hong Kong, Taiwan, Mainland), similarly have no effect on any of the results reported here.

⁴ Eligibility was determined by the following criteria:

gender: males only;

education: M.S. graduates of the Southern Cal U engineering school;

relevant employment: at least one, post-M.S. engineering job;

nativity and ethnicity: either white, U.S.-born, or Asian-born, as defined above.

Model 1 shows that immigrants suffer from a lower rate of returns to experience, just as predicted by H1. But as noted above, the assimilation approach contends that changes in the skill level of immigrants, most importantly investments in further human capital and growing facility in English, lead to a convergence of immigrant and native earnings. While our sample selects for persons who are already high in human capital, a significant portion of the sample acquired an MBA after receipt of the M.S. Selective additional human capital investment does indeed increase earnings and an MBA has a positive, significant effect on the log of earnings. But adding these additional measures of human capital has no effect on the immigrant variables, supporting H1. (*Model 1 not available online*)

Whereas much of the glass-ceiling research is concerned with uncovering any disadvantages associated with foreign *birth*, foreign *education* may be a liability of equal, if not greater, weight. After all, the story of foreign-born persons who move to the United States as children and end up as graduate engineers after moving through our school system is one of success; it seems unlikely that this experience would not include exposure to the American way of doing business. By contrast, engineers who are mainly, if not entirely, educated abroad may arrive with needed technical skills, but not the other social competencies needed at the worksite. An extension of the assimilation approach would suggest that the native/foreign disparity in rates of return to experience reflects the disadvantages suffered by those 3 out of every 5 immigrants whose U.S. schooling began at the post-graduate level. However, as shown in Model 2, inserting a dummy for a U.S. Bachelor's degree yields no change in any of the immigrant variables.

Alternatively, any immigrant disadvantage may be more heavily influenced by the effects of foreign training and experience, rather than foreign education, as such. Foreign experience may have adverse effects because of a failure to impart needed social skills, or simply because it doesn't generate signals recognized as reliable or readily interpretable by U.S. employers. But as with the case of foreign education, the assimilation hypothesis would anticipate that foreign experience would yield a depressing impact at the outset of the career, the effects of which would gradually disappear. Though a substantial portion (13.4%) of our immigrant respondents reported foreign experience, adding a dummy for this variable did not alter any of the immigrant variables.

Differences in language facility may also contribute to any immigrant disadvantage and our survey looked at language facility in two different ways. Following the census procedure, we asked respondents to rate their English language proficiency. As language facility is likely to be context dependent, with those who speak English at home and in public different from those who speak English only in one setting and not in the other, and is also affected by the place and life cycle stage in which the language was learned, we asked respondents about the use of English at home, and at various stages of their schooling career. Levels of language facility, however, rank high among the immigrant members of our sample: 62 percent describe themselves as speaking English very well and 35 percent as speaking English; the interviewers were slightly more impressed with the respondents' English language facility, rating 67 percent as speaking English fluently and 31 percent as speaking English normally. Not surprisingly, then, self-described language facility yields neither a significant effect nor a change in the values or significance of the immigrant variables. The context variables paint a different portrait of the linguistic patterns

of our respondents: on the one hand, not quite 30 percent of the immigrant sample was exposed to English prior to the commencement of undergraduate studies; moreover, 80 percent of the immigrant respondents continue to speak a language other than English at home, a suggestion of possible discomfort or inadequacy in English in more intimate or unstructured settings. Nonetheless, the inclusion of these contextual language dummies neither altered the values in the original regression equation nor produced any significant effects.

Alternative estimations: Earlier, we made a case for the virtue of our research design: it yields a sample of respondents who are quite homogeneous in the quantity, as well as the quality, of their human capital, which in turn reduces the likelihood of spurious effects resulting from underlying differences in either of these two factors. But our design choice yields a corresponding vice: a relatively small sample, which in turn makes any results more vulnerable to the effects caused by a small number of outliers among our observations. Thus, an examination of the scattergram for the bivariate relationship between engineering work experience and the log of annual earnings, displayed in Figure 1, seems to support H1. However, one can also observe a number of cases that fall disturbingly far from the main area of concentration in the graph. The presence of these outliers, in a sample as small as ours, increases the likelihood that the estimates from the ordinary least squares (OLS) regressions, reported above, may not be reliable (Fox 1997, 267-270; Hamilton 1992, 184-188).

Thus visual inspection raises suspicion; to check those doubts, we have generated a proportional influence plot of Cook's D, an overall measure of influence of a particular observation on all coefficients in the model, residuals, and predicted log income from the OLS regression estimates (Fox 1997, 276-277; Hamilton 1992, 132). The Cook's Ds are scaled so that the observations with $D \geq 1$ are plotted with about 100 times the size of the least influential observations (Hamilton 1993, 106). As can be seen from Figure 2, the outliers do indeed exercise a high level of influence on the estimated coefficients, making alternative estimations imperative.

One possibility might have been to delete all the influential observations and report the OLS regression results, as estimated from the trimmed data. Instead, we have chosen an alternative: keep all of the observations, but estimate the model using a different estimation procedure known to be more resistant to the outliers. We estimate the model using a robust estimation called M-estimation (Wu 1985; Fox 1997, 405-414; Hamilton 190-212) which yields results that are especially "robust" in the face of outliers on the dependent variable.⁵

Not surprisingly, given the potentially distorting effects of the outliers, the alternative estimation does alter the substantive results, though in ways consistent with the glass-ceiling hypothesis (See Table 2). On the one hand, the robust regression reduces the effects associated with those outliers representing the highly paid, younger workers among the members of our foreign-born sample. Consequently, the positive effects of foreign birth -- a counter-intuitive finding -- drop from about 38 percent in the regression run under OLS $((\exp(0.327)-1)*100)$ to 16 percent $((\exp(0.156)-1)*100)$ in the regression run under M-estimation; for this reason, the effect of foreign-birth is no longer significant. On the other hand, the "glass ceiling effect," that is, the negative coefficient for the interactive term (fb*yrs), remains significant, albeit at the 0.05 level.

⁵ This estimation procedure is routinely available in STATA (StataCorp 1997).

Substantively, a different earnings trajectory emerges, so that the immigrant begins 17 years after the first job, as opposed to 19 years under OLS, as can be seen from Figure 3.

Table 2. Results of the different estimations of regressions on earnings by selected variables: Southern California U, Engineering M.S. alumni—authors' survey (*not available online*)

Conclusion

Socioeconomic diversity is the distinguishing feature of today's immigration, with an unprecedentedly large proportion of the foreign-born arriving with advanced degrees and moving into professional positions. The scholarly literature paints a positive picture of the adaptation of these high-skilled immigrants, with some initial disadvantages quickly succeeded by movement into career paths similar to those enjoyed by natives. By contrast, there is a concern among business and advocacy groups, as well as policymakers, that industry wants foreign-born technical labor, but is not ready to provide full promotional opportunities. Rephrased in terms of the academic debate, the contrast between the research and "real world" views corresponds to the cleavage between assimilation and segmentation approaches to immigrant progress.

The results from this paper suggest that some form of labor market segmentation, so common at lower levels of the economy, is also restricting the mobility of the highly skilled foreign-born engineers whom we have studied. Our key finding shows that immigrants receive a significantly lower return to experience than do their native-born counterparts. Consequently, the immigrant's career takes a distinctively different shape, as shown in Figure 3. As a highly selective group, coming from advantaged circumstances and needing to jump high hurdles in order to enter the U.S. system of higher education, the foreign-born engineers in our sample begin with a slight advantage (though one of somewhat doubtful statistical significance). That lead, however, diminishes steadily over the course of the career: after 17 years of experience, native-born engineers surpass their immigrant counterparts, enjoying continuous earnings growth. By contrast, the foreign-born engineers not only lose any former advantage, but find that their earnings slip in the later stages of the career.

We interpret this finding as evidence of discrimination. Such inferences are common, and often questionable, but less questionable in this case since we also know something about our respondents' perceptions of the opportunity structure they confront. Those perceptions are not fully reported here, as they are the subject for another paper. Suffice it to say that, compared to natives, and after controlling for background characteristics, the immigrant engineers are significantly more likely to report that they have experienced some act of work-related discrimination, are significantly more likely to indicate that they would *not* pursue an engineering career if given the opportunity to do it all over again, and are significantly more likely to tell us that knowing the right people and being an Anglo are very important for getting ahead. Given such consistency, between the economic disparities revealed in this paper and the disparate perceptions of opportunity, we feel confident in concluding that in our search for an immigrant glass ceiling we have indeed found one.

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