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Skilled Labor Mobility and Firm Value: Evidence from a Natural Experiment

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Skilled Labor Mobility and Firm Value: Evidence from a Natural Experiment

BY

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ACCEPTANCE

This dissertation was prepared under the direction of the Mo Shen's Dissertation Committee. It has been approved and accepted by all members of that committee, and it has been accepted in partial fulfillment of the requirements for the degree of Doctor of Philosophy in Business Administration in the J. Mack Robinson College of Business of Georgia State University.

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Lastly, I dedicate this dissertation to my parents Hao Shen and Shanshan Zhu for their love and support.

ABSTRACT

Skilled Worker Mobility and Firm Value: Evidence from a Natural Experiment

BY

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Committee Chair: Dr. Omesh Kini

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Skilled workers are important sources of human capital who are often in short supply and costly to replace. In this paper, I assess how skilled labor mobility affects corporate valuation in a policy-relevant setting of foreign skilled workers' mobility constraints during the U.S. green card application process. Based on a detailed employee-level dataset, I exploit exogenous variations in labor mobility due to Department of State's imprecise estimates of green card availability, including a mistake that inadvertently allocated green cards to a large group of foreign workers. Using multiple test settings, I find that skilled labor mobility has a negative impact on firm value. This effect is stronger for firms with higher labor adjustment costs. Additionally, the wages of skilled workers increase when immigration policy relaxes mobility constraints. Further analysis suggests that reduction in long-term investment is another potential channel through which labor mobility adversely impacts firm value.

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Abstract

Skilled workers are important sources of human capital who are often in short supply and costly to replace. In this paper, I assess how skilled labor mobility affects corporate valuation in a policy-relevant setting of foreign skilled workers' mobility constraints during the U.S. green card application process. Based on a detailed employee-level dataset, I exploit exogenous variations in labor mobility due to Department of State's imprecise estimates of green card availability, including a mistake that inadvertently allocated green cards to a large group of foreign workers. Using multiple test settings, I find that skilled labor mobility has a negative impact on firm value. This effect is stronger for firms with higher labor adjustment costs. Additionally, the wages of skilled workers increase when immigration policy relaxes mobility constraints. Further analysis suggests that reduction in long-term investment is another potential channel through which labor mobility adversely impacts firm value.

JEL classification: G30, G32, G38, J20, J24, J40, J61, J68

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1. Introduction

Labor input has become increasingly important for modern economic growth, but firms are not the residual claimants of employees' human capital (Hart and Moore 1990; Zingales 2000). In a frictionless labor market, workers can take away key human capital by moving to other firms. Labor mobility friction is particularly important for firms hiring skilled workers, who are often in short supply and difficult to replace (Oi 1962; Shapiro 1986). In a knowledge economy, shareholder's assessment of firm value depends on whether the firm can retain its skilled workers (Donangelo 2014; Belo et al. 2017).

Theories of finance and labor economics offer different predictions on the relation between skilled labor mobility and firm value. Skilled labor mobility can be detrimental to firm value for several reasons. Workers gain more bargaining power when they become more mobile, allowing them to use competing job offers to negotiate for higher wages (Balasubramanian et al. 2017). As such, firms are less able to extract labor rents from mobile employees, thereby suffering value losses. Labor mobility also negatively impacts firm value if the departures of valuable employees disrupt the progress of long-term projects and thus dampen the productivity of capital investments (Jeffers 2017). Additionally, firms are vulnerable to trade secret disclosure if contractual mobility constraints cannot prevent key research and development personnel from joining rival firms (Png 2015; Klasa et al. 2017). Labor mobility, however, can also improve firm value by encouraging workers to make ex-ante human capital investments since mobile workers are less likely to be held up by employers (Fulghieri and Sevilir 2011). In addition, a mobile labor market generates positive externalities for firms, such as creating better employer-employee matches and facilitating knowledge transfers (Audretsch and Feldman 1996; Carlino and Kerr 2014; Pan 2017).

Given the bi-directional theoretical predictions, the relation between skilled labor mobility and firm value becomes an empirical question. The extant research on this issue has been inconclusive. For example, two studies that exploit changes in the state-level enforceability of non-compete agreements (an employment contract that prevents employees from joining rival firms) come to different conclusions. While Garmaise (2011) finds an insignificant relation between firm value and mobility, Younge and Marx

(2016) suggest that constraining employee mobility leads to significant firm value appreciation. Additionally, theories suggest that skilled labor mobility can influence firm value through multiple channels such as labor costs, capital investment efficiency, and employee productivity. Therefore, differentiating alternative theoretical predictions requires researchers to examine the real effects of skilled labor mobility along with firm value implications.

In this paper, I empirically examine how skilled worker mobility impacts firm value and jointly evaluate two important contributing channels: labor costs and investments. I improve upon existing studies along two important dimensions. First, I construct a novel firm-level measure of skilled labor mobility based on exogenous labor mobility variation during foreign workers' green card applications. As a vital source of high-skilled workers in the United States, immigrants have made a significant contribution to domestic economic growth (Kerr and Turner 2015). The influx of foreign workers is an important factor for the success of the U.S. technology sector, especially in Silicon Valley, where nearly three-quarters of technology workers are foreign-born (Silicon Valley Community Foundation 2017). Unlike state-level changes in employee mobility, a firm-level skilled labor mobility variable enables me to effectively separate skilled labor mobility's impact on individual firms from the externalities of a mobile geographic labor market. Secondly, I exploit rich variation in mobility shocks to conduct a battery of tests on annual, quarterly, and daily changes in firm value. I also study skilled workers' choices to move and wage levels following exogenous increases in labor mobility. This comprehensive approach allows me to quantify and distinguish various theoretical predictions on the firm value impact of mobility frictions in the labor market.

The exogenous variations in labor mobility stem from the imperfections in the current green card allocation system: foreign employees cannot freely switch jobs until they obtain a green card. The Department of State (DOS) allocates green cards based on *estimated* green card availability. However, these green card allocation decisions are imprecisely estimated due to limited information or miscommunication between regulators, causing workers to be disproportionately promoted (demoted) into more (less) mobile labor market conditions. Therefore, the variations in green card availability are exogenous shocks to the

mobility of skilled foreign workers. Moreover, in 2007, a coordination failure between government agencies led DOS to allocate green cards to all petitioning employees erroneously. This incident significantly increases skilled labor mobility.

I use a unique administrative dataset to map exogenous green card availability shocks to a firm-level skilled labor mobility measure. The dataset includes all individual foreign workers' temporary work visa petitions (H1B visas) and green card petitions filed through the United States Citizenship and Immigration Services (USCIS) from 2001 to 2014. I identify the employers of skilled foreign workers in the dataset and calculate the percentages of mobility-constrained skilled workers in a firm. I then combine the firm-level employment information with the time-series changes in regulator's estimations for green card availability to build measures of skilled labor mobility. The test methods include panel regressions, difference-in-differences (DiD) analyses surrounding the 2007 unexpected mobility shock, and event study approaches featuring green card allocation decisions that significantly impact worker mobility.

A preview of my finding follows. As a validation of the constructed mobility measures, I find that the availability of green cards is significantly related to the job switching rate of foreign workers. This result suggests that green card availability does have important implications on the labor market consequences of foreign workers. I then turn to the analysis of a large sample of individual foreign worker wages. In various models with multidimensional nationality, state, and occupation fixed effects, I find robust evidence that foreign workers' salaries and their compensations relative to local peers are higher when green cards are more readily available. The point estimates suggest that expediting the green card filling by an additional year leads to an annual wage increase of about $164 to $234.

Having documented the impact of mobility on individual workers, I estimate panel regressions to analyze whether labor mobility has an impact on firm value (Tobin's Q). I also employ DiD analyses around the 2007 green card allocation incident as another test setting. The regulator's miscalculation unexpectedly allocated green cards to all petitioning foreign workers, thus relaxing the mobility constraints for a large group of skilled workers. In the DiD regressions, I focus on how this exogenous shock differentially impacts

companies more reliant on foreign workers. In addition, I confirm the findings in the above testing settings and gauge the economic magnitudes of labor mobility by studying market reactions in short windows surrounding several significant green card allocation announcements.

In the panel regressions, I find that skilled labor mobility has a significant adverse impact on firm value. This finding is also supported by the quarterly DiD regressions surrounding the 2007 green card misallocation incident—firms whose skilled workers become more mobile incur steeper value losses when administrative agencies inadvertently allocated green cards to foreign workers. I also verify that the documented valuation impact is not observable before the mobility shock occurs. Additionally, event studies also support the negative relation between labor mobility and firm value. Based on the risk-adjusted returns in days of regulatory decisions on green card availability, I find that average firm value increases by $15,000 to $22,000 per additional year of delay in an individual foreign worker's green card filings. These numbers are more than 20% of the average annual wages paid to a skilled foreign worker.

To provide additional insights to the valuation findings, I analyze the valuation results in subsamples of firms formed by R&D intensity, sales growth, demand for skilled workers, the level of product market competition, and worker's outside job opportunities. I find that the adverse effect of skilled labor mobility on firm value is stronger in firms with higher R&D intensity, sales growth, and demand for skilled workers. These findings suggest that labor mobility is more detrimental to firm value in environments where workers' human capital, especially firm-specific human capital, is likely to be more important. Additionally, the adverse valuation effect is also stronger when workers have more outside opportunities and when firms face more imminent product market risks. Therefore, threats to trade secrets can contribute to the negative relation between skilled labor mobility and firm value.

Given the magnitude of the market reaction, labor cost is unlikely to be the only factor that contributes to the valuation effect. To identify alternative channels through which mobility affects firm value, I study changes in investments when skilled employees become more mobile. Analyzing investments allows me to determine whether skilled labor mobility disrupts firms' capital input in long-term projects.

Employing the same specifications that I had earlier used for determining the firm value effects of labor mobility, I find that firms reduce physical capital investments when skilled workers are more mobile. In particular, a one standard deviation increase in the skilled mobility measure is associated with about 1.2% drop in the firms' investments. The finding in investment level supports the argument for the complementarity between skilled human capital and physical capital (Jeffers 2017). Overall, these findings suggest that skilled labor mobility negatively impacts firm value by increasing firms' labor costs and dampening firms' investments. Reduction in long-term investments is potentially an important channel through which mobility frictions affect firm values.

This paper makes several contributions to the existing literature. A developing line of research studies the real impact of labor mobility constraints on various corporate policies. So far, the research in this field has been predominately focused on exploiting state-level variations in labor market constraints. For example, a large body of empirical work studies how state-level non-compete agreement enforceability affects innovation (Png 2015), investments (Starr 2015; Jeffers 2017), mergers and acquisitions (Younge, Tong, and Fleming 2015), entrepreneurship (Jeffers 2017), and executive compensation (Garmaise 2011). Although this strand of research enhances our understanding of labor market frictions, it also has several noticeable limitations to identify the implications of labor mobility. First, using the state-level variation on labor mobility ignores the use of actual contracts between employees and firms. However, studies based on surveys of non-compete contracts (Starr, Bishara, and Prescott 2017) suggest that the binding nature of labor mobility constraint is more related to the actual use of non-competes rather than the level of enforceability in the states. Second, studies based on state-level shocks cannot directly identify the mobility constraints of skilled workers, whose human capital is more important to firms. These drawbacks can potentially prevent researchers from analyzing the effect of mobility constraints in more relevant economic settings. In this paper, I identify the actual employment information of skilled workers using a comprehensive dataset on all green card applications sponsored by U.S. public firms. I also combine the dataset with a unique institutional mobility constraint on skilled labor to construct a measure that captures

firm-level sensitivity to exogenous mobility shocks. Using this measure, I find that variations in mobility constraints have implications for firm value, labor costs, and investments. These findings suggest that labor mobility frictions of skilled workers have real impacts on corporate policies.

My study is motivated by calls to understand the rising importance of human capital. Contrary to the neoclassical models that view labor as a semi-fixed factor input (Oi 1962), the findings in this paper highlight the importance of the complementarity between skilled human capital input and physical capital input. Workers' skill level magnifies the impact of labor market frictions on corporations since skilled workers are more important to firms and also more difficult to replace (Belo et al. 2017; Ghaly, Anh Dang, and Stathopoulos 2017). The results on corporate valuation also connect to theoretical models that relate labor market frictions to equilibrium asset returns (Donangelo 2014; Belo, Lin, and Bazdresch 2014; Favilukis and Lin 2016; Belo et al. 2017). For example, Donangelo (2014) models labor mobility as a source of operating leverage that amplifies the influence of industry shocks on firms, thereby increasing firms' exposure to systematic risks. In the empirical tests, the author finds that firms in industries with higher labor mobility have higher cross-sectional returns than those in less mobile industries. Belo et al. (2017) suggest that the hiring frictions of skilled workers have a significant impact on stock returns due to the high labor adjustment costs associated with skilled workers.

Immigration policies have attracted much academic interest in recent times.[1] This study discovers a novel channel through which immigration policies affect corporate policies. The nascent finance studies on immigration policies focus extensively on the supply shocks of foreign workers (Ashraf and Ray 2016; Xu 2016). Instead, I focus on a more nuanced but important attribute of the current immigration system – the green card allocation – which has mostly remained unchanged since the Immigration Act of 1990. The efficiency of the permanent residency allocation is subject to debate in an era with rising demands for

[1] For example, related works include Peri, Shih, and Sparber (2015b) on regional growth, Doran, Gelber, and Isen (2016) on firm profit; Kerr and Lincoln (2010) on innovation; Hunt (2011), Kerr and Kerr (2013), Hunt (2015), and Kerr, Kerr, and Lincoln (2015) on worker mobility and employment structure; Borjas and Doran (2012) and Peri, Shih, and Sparber (2015a) on domestic worker's interest; and Hira (2007) and Matloff (2003) on criticisms of H1B programs. See Kerr and Kerr (2011) and Kerr et al. (2016) for surveys on immigrants' impact on the economy.

skilled labor in the U.S. economy. Recently, business magnates such as Sheldon Adelson, Warren Buffet, and Bill Gates have proposed to remove the worldwide cap on the annual number of green cards to nationalize more "talented graduates" (Adelson, Buffett, and Gates 2014). The findings in this paper suggest that the operational inefficiencies in the current green card allocation system not only affect individual foreign workers' welfare but are also met with significant capital and product market responses. As a response to calls for immigration system overhaul, in October 2015, DOS and USCIS revised the green card allocation scheme by releasing more information on immigration petitions to help foreign workers and employers estimate the length of immigration petitions. The efficacy of the new system remains an unexplored topic. My paper suggests that immigration policy's influence on the corporate sector can be a significant factor for policymakers to consider in evaluating the existing immigration system.

The remainder of this paper is structured as follows. Section 2 contains the hypotheses for the relation between labor mobility and firm value. Section 3 introduces the institutional knowledge to develop the empirical setting. Section 4 describes the data and the main variables. Section 5 presents the findings. Section 6 concludes the paper.

2. Labor Mobility and Firm Value

In this section, I develop theoretical arguments on the two-tiered impact of labor mobility on firm value. Based on theories in finance and labor economics, I argue that making the employees more mobile can negatively impact firm value by increasing labor costs, reducing investment productivity, and posing threats in product markets. Alternatively, skilled labor mobility can also improve firm value by incentivizing employees to invest in general human capital and promoting better employer-employee matching. Given the two opposing effects above, the relation between skilled labor mobility and firm valuation becomes an empirical issue. The net firm value effect depends on the relative strength of the two economic forces.

Mobility reduces the rent firms can extract from skilled employees. Mobile employees are more likely to receive other job offers, especially in a dense labor market with many alternative employers. As

such, they are less likely to be held up by their existing employers (Balasubramanian et al. 2017). Additionally, higher employee mobility dampens the employers' firing threat especially in regimes where legal wedges do not provide protections for unjust employee dismissal (Acharya, Baghai, and Subramanian 2014). Due to mobile employees' enhanced bargaining power, existing employers cannot freely exploit the differences between wages and workers' marginal productivity, thus increasing the labor costs of the firms. These channels predict that major component of firm value losses is the incremental wage costs associated with a more mobile workforce.

As labor becomes a more important input in firm's production, labor mobility could also lead to distortions in firm's investment decisions, adding to another channel that results in firm value losses. The resulting firm value losses stem from forgone positive NPV projects and impaired investment efficiency. For example, losses of employees at key development stages can significantly disrupt projects that require long gestation periods, adding a salient operating cost to the firm (Donangelo 2014). The detrimental effect is stronger for skilled workers since their human capital complements physical capital (Autor, Katz, and Krueger 1998). Furthermore, employees' job duties can also have differential effects on the economic magnitudes of investment distortion. Skilled workers with specific-investments, such as technical know-how on firm-specific projects, are harder to hire or replace due to their experience and training (Williamson 1985). Similarly, departing workers who are engaged in multiple projects can lead to more severe disruptions. Therefore, I expect that mobility-induced investment distortion to be more value-destroying for firms employing workers with more specific human capital investments and for firms whose workers work on multiple investment projects. As a side effect, labor mobility also discourages firm's contribution to worker training since employers cannot fully internalize the benefits of human capital investments if skilled employees subsequently join another company (Starr 2015).

Since firms are not isolated participants in the labor market, the competitive effect of labor mobility is yet another reason why skilled labor mobility can be detrimental to firm value. Skilled workers often have access to the core technologies of their employers, thus making them attractive to rival firms

that attempt to gain the upper hand in cut-throat product market competitions. Afraid of the usurpation of trade secrets, employers have lobbied for effective institutional constraint on employee mobility, such as the inevitable disclosure doctrine, to prevent skilled workers from sharing trade secrets with competitors (Png 2015). For example, companies in the technology sector even go so far as to use private internal contracts to prevent employee poaching (Stone 2014). Not surprisingly, the cost associated with losing trade secret is significant for employers. For example, Klasa et al. (2017) find that legal protection of trade secret is a critical determinant of firm's financial policy, especially when competition is more intense.

Alternatively, there are two major reasons why labor mobility can contribute to firm value. A more mobile labor market incentivizes employees' investments in the general human capital, potentially increasing the quality of firms' labor factor input. When mobility constraint prevents the workers from seeking alternative job offers, employees refrain from investing in human capital as these investments are not rewarded in the labor market (Fulghieri and Sevilir 2011; Acharya, Baghai, and Subramanian 2014). Therefore, labor mobility increases firm value in environments where workers underinvest in general human capital.

Although labor mobility could exert an adverse competitive effect on firm value, it can also contribute to firm value through the allocative effects of the labor market. A mobile market for skilled employees reallocates workers to the more productive areas, generating better-matching between firms and employees. Therefore, firms' productivity improves in mobile labor market thanks to the complementarity between firm attributes and employees' human capital (Pan 2017). Free personnel movements within regions also yield endogenous growth for local economic activities (Carlino and Kerr 2014; Overman and Puga 2010; Audretsch and Feldman 1996). In other words, firms become more productive due to a larger pool of available skilled workers and technology spillovers in the region (Dougal, Parsons, and Titman 2015). Therefore, the influence of labor spillover on firm value will be stronger for firms that are in need of higher quality human capital and experienced employees.

3. Green Card and Labor Mobility

An ideal test to causally identify the relation between firm value and mobility is to exogenously assign workers in some firms to mobile (immobile) labor market conditions. Subsequently, researchers can compare the resulting changes in firm value following this random experiment. In a similar spirit, I utilize the green card allocation system to create a continuous measure of worker mobility. The exogenous variation stems from regulator's imprecise estimation of green card availability. In this section, I describe the current U.S. employment-based immigration system for establishing my experimental setting on high-skilled mobility. I first introduce foreign worker' mobility constraints during green card application and give a simplified explanation of the mobility measures. I then describe the green card allocation system with a focus on the exogenous green card availability shocks. The section concludes with a significant green card allocation error that I also exploit in the statistical analysis.

3.1 Green card and mobility

Foreign workers can work for U.S. companies under a temporary work visa (H1B visa) for at most six consecutive years. During this period, these workers can only be employed in certain jobs which employers are willing to sponsor the employment. Most workers interested in staying in the U.S. for longer need to apply for permanent residency (green card) during the valid periods of H1B visa. An approved green card entitles foreign workers to similar labor market conditions as U.S. citizens.

Besides limited outside employment opportunities during H1B visa period, foreign workers become even more immobile when they apply for green cards (Bhattacharya 2015). A petitioning foreign worker first goes through labor certification and background examination to certify current employment and family information. Even a relatively fast certification process takes one to two years. Afterward, green card applicants file for another USCIS petition, which also could take one to two years. Finally, the worker obtains permanent residency only *when a green card becomes available*. The wait time for the last process is indefinite. Without a green card, a worker who switches jobs needs to complete at least another round of labor certification and background examination. In the worst case scenario, green card applicants need to

redo the entire green card process if they move without a completed labor certification. Additionally, since employers sponsor green card applications, companies can choose to delay the green card filings or even withdraw the applications in certain situations. The threats come at a significant cost for employees especially when they are in the middle of green card applications. Therefore, institutional features of the U.S. immigration system make it undesirable for foreign workers to move while applying for green cards.

3.2 Green card allocation: a simple example

Given the institutional feature of permanent residency application, the availability of green cards dictates the mobility of foreign workers. Exogenous changes in green card availability would create an experiment to identify the causal effect of mobility on firm-level outcomes. In this section, I illustrate the primary mechanism of the green card application to introduce empirical proxies for worker mobility. Subsequent sections explain the details and the exogenous nature of the green card allocation.

DOS allocates green cards on a first-come, first-serve basis. A petitioner's place in the queue is the date he/she starts the immigration process (*priority date*). Applicants with earlier priority dates obtain green cards sooner. The DOS uses cut-off dates to assign green cards. Workers who apply before the cut-off dates will get green cards.

Suppose a foreign worker applies for a green card on January 1st, 2014 and the current cut-off date is January 1st, 2010. Then the worker cannot obtain a green card for now. The distance between the priority date and the cut-off date becomes an empirical proxy for that workers' mobility. The longer the distance, the longer the workers remain in immobile labor market conditions. In other words, the distance to the green card is four years. Alternatively, a cut-off date of January 1st, 2012 would shorten the distance to two years, making the worker more mobile. Likewise, an exogenous change that moves the cut-off dates to January 1, 2008 means that the foreign worker's mobility decreases since she is now six years away from a green card.

Generalizing from the above example, given two cut-off dates announced in times t and $t-1$, the changes in green card availability for a given worker i working in an economic unit (firm, states, etc.) k can be expressed as:

$$Green\ Card\ Availability_{i,k,t} = CutOff\ Date_{i,k,t} - CutOff\ Date_{i,k,t-1}$$

A positive $Green\ Card\ Availability$ means that workers are more mobile. For an economic unit with N such workers, the measure that captures the aggregated mobility is:

$$Mobility_{k,t} = \sum_{i=1}^{N} Green\ Card\ Availability_{i,k,t}$$

In the main analysis, I aggregate the mobility measure at the firm level. I also compute a measure for all foreign workers within a state to gauge how green card availability affects the foreign workers in a state.

3.3 Details of Green card allocation mechanism

Having illustrated the primary mechanism of green card allocation, I now turn to the details of the immigration system to introduce the exogenous variation in worker mobility. The annual green card quota for skilled foreign workers and their family members is about 80,000. DOS has the sole authority to allocate green cards. The allocation mechanism rations green cards based on workers' skills and places of birth. There are two skill types: Professional Workers (EB-2) and Skilled Workers (EB-3). Within each skill type, there are five different country classifications: China, India, Mexico, the Philippines and Other (all other countries except those mentioned above). [2]

Every month, DOS publishes monthly *visa bulletins* detailing green card availability in a 2 x 5 matrix table. Panel A of Figure 1 presents the visa bulletin for April 2012. I refer to each cell in the table

[2] Immigration agencies establish this system to prioritize the immigration of more talented workers and ensure ethnicity diversity. Professional workers, with a master's degree or above, can get their green card faster. The immigration law stipulates that any one country cannot exceed 7% of the annual allocation for a skill type unless the demand from all other countries has been fulfilled. Because the demand for green cards from China, India, Mexico, and Philippines dramatically exceeds supply, DOS arranges separate queues for workers from these countries.

as a *preference category*. Workers who previously petitioned for immigration before the cut-dates in the cell can obtain a green card. For example, professional Indians workers who had applied before May 1, 2010, can obtain a green card in that month. A cut-off date of "C" means that green cards are available for all foreign workers in that category.

The table also lists the percentages of green card applicants in each preference category based on all petitions filed from 2006 to 2014. The most densely populated group is that of professional Indian workers (38.6%). Only around 17% of all foreign workers from three preference categories (Professional workers from all countries except China and India) filing for green cards are not quota-constrained. Thus green card availability estimations made by DOS significantly influence the labor market opportunities of a large group of high-skilled workers. In subsequent analysis, I focus the analysis on workers from these seven preference categories.

3.4 Exogenous green card availability variation

The variation in monthly cut-off dates creates exogenous variation in green card availability and hence foreign worker mobility. The cut-off dates do not merely reflect a predictable supply and demand relation. Instead, these dates are the estimates made by the administrators (The Department of State 2016). The observed monthly green card availability suggests that the imprecision in the estimated cut-off is significant. Panel B of Figure 1 plots the cut-off dates for professional Indian workers, professional Chinese workers, and skilled Indian workers. The graph indicates that the time-series pattern of the cut-off dates does not resemble a chronological sequence. Instead, DOS frequently dials back the cut-off dates to an earlier date. The preponderance of reversals (significant advancements) in cutoff dates suggests that the administrator can overestimate (underestimate) the availability of green card.[3] Moreover, the green card

[3] Information opaqueness is a significant reason for the volatility of cut-off dates. Although the annual green card quota is a fixed number, the availability of green cards for each country also relates to the number of applications from other countries. Too many allocations to the four oversubscribed countries crowd out applicants from the rest of the world while too few allocations waste the green card quota. The demand for green cards is also uncertain. To estimate demand, the DOS relies on green card petitioning information from the USCIS, which only provide estimates of green card petitions since workers can file multiple applications or forfeit their applications due to miscellaneous reasons

allocation system has never been changed due to firms' lobbying during the sample period. This desirable feature also reduces the concern of potential omitted firm-level variables that bias multivariate regression analyses.

3.5 Green Card Misallocation in July 2007

I now introduce a coordination failure between government agencies that led to a severe green card availability estimation error. The incident suggests that DOS does not have complete information to estimate green card availability. I also exploit this event in the empirical tests.

On June 12, 2007, DOS made a surprising announcement in the visa bulletin, claiming that green cards would be available for all petitioners. In response, foreign employees rushed to send their packages to USCIS in bulk, hoping to obtain permanent residency soon. However, on July 2, 2007, the DOS issued an emergency update to cancel the previous green card allocation decision. The DOS claimed that it recently found that USCIS had already used up all green cards for the fiscal year, and hence the administrator would not allocate any green cards for the rest of the fiscal year. At the same time, USCIS returned all green card petitions received in June. The bulletin retraction triggered a public outcry from the green card petitioners who openly denounced this decision and organized a nonviolent protest (Herbst 2007). One day after the DOS emergency announcement, Senator Zoe Lofgren, the Chairwoman of the Subcommittee on Immigration wrote a public letter to USCIS and DOS protesting the sudden revocation of green card allocation decisions. Perhaps due to the public and political pressure, DOS announced on July 17, 2007, that it would honor the announcement in June 12 and process all applications filed before August 17, 2007. After foreign workers started resending the green card petitions, USCIS made a press release on August 3, 2007 announcing that the agency had received a large number of green card petitions. After the turmoil, reports estimated that the USCIS received 300,000 green card petitions over the course of a month.[4]

[4] For a full review of the 2007 visa bulletin events, please refer to Patrick (2007).

4. Data and Main Variables

4.1 Cut-off dates

I obtain the visa bulletin from DOS website, which publishes the cut-off dates for all preference categories and maintains a historical time-series of cut-off dates since 1992. The green card allocation system came to practical use in the fiscal year 2005 due to an increasingly larger pool of green card applicants. Before 2005, the supply of green cards exceeded demand hence most preference categories were "Current" throughout the entire fiscal year. For each monthly bulletin file, I obtain the cut-off dates for all preference categories and the publication dates of visa bulletins. In subsequent analysis, I use these dates to analyze the market announcement effects around the days DOS issued visa bulletins.

4.2 H1B and Green Card Petitions

I obtain the information on H1B employees and green card sponsorship from a Freedom of Information Act request (FOIA) filed in August 2015. The received dataset contains all H1B petitions (I-129 forms) and permanent residency petitions (I-140 forms) from the fiscal year 2001 to the fiscal year 2014. Each observation is a single petition of a foreign employee during the fiscal year. The dataset on H1B petitions contains the petitioning employers' name, employee's work location, country of birth, and job classification. The dataset also contains information on the objectives of H1B visas, allowing me to differentiate whether an employee is a new H1B worker, a continuing worker, or an external hire.

The dataset on green card petitions contains similar information for employer names and employee location. The green card petition dataset also contains green card applicants' dates of immigration petition and skill classification by the administrative agencies, allowing me to connect the foreign worker's petitions with the time-series changes in green card availability. The requested dataset does not contain more detailed demographic information, such as gender, age, or educational attainment. In both datasets, key information on employee identity is redacted, making it impossible to track individuals longitudinally.

The requested datasets from USCIS contain employer names. To identify the public firms in the datasets, I conduct a fuzzy name-matching with COMPUSTAT firms over the same period. Since both

datasets contain millions of observations, I choose to match all entities that filed more than 30 petitions during the sample period (around three petitions per year). This criterion enables me to do a visual check on all names matches generated by the name-matching program.[5] I also check the unmatched names in online search engines and discard the observations if I cannot identify a public firm or subsidiary associated with the H1B petitioner.

Table 2 presents the two-digit NAICS industry distribution of the firms identified from the foreign worker employment petitions. I use consistent NAICS 2007 codes to classify industries. After excluding firms in the financial and utilities industry (2-digit NAICS codes 22, 52, and 53), I identify 925 employers of foreign workers based on my name-matching algorithm over the period of 2006 to 2014. Table 2 reports the number of firms in the sample and the number of COMPUSTAT firms in a two-digit NAICS industry. For each industry, I list the number of firms in the sample and the total market value of all sample firms scaled by the industry market capitalization. Firms relying on skilled foreign workers are mostly concentrated in manufacturing, information, and professional service industries since these sectors have more considerable demands for skilled workers. Overall, these firms account for 9.3% of all COMPUSTAT firms, but represent 39.5% of the equity market value. These statistics suggest that the sample firms are industry leaders, with significant influence on the U.S. equity market.

4.3 Firm's Employment Information

I start with estimating the number of foreign skilled works whose labor market opportunities are affected by the green card availability. I use COMPUSTAT gvkey as an identifier to track the time-series information on foreign skilled worker employment in the sample. I then aggregate the petition-level data to the firm-level variable that captures the number of foreign workers.

[5] I standardize the company names and use the SAS function COMPGED to calculate a score of similarity between the two strings. I then visually check all matching strings. I also randomly select unmatched strings to ensure matching quality.

I obtain the number of foreign workers in each immigration preference category ($Num\ Foreign\ Workers$) based on the FOIA request. According to the green card allocation mechanism, professional workers from the four oversubscribed countries and all skilled foreign workers are subject to green card availability shocks. These workers consist of two groups: the first group includes the workers with approved immigration petitions but no available green cards, while the second group includes workers who are still in the process of labor certification and immigration petitioning. For the first group, I aggregate the immigration petition forms (I-140) to arrive at a firm-year observation. Since USCIS keeps the priority dates of green card applicants, I am able to calculate when a worker obtains a green card based on monthly cut-off dates. I estimate the number of workers in the second group based on the number of newly hired H1B workers who joined the firm during the current and previous years. Because the company's internal approval and the immigration petitioning process take over two years, the recently-recruited H1B workers are unlikely to have an approved immigration petition. I thus avoid double counting the number of mobility-constrained workers. I aggregate these two groups to obtain the total number of mobility-constrained workers. I subsequently estimate the proportions of workers under each preference category based on nationality and skill-based immigration classification (Professional or Skilled) information reported in the green card petition files.

4.4 Main variables construction

Having obtained an annual estimate of the number of foreign workers, I now construct the skilled worker mobility variable. The rationale follows section 3.2. To arrive at the measure(s), I address two issues in this section. Firstly, since the cut-off date varies on a monthly frequency, I need to compute the annual changes in the cut-off dates to match with the financial information of firms. Secondly, I need to scale the foreign worker mobility variable to capture the heterogeneity in firms' dependence on skilled foreign workers.

To address the first issue, I first calculate the annual changes in cut-off dates for each of the seven quota-constrained skill and nationality preference categories listed in Figure 1.[6] For each preference category, I use the first cut-off date in reverse chronological order for a given fiscal year to reflect the status of green card processing. I define this date as the *annual cut-off date*. These dates represent the best chances for foreign workers to file for a green card over a year. Figure 2 marks the annual cut-off dates for professional Indian workers for the fiscal years from 2012 to 2014. Graphically, these dates are the highest vertical points in a year. Changes in annual cut-off dates capture the availability of green card processing for workers in that category.[7] A positive time-series change suggests that more skilled workers can file for a green card and also increases the likelihood of the existing applicants to obtain a green card soon. Conversely, a negative change prevents all existing foreign workers from filing for a green card, revealing that green cards are in short supply.

$$Annual\ Green\ Card\ Availability_{p,t} = Annual\ CutOff\ Date_{p,t} - Annual\ CutOff\ Date_{p,t-1},$$

In the equation above, p denotes a preference category, such as professional Chinese workers, skilled Indian workers, etc., and t denotes the year. For example, according to Figure 2, the annual cut-off dates in the fiscal years 2014 and 2013 are May 1, 2009, and June 15, 2008. The change in green card availability for the fiscal year 2014 is 11 months or 0.92 years. Note that the mobility variable can be negative if the visa bulletin cut-off dates are reverted to a previous date. For example, the mobility variable is -1.92 years (23 months) based on the annual cut-off dates for fiscal years 2012 and 2013.

Following the notations used in the previous section, I define the aggregate skilled worker mobility for a firm k as:

[6] In other words, this means that I calculate those preference categories not marked with "C". Recall that professional workers other than those from China and India are not subject to constrained green card allocation

[7] In the Internet Appendix, I use a time-series demeaned version of the changes in cut-off dates to construct alternative versions of skilled worker mobility variable. The findings on mobility and firm value are unaffected.

$$Mobility\_Firm_{k,t} = \sum_{p=1}^{7} Num\ Foreign\ Workers_{k,p,t} \times Annual\ Green\ Card\ Availability_{p,t}$$

With the aggregate mobility metric, I can compute firm's sensitivity to green card allocation by scaling the variable $Mobility\_Firm_{k,t}$ by the size of the firm's high-skilled workforce. In other words, the variable reflects the average change in the high skilled workers, assuming that the domestic workers' sensitivity to green card allocation is zero.

I use three alternative ways to define the size of the high-skilled workforce in a firm. The main definition is the number of STEM (Science, Technology, Engineering, and Mathematics) workers in a firm. Foreign workers account for a disproportionate share of STEM jobs (Hanson and Slaughter 2017). A primary purpose of the H1B program is to compensate the shortage of STEM workers in the United States. As such, I need to obtain the number of domestic STEM workers in a firm. I start by estimating a U.S. public company's domestic employment. Some companies report this number in the COMPUSTAT historical segment file. For firms without direct measures of domestic employment information, I use the number of workers reported in COMPUSTAT Annual file. For a subgroup of multinational companies without domestic employment information, I scale the employment number by the proportion of domestic sales reported in the COMPUSTAT historical segment files.[8] I then obtain the number of domestic STEM workers as the product of domestic employment and the percentage of STEM workers in a four-digit NAICS industry as reported in the Occupation Employment Statistics (OES) of the Department of Labor. The main mobility measure is:

$$Mobility\_STEM_{k,t} = \frac{Mobility\_Firm_{k,t}}{Num\ STEM\ Workers_{k,t}}$$

Since most of the skilled foreign workers have a bachelor's degree or above, I also match the Standard Occupational Classification (SOC) in the OES dataset with the typical education requirement data

[8] Multinational companies are defined as firms whose foreign sales account for more than 25% of the revenue (Pinkowitz, Stulz, and Williamson 2016).

obtained from O*NET and calculate the proportion of STEM occupations that require a bachelor's degree. The second mobility measure is:

$$Mobility\_HESTEM_{k,t} = \frac{Mobility\_Firm_{k,t}}{Num\ STEM\ Workers\ Requiring\ A\ Bachelor's\ Degree_{k,t}}$$

Finally, I also use the number of R&D workers as the total population of skilled workers. According to the National Science Foundation (NSF), R&D workers are employees who engage in scientific and engineering tasks with degrees equivalent to at least a four-year college training. This definition is also aligned with the educational attainment of the foreign workers considered in this study since college education is an important qualification for immigration. Since the finest level of industry classification in the NSF statistics is at the three-digit NAICS level, I multiply company's domestic employment by the proportions of R&D workers in each three-digit NAICS industry reported by NSF.

$$Mobility\_RD_{k,t} = \frac{Mobility\_Firm_{k,t}}{Num\ R\&D\ Workers_{k,t}}$$

The unit for both variables is a year. A large value suggests foreign workers are mobile. One can interpret this variable as a proxy for the aggregate changes in green card application length for all skilled workers in a firm.

4.5 Firm-level summary statistics

The panel dataset starts from the fiscal year 2007 and ends in the fiscal year 2015 since I lag the mobility variables by one year. The sample includes 925 firms and 6,679 firm-years. Panel A of Table 1 reports information on the employment of foreign workers and main variables. On average, the skilled foreign workers consist of 21% of a firm's STEM workers, 26.7% of the workers for STEM workers requiring at a bachelor's degree, and 27% of R&D workers.[9] The average skilled labor mobility in the sample ranges from 0.11 years to 0.16 years. The large standard deviation suggests that the green card

[9] The distribution of these variables is skewed. In the Internet Appendix, I construct the main variable based on log percentages and obtain similar findings.

mobility shocks exhibit strong time-series variation, thus providing interesting dynamics regarding skilled labor mobility.

Panel B of Table 1 report information on main dependent variables and other independent variables obtained from COMPUSTAT. Dollar-denominated items are inflation adjusted to 2009 dollars. Additionally, all variables based on COMPUSTAT are winsorized at their 1% and 99% levels. The mean (median) *Tobin's Q* and return on assets (*ROA*) are 2.21 (1.77) and 10% (12%), respectively. The average total investment in capital expenditures and R&D expenses is about 13% of firm's total assets. Further, the mean (median) firm size (*Total Asset*) is approximately $11.3 billion ($1.6 billion). The mean (median) levels of R&D intensity (*R&D*), leverage (*Leverage*), and cash as a proportion of total assets (*Cash Holdings*) are 9% (4%), 18% (15%), and 25% (19%), respectively. The mean (median) firm age (*Firm Age*) is 25 years (18 years). In Panel C of Table 1, I report the summary statistics for the Quarterly COMPUSTAT sample around the 2007 green card misallocation event. The distribution of variables is similar to the annual sample except for income statement items based on quarterly transactions (investment, R&D expenditures, and cash flows).

4.6 Moving Rates

Since 2007, the USCIS dataset includes a separate category for H1B visas issued due to job changes but does not collect the identity of the original employer of the job-hopping employees. I thus focus on geographic labor market within a state to measure the mobility of H1B workers. For each state, I calculate the percentage of H1B workers who switch to another employer in a given year (*State Moving Rate*). Panel D of Table 1 presents the distribution of the mobility variable in the sample period from 2007 to 2014. On average, each state has about 12,000 H1B workers, and about 5% of H1B workers move to another employer in each year.

To capture the mobility of H1B workers in a state, I follow the rationale in the previous section and define the mobility variable as:

$$Mobility\_State_{s,t} = \frac{\sum_{p=1}^{7} Num\ H1B\ Workers_{s,p,t} \times Annual\ Green\ Card\ Availability_{p,t}}{Num\ H1B\ Workers_{s,t}}$$

In the equation above, s denotes a state, and p denotes a preference category. The table also includes other information about the state such as the GDP Growth rate, Income Per Capita, and Unemployment Rate that captures the economic development and labor market conditions in these states.

4.7 PERM Worker Wages

I obtain workers' wages from the Office of Foreign Labor Certification (OFLC) of the Department of Labor, which publicizes all labor certification information for foreign workers filing for green cards (also referred to as "Permanent Labor Certification" or "PERM"). The labor certification process ensures that the employment of foreign workers does not adversely impact the welfare of domestic workers. The OFLC maintains the information according to the Immigration and Nationality Act (INA), which stipulates that the wages of green card petitioners must exceed the wages of domestic workers doing the similar job in the same locations. Only workers whose employment offers are certified by the OFLC can move forward with their green card petition with USCIS. Therefore, the dataset contains the foreign worker's information at the start of green card application.

The PERM datasets list the petitioner's country of birth, ranges of the wage offers, the prevailing wage for the local area used by administrators in labor certification, and universal SOC occupation codes. I collect all petitions filed and successfully certified by the OFLC from the fiscal year 2007 to the fiscal year 2015.

To empirically evaluate the mobility of workers in the sample, I link the nationality of the workers reported in the PERM file with the changes in cut-off dates to compute a country-year variable. However, the OFLC dataset does not report whether a worker is considered a professional or a skilled worker in the green card application. To circumvent this issue, I use each country's annual percentages of professional workers ($\%Professional\ Workers_{c,t}$) and skilled workers ($\%Skilled\ Workers_{c,t}$) reported in the FOIA request file to calculate a weighted average variable that captures worker's mobility. In other words, the

measure for worker mobility is the annual probability-weighted green card availability for a country. This treatment is necessary since the green card allocation system gives preference to more skilled workers. Ignoring the national heterogeneity in foreign workers' skill endowment would bias the inferences in the wage analysis. I do not scale this variable since the unit of observation is a single worker.

Specifically, for each country c in a year, I define the mobility variable as:

$$Mobility\_Worker_{c,t} = \%Professional\ Workers_{c,t} \times Profesional\ Worker\ Green\ Card\ Availability_{c,t} + \%Skilled\ Workers_{c,t} \times Skilled\ Worker\ Green\ Card\ Availability_{c,t}$$

Panel E of Table 1 provides the summary statistics for all workers with valid annual wage information, based on green card labor certification files. The mean and median wage is more than $88,000, higher than the national average STEM worker wage ($78,164 in 2009). I also report the ratio of the workers' actual wage to the local prevailing wage used for labor certification (*Wage/Prevailing Wage*). The ratio has to be larger than one according to the requirement of labor certification. On average, a green card petitioner's salary is about 18% higher than an average worker doing a similar job locally. The wage information also suggests that the workers in the sample are important to the employers, possibly due to their more valuable human capital. I also report the assessment of foreign worker's skill level ranged from 1 to 4 in the disclosure data. Level 1 to 4 represent "Entry/Beginning", "Qualified", "Experienced", and "Full Competent", respectively.

5. Empirical Findings

5.1 Job switching decisions of H1B workers

In this section, I first examine whether the green card process increases the mobility of skilled foreign workers. The test focuses on H1B worker's decisions before getting a green card. Since the mobility variable I construct is a continuous measure that captures the distance to mobile labor market conditions, I expect H1B worker to move more frequently even if they have not yet obtained a green card. In other words,

if exogenous changes in green card availability lower the cost of moving, some H1B workers will move when the expected gains from job hopping exceed the job switching costs induced by the green card process. Another direct test is to observe the job switching choices before and after a foreign worker obtains a green card. Unfortunately, the test is not feasible for this study since the dataset maintained by USCIS does not track foreign workers after they obtain green cards. The estimates in my empirical test can be viewed as a lower bound of the economic magnitude of the direct test since acquiring a green card will lower the immigration-related mobility costs to zero.

I compute the proportions of H1B visas issued due to job switches in each state and construct a state-year panel. In Table 3, I use three models to analyze whether mobility variables constructed based on green card availability effectively affect the job switching decisions of H1B workers in the state. The first model features an OLS regression on H1B worker moving rate and the mobility variable; the second model includes year dummies to absorb time trends. I also control for the state's economic and labor market conditions. In the third model presented below, I use a more stringent specification with both state fixed effects (α_s)and year fixed effects (α_t).

$$State\ Moving\ Rate_{s,t} = \beta_0 + \beta_1 Mobility\_State_{s,t-1} + \gamma_{s,t-1} + \alpha_s + \alpha_t + \varepsilon_{s,t} \quad (1)$$

Estimates from all three models suggest that increasing green card availability correlates with a higher proportion of H1B workers who seek alternative career opportunities. Based on the first two model, one standard deviation change in the green card mobility variable increases the moving rate of H1B workers by 0.3% in absolute terms. If these changes are evaluated relative to the average moving rate of a state (5.3%), it suggests that one standard deviation change in the mobility variable is associated with 6.3% to 6.8% increase in moving rate. In Model (3), I find that the relation between changes in green card processes and H1B worker's mobility is still positive and significant at 10% level. The magnitude of the effect, however, shrinks by half in models focusing on within state variations.

5.2 Wages

This section presents evidence relating the mobility of workers to their wages. I obtain wage data for all workers petitioning for labor certifications. In the green card labor certification sample, each observation is a single petition by the foreign employee. It is worth noting that this sample only includes workers filing for a green card. Therefore, the estimate in the linear regression reflects the conditional comparison between foreign workers who experience different green card mobility shocks. Similar to the arguments in the previous section, the point estimates in these tests are lower bounds of the actual wage improvement when a foreign worker obtains a green card.

I estimate a pooled cross-sectional regression model on all worker petitions from 2007 to 2015.

$$Wage_{i,c,t} = \beta_0 + \beta_1 Mobility\ Worker_{c,t-1} + \gamma_{i,c,t-1} + \alpha_c + \alpha_t + Other\ FE + \varepsilon_{i,c,t} \quad (2)$$

In the above model, i denotes a worker petition, c denotes worker's nationality. I include nationality, year fixed effects, and other location or occupation fixed effects.

In Panel A of Table 4, I analyze the relation between worker mobility and their wages. The models control for labor skill and worker's nationality and include indicators for workers' occupation and the state of location. Model (3) and (5) include state-year and occupation-years fixed effects to absorb regional economic shocks or demand shocks for occupation in specific time periods. In all models, I find that labor mobility is positively associated with the wages of the H1B workers. The relation is statistically significant, but the economic magnitude is not sizeable relative to the average wages of the workers. One standard deviation change in *Mobility_Worker* increases employee wages by about 0.5%. In other words, reducing the expected length of green card application by one year is associated with an increase of $164 to $234 in foreign workers' annual wages.

In Panel B of Table 4, I also analyze the changes in workers' wage premium when they are closer to obtaining permanent residency. All but the first model indicate that higher mobility has a positive statistical relation with foreign worker's wage premium over domestic workers at least at 1% level. In

summary, relaxing mobility constraints increases both the level of compensation and wages relative to local peers. These results combine to suggest that relaxing labor mobility constraints is associated with an increase in workers' wages. The wage effect is likely due to mobile workers' higher bargaining power. It also suggests that firms incur higher labor costs when workers become more mobile.

5.3 Analysis of firm value

I now analyze the net effect of skilled labor mobility on firm valuation. I use the following specification to study how skilled labor mobility influences firm valuation:

$$Q_{k,t} = \beta_0 + \beta_1 \times Skilled\ Labor\ Mobility_{k,t-1} + \gamma_{k,t-1} + \alpha_t + \alpha_k + \varepsilon_{k,t} \quad (3)$$

In the equation above, $Skilled\ Labor\ Mobility_{k,t-1}$ is one of the three versions of skilled labor mobility variable introduced in the previous section (*Mobility_STEM*, *Mobility_HESTEM* or *Mobility_RD*). The models include other determinants of firm value, firm fixed effects α_k, and year fixed effects α_t to focus on the conditional effects of skilled mobility on Tobin's Q.[10] The sign of β_1 reflects the net effect of skilled labor mobility on firm value.

Table 5 reports the results from this analysis. The findings suggest that skilled labor mobility is negatively associated with Tobin's Q. The coefficients of the skilled mobility variable are negative and statistically significant at the 1% level. The magnitudes of the coefficients suggest that one standard deviation change in the skilled worker mobility variable is associated with 1.36%, 1.43%, and 1.94% decrease in Tobin's Q, respectively. These results provide initial support for the adverse effect of labor mobility on firm value. Given the large equity values of the sample firms, skilled labor mobility is associated with considerable shareholder wealth decrease. Additionally, R&D intensity, ROA, and sales growth positively relate to firm value, suggesting that firm's innovative input and growth prospect are also significant contributors to value creation. I also find that young firms are associated with a higher valuation.

[10] In a recent paper, Peters and Taylor (2017) propose a new definition of Tobin's Q (*Total Q*) by incorporating intangible capital. The findings are unchanged using this alternative definition. Internet Appendix Table 1 reports these findings.

5.4 Subsample analyses

Having established a negative association between corporate value and skilled labor mobility, I now turn to subsample analyses to further understand the economic mechanism for this documented relation. In previous sections, I posit that skilled labor mobility is more detrimental when: (1) workers' human capital investment is more specific and (2) workers engage in multiple projects. I use R&D intensity and sales growth as proxies for a firm's labor adjustment costs. High R&D firms require highly-skilled and more specific human capital investments (Kale and Shahrur 2007; Kale, Ryan, and Wang 2016). Skilled labor mobility poses a more significant threat to high-growth firms because the marginal cost of losing an employee is higher in fast-growing firms dependent on human capital input.

To characterize the extent of product market competition, I use the product market fluidity measure developed by Hoberg, Phillips, and Prabhala (2014). Fluidity is computed based on the product market language descriptions in a firm's 10-K. A large fluidity measure suggests that a firm faces fierce product market competition. I hypothesize that the cost associated with trade secret disclosure is more significant when firms operate in more competitive landscapes, thereby exacerbating the adverse valuation effect of skilled labor mobility. Similarly, I also investigate the interaction between skilled labor mobility and workers' external opportunities. I divide the sample by the four-digit NAICS labor mobility measure developed by Donangelo (2014). A high value of the mobility measure indicates that workers can port their skills across various industries. To examine the incremental effect of labor skills on firm value, I use the labor skill measures constructed by Belo et al. (2017) to define industries with high labor skills.

Table 6 reports the results from the subsample analyses. I interact the STEM worker mobility variable with indicators for above-median R&D intensity, sales growth, product market fluidity, outside labor market opportunity, and labor skill. I find that the negative association between skilled labor mobility and firm value is stronger in these subsamples. All interaction terms are significant at least at the 10% level. The subsample results indicate that labor mobility is more detrimental to firm valuation when the labor factor is costly to adjust, potentially resulting in investment distortions. The finding based on the extent of product market competition suggests that trade secret leakage is another cost associated with skilled labor

mobility. I also find that the adverse valuation effect of mobility is more significant for industries employing workers with abundant outside job opportunities. Additionally, the negative interaction term in Model (5) suggests that firms hiring more skilled workforce incur more substantial valuation losses when workers are more mobile.

5.5 Quarterly valuation analysis around the 2007 green card misallocation event

This section analyzes the valuation impact of the 2007 unexpected green card availability shock to test the relation between mobility and firm value in a different setting. The analysis exploits the cross-sectional differences in the changes in worker mobility induced by the 2007 green card allocation shock. The empirical model compares the changes in quarterly Tobin's Q around the quarter of green card misallocation announcement.

Specifically, I use the proportions of foreign workers in the fiscal year 2006 and the changes in mobility due to the 2007 shock to define the firm's exposures to the 2007 shock. Take the variable constructed based on the number of STEM workers as an example. For each firm k, the changes in mobility induced by the green card misallocation is computed as:

$$Mobility\_STEM\_2007_k = \sum_{p=1}^{7} \frac{Num\ Foreign\ Workers_{k,p,2006}}{Num\ STEM\ Workers_{k,2006}} \times Green\ Card\ Availability_{p,2007}$$

In the equation above, p is one of the seven preference categories introduced in the previous section. Similarly, I also compute other versions of mobility variables based on STEM workers with at least a bachelor's degree ($Mobility\_HESTEM\_2007_k$) and R&D workers ($Mobility\_RD\_2007_k$). The percentages of foreign workers use in the test are calculated at the end of 2006 and thus unlikely to be affected by the green card misallocation in the following year.

As a first step, I plot daily stock returns from June 1, 2007 to August 31, 2007 for firms in the sample. To facilitate comparison, I separate the skilled worker mobility variable into two dichotomous groups: firms with above-median changes in mobility and those with below median changes. Figure 2 plots

the cumulative abnormal returns for equally-weighted portfolios consisting firms in the two groups. The blue line represents the cumulative daily stock returns for firms experiencing the more significant changes in skilled worker mobility ("high group"), while the black line represents the firms with smaller changes in skilled worker mobility ("low group"). The high group suffered small temporary downward stock returns when DOS announced that green cards are available for all workers. Similarly, the firms dependent on foreign workers experienced a small brief upward stock return when DOS withdrew the previous decisions. The direction of the market reaction is roughly consistent with the negative association between worker mobility and firm value; however, the magnitudes of returns are not significant and quickly dissipated in a few days. It is possible that senatorial denouncement of the DOS decision and the public outcry around the same time increase the uncertainty of the announced green card allocation. Following the decision to grant green cards to all petitioners on the July 17, 2007, all firms employing skilled foreign workers experienced a significant drop in stock prices, especially for firms in the high group. The downward trend continued when the USCIS announced that there were substantial backlogs in green card processing on August 3, 2007. At the end of the event, the high group experienced a negative cumulative market return of about -1% over the entire window. The graphic analysis suggests that DOS's surprising announcement is associated with lower stock returns for firms dependent on foreign workers.

As a formal test, I study the changes in firm value induced by this incident. To center the experiment on the unexpected policy change, I analyze the changes in valuation around the quarter of the event. For each firm, the event quarter is the fiscal quarter encompassing the DOS final decision date (July 17, 2007). The empirical model then compares changes in Tobin's Q three quarters before and after the event quarter. I choose an event period of seven quarters to mitigate the impact of other contemporaneous shocks, for example, the crash of stock market in the third quarter of 2008.[11] I estimate a model with year and quarter fixed effects. The treatment variable is the changes in skilled worker mobility induced by the green card

[11] In the Internet Appendix, I conduct DiD test using an annual measure of Tobin's Q over the period 2006 to 2009 and find similar results.

misallocation, for example, $Mobility\_STEM\_2007_k$. I interact the treatment variable with a dummy variable $Post_t$ that equals to one for the three quarters following the event quarter. The interaction between treatment and post dummies is the main variable that identifies the differential effect of mobility on firms whose foreign workers become more mobile. The marginal effects of the treatment variables and post dummies are absorbed by the year and quarter fixed effects.

$$Q_{k,t} = \beta_0 + \beta_1 \times Mobility\_STEM\_2007_k \times Post_t + Controls_{k,t-1} + \alpha_k + \alpha_t + \varepsilon_{k,t} \quad (4)$$

To facilitate comparison with a standard DiD model, I also interact dummies indicating firms with above-median changes in worker mobility ($Hi\ Mobility\_STEM\_2007_k$) with the post indicator. The coefficient β_1 identifies the differential change in Tobin's Q following the 2007 green card allocation event.

$$Q_{k,t} = \beta_0 + \beta_1 \times Hi\ Mobility\_STEM\_2007_k \times Post_t + \gamma_{k,t-1} + \alpha_k + \alpha_t + \varepsilon_{k,t} \quad (5)$$

Table 7 reports the estimation of the DiD models. The first three models present the interactions between the continuous measure of labor mobility and the *Post* dummy. The next three models present the interaction between the discrete variable and the *Post* dummy. In all specifications, the interaction terms between the *Post* dummy and the variation in the skilled labor mobility are negative and significant at least at the 1% level, supporting the findings in the panel regressions. The results also indicate that skilled labor mobility exerts a negative net effect on corporate valuation.

To check the validity of the DiD design, Figure 4 plot the changes in Q during the sample period. I run the following dynamic treatment dummy model.

$$Q_{k,t} = \beta_0 + \sum_k \beta_k Quarter[n]_{k,t} + \gamma_{k,t} + \alpha_k + \alpha_t + \varepsilon_{k,t} \quad (6)$$

In the equation above, $Quarter[n]_{i,t}$, equals to one for firms have above-median STEM worker mobility in quarter n (n=-3,…,+3). Quarter 0 is the event quarter. The coefficient on $Quarter[n]_{i,t}$ captures the differences in Tobin's Q between the treatment firms and the control firms in quarte[n]. Figure 4 plots the point estimates of the treatment dummies and their 90% confidence intervals over a sample period from

quarter -4 to 3. I find that the difference between the two groups is close to zero until the quarter of DOS green card allocation announcement. The Tobin's Q of the treatment group dropped significantly following the announcements of the green card allocation. The graphic analysis supports the validity of the experiment.

5.6 Event studies

I now turn to the analysis of firm's market reaction on the announcement days of green card availability. To capture the most exogenous changes in visa bulletins, I focus on all events in which the DOS dials back the cut-off dates, i.e., these announcements delay the foreign worker's green card application. There are two distinct advantages to study these events. First, the reversal in green card availability is a clear indication of the imprecision or even mistakes in green card availability estimation. Second, the magnitudes of the cut-off date changes are significantly larger than other regular monthly visa bulletin announcements. Since each of the seven preference categories has different cut-off dates, I choose the announcement days when more than 50% of the foreign workers in the sample experienced a cut-off date reversal compared to the previous month. In other words, these announcements delay the green card filing process of more than 50% of the foreign workers.

Table 8 presents all eight announcements and the changes in cut-off dates for five major types of foreign workers. The changes in the cutoff dates are significant. For example, the cutoff dates for professional Indian workers, the most populated foreign workers in the sample, were pushed back for at least a year in these events. Four of the announcements occur in September possibly because DOS tends to adjust cut-off dates at the start of a fiscal year.[12]

I first compute the monthly changes in green card availability for each preference category p as:

$$Monthly\ Green\ Card\ Availability_{p,t} = Monthly\ CutOff\ Date_{p,t} - Monthly\ CutOff\ Date_{p,t-1}$$

[12] The U.S. government fiscal year starts in October of the previous year. The visa bulletin for October is announced in September.

I then substitute the annual changes in cutoff dates with this variable to compute the changes in aggregate green card availability in a month:

$$Monthly\ Mobility\_Firm_{k,t} = \sum_{p=1}^{7} Num\ Foreign\ Workers_{k,p,t} \times Monthly\ Green\ Card\ Availability_{p,t}$$

I scale $Monthly\ Mobility\_Firm_{k,t}$ by proxies for the skilled labor population to obtain measures of the skilled worker mobility: *Mobility_STEM_Month*, *Mobility_HESTEM_Month*, and *Mobility_RD_Month*. These variables capture the changes in green card availability induced by the monthly DOS announcements.

I analyze the relation of the monthly mobility variable with short-term market announcements in the (-1, +1) and (-2, +2) window. I use market adjusted returns and Fama-French-Carhart four-factor model to compute risk-adjusted returns. Adoption of the four-factor model is motivated by the firm characteristics in the sample since the sample includes a high proportion of low book-to-market stocks and "glamor stocks" that likely receive more investor attention. The empirical design pools all announcements in a regression with firm and event fixed effects. The event fixed effects address the cross-sectional correlation of returns in the same announcement days. The model also includes the control variables used in Tobin's Q regressions. Specifically, I estimate the following model:

$$CAR\ (-d, +d)_{k,t} = \beta_0 + \beta_1 \frac{Monthly\ Mobility\_Firm_{k,t}}{Num\ Skilled\ Workers_{k,t}} + \gamma_{k,t} + \alpha_k + \alpha_t + \varepsilon_{k,t} \quad (7)$$

In the model, $Num\ Skilled\ Workers_{k,t}$ represents one of the three proxies for firm-level skilled worker population used in the previous analysis. α_k indicates firm fixed-effects and α_t indicates dummy variables for each of the eight events.

Panel A and B of Table 9 report the results of the announcements effect using the market adjusted returns and four-factor adjusted returns. In all specifications, I find that monthly changes in the green card availability variable are associated with lower abnormal returns around unexpected visa bulletin reversals. To gauge the economic magnitude, I scale the changes in green card availability by the market value of the firm two days and three days before the announcement. Specifically, I run the following regression for the risk-adjusted abnormal returns in the short event window (-d, +d):

$$CAR\ (-d, +d)_{k,t} = \beta_0 + \beta_1 \frac{Monthly\ Mobility\_Firm_{k,t}}{Markt\ Value\ (-d-1)_{k,t}} + \gamma_{k,t} + \alpha_k + \alpha_t + \varepsilon_{k,t} \quad (8)$$

The unit of the market value is in thousand U.S. dollars. The coefficient β_1 captures the dollar value of the annual immobility rents. In Panel C of Table 9, I report four models based on the equation above. The coefficient β_1 is negative and significant in three of the four specifications. On average, firm value increases by \$15,000 to \$22,000 per additional year of delay in a single foreign worker's green card filings. This estimate is more than 20% of the annual wages of the workers reported in the wage analysis.

5.7 Investments

Having documented a consistent negative relation between mobility and firm value, I now exploit the potential channels for value losses associated with relaxed skilled worker mobility. Given that the magnitude of the wage effect is significantly smaller than the annual mobility rent reflected from the capital market, other channels linking mobility and firm value might play an important role.

Following the hypothesis on labor mobility's influence on capital investment, I empirically evaluate whether the level of capital investment responses to changes in skilled labor mobility. I combine capital expenditure and R&D to obtain the overall investment level in physical capital and scale the investment by the previous year's total assets. The model is set up similarly to the panel regressions on Tobin's Q.

$$CAPXR\&D_{k,t} = \beta_0 + \beta_1 \times Skilled\ Labor\ Mobility_{k,t-1} + \gamma_{k,t-1} + \alpha_t + \alpha_k + \varepsilon_{k,t} \quad (9)$$

In Table 10, I report three specifications relating skilled worker mobility and investments. All point estimates on the skilled worker mobility variable are negative and significant at least at the 5% level, suggesting that firms decrease investments when skilled employees become more mobile. According to the first specification, a one standard deviation increase in the STEM worker-based mobility measure is associated with about 1.2% drop in firms' investments.

As yet another test to validate the findings on worker mobility and investments, I analyze the changes in quarterly investments around the Jun 2007 green card misallocation event in Table 11.[13] The specification is similar to the DiD analysis on quarterly Tobin's Q. The patterns of the findings are similar to those in Table 10 in that firms employing more foreign skilled workers reduce investments following the surprising announcement on foreign worker mobility. All six models indicate that firms experiencing more significant shocks in worker mobility decrease their investments. Overall, firms reduce investments in physical capital when skilled workers become more mobile. These findings are in line with the investment distortion hypothesis.

6. Conclusion

In this paper, I use the setting of the U.S. immigration system to understand the impact of skilled labor mobility on corporate valuation. DOS assigns green cards to most foreign workers based on estimated cut-off dates. However, the variation in cut-off dates reflects estimation imprecisions in green card availability predictions. Therefore, I construct a novel measure based on the time-series variation of estimated green card availability to analyze the corresponding changes in firm value.

I find that skilled labor mobility has a significant adverse impact on firm valuation. This finding is supported by several experimental settings featuring exogenous variations in green card availability. Increasing worker mobility is associated with increases in labor costs and reduction in physical capital investment. Based on magnitudes of the findings, investment reduction induced by labor mobility shocks

[13] The Internet Appendix reports DiD tests using an annual measure of Investments over period from 2006 to 2009 with similar results.

is potentially an important driver of firm value. At the same time, the findings do not support the positive effects of a more mobile labor force

Immigration policy studies are important to economists and policymakers alike. This study indicates that the current U.S. immigration system has a profound influence on foreign workers and their employers. As such, further studies on immigration-induced immobility in various other economic settings, such as entrepreneurship, can shed light on the welfare implications for foreign workers and the U.S. immigration system.

Appendix: Definition of variables

State panel variables:

a. *State Moving Rate (%)*: It is the percentage of H1B workers who switch to another employer in a given state. Source: Form I-129 obtained from USCIS FOIA request
b. *Mobility State*: It is the changes in green card availability for all H1B workers in a given state. A high number indicates that the H1B workers in the state are mobile
c. *Num H1B Workers*: It is the total number of employed H1B workers in a given state. Source: Form I-129 obtained from USCIS FOIA request.
d. *GDP Growth (%)*: It is the annual real GDP growth in a given state. Source: Bureau of Economic Analysis Regional Economic Accounts
e. *Income per Capita*: It is the annual income per capita in a given state, deflated to 2009 U.S. Dollars. Source: Federal Reserve Bank of St. Louis Published Data Lists
f. *Unemployment Rate (%)*: Annual unemployment rate in a given state. Source: Federal Reserve Bank of St. Louis Published Data Lists

Wage Analysis:

a. *Wage*: It is the average of the lower range and the upper range of a foreign worker's wage offer, deflated to 2009 U.S. Dollars. Source: Office of Foreign Labor Certification Disclosure Data
b. *Mobility Worker*: It is the changes in green card availability for a worker based on his (her) country of birth. A higher number indicates that the worker is more mobile.
c. *Prevailing Wage*: It is the average wage paid to similarly employed workers in a specific occupation in the area of intended employment. Source: Office of Foreign Labor Certification Disclosure Data, deflated to 2009 U.S. Dollars
d. *Wage/Prevailing Wage*: It is the ratio of wage over prevailing wage. The Immigration and Nationality Act (INA) requires that the ratio be higher than one for all foreign workers applying for an employment-based green card.
e. *Prevailing Wage Level*: It is the level of prevailing wage determination certified by the National Prevailing Wage Center. Level 1 to 4 represent "Entry/Beginning", "Qualified", "Experienced", and "Full Competent", respectively. Source: Office of Foreign Labor Certification Disclosure Data

Mobility variables:

a. *Mobility_STEM (Years)*: It is the weighted average changes in green card availability for STEM workers in a firm. A higher number indicates that the firm's STEM workforce is more mobile. The weight is the percentage of STEM workers in one of the seven skill and nationality-based immigration categories: professional Chinese workers, professional Indian workers, skilled Chinese workers, skilled Indian workers, skilled Mexican workers, skilled Philippine workers, and skilled workers from all other countries.
b. *Mobility_HESTEM (Years)*: It is the weighted average changes in green card availability for STEM workers requiring a bachelor's degree or above in a firm. The weight is the percentage of such STEM workers in one of the seven skill and nationality-based immigration categories: professional Chinese workers, professional Indian workers, skilled Chinese workers, skilled Indian workers, skilled Mexican workers, skilled Philippine workers, and skilled workers from all other countries.
c. *Mobility_RD (Years)*: It is the weighted average changes in green card availability for R&D workers in a firm. The weight is the percentage of R&D workers in one of the seven skill and nationality-based immigration categories: professional Chinese workers, professional Indian workers, skilled Chinese workers, skilled Indian workers, skilled Mexican workers, skilled Philippine workers, and skilled workers from all other countries.
d. *%Foreign STEM*: It is the percentages of foreign workers in a company's STEM workforce.
e. *%Foreign HESTEM*: It is the percentages of foreign workers in a company's STEM workforce requiring a bachelor's degree or above.
f. *%Foreign RD*: It is the percentages of foreign workers in a company's R&D workforce.

Firm-year panel variables:

a. *Q*: It is calculated as [Total Assets (at) – Common Equity (ceq) + (Common Share Price (prcc_f) * Common Shares Outstanding (csho))] / Total Assets (at).
b. *CAPXR&D*: It is calculated as Capital expenditure (capx) plus research and development expenditure (xrd) scaled by the beginning-of-year assets (at).
c. *Total Asset ($ Millions)*: It is calculated as Total Assets (at) reported in COMPUSTAT, deflated to 2009 dollars.
d. *Firm Age (Years)*: It is the number of years a firm appears in COMPUSTAT.
e. *R&D*: It is calculated as the R&D Expenditure (xrd) / Total Assets (at). R&D expenditure is set to zero for missing observations.
f. *ROA*: It is calculated as the Operating Income before Depreciation and Amortization (oibdp) / Total Assets (at).
g. *Cash Holdings*: It is calculated as the Cash and Short-term Investments (che) / Total Assets (at).
h. *Leverage*: It is calculated as [Short-term Debt (dlc) + Long-term Debt (dltt)] / Total Assets (at).
i. *Sales Growth*: It is calculated as [sales (sale) in year t –sales in year t-1]/ sales in year t-1.
j. *Cash Flow*: It is the summation of Income before Extraordinary Items (ib) and Depreciation and Amortization (dp), scaled by Total Asset (at) in the previous year.
k. *High R&D*: It is an indicator variable set to one if R&D intensity is above the sample median.
l. *High Sales Growth*: It is an indicator variable set to one if sales growth is above the sample median.
m. *High Product Market Risk*: It is an indicator variable that equals to one if the text-based measurement of product market threat constructed by Hoberg, Phillips, and Prabhala (2014) is above the sample median.
n. *High Outside Opportunities*: It is an indicator variable that equals to one if the labor mobility measure constructed by Donangelo (2014) is above the sample median, downloaded from the author's website.
o. *High Labor Skill*: It is an indicator variable that equals to one for high skill industries defined by Belo et al. (2017), downloaded from the authors' website.

Firm-quarter panel variables

a. *Qtr Q*: It is calculated as [Total Assets (atq) – Common Equity (ceq) + (Common Share Price (prccq) * Common Shares Outstanding (cshoq))] / Total Assets (atq).
b. *Qtr CAPXR&D*: It is calculated as the summation of quarterly capital expenditure and R&D expenses. (xrdq), scaled by total assets (atq). Quarterly capital expenditure is capxy for the first fiscal quarter; capxy-lag 1 capxy for other quarters.
c. *Qtr Total Asset($ Millions)*: It is calculated as the Total Assets (atq) reported in COMPUSTAT Quarterly Database, deflated to 2009 dollars using the U.S. GDP deflator from the Bureau of Economic Analysis.
d. *Qtr R&D*: It is calculated as the R&D Expenditure (xrdq) / Total Assets (at). R&D expenditure is set to zero for missing observations.
e. *Qtr ROA*: It is calculated as the Operating Income before Depreciation and Amortization (oibdpq) / Total Assets (atq).
f. *Qtr Cash Holdings*: It is calculated as the Cash and Short-Term Investments (cheq)/ Total Assets (atq).
g. *Qtr Leverage*: It is calculated as the Long-term Debt (dlttq)/ Total Assets (atq).
h. *Qtr Sales Growth*: It is calculated as [sales (saleq) in year t –sales in year t-1]/ sales in year t-1.
i. *Qtr Cash Flow*: It is calculated as the summation of Income before Extraordinary Items (ibq) and Depreciation and Amortization (dpq), scaled by Total Asset (atq) in the previous quarter.

References

Acharya, V. V., R. P. Baghai, and K. V. Subramanian. 2014. Wrongful Discharge Laws and Innovation. *Review of Financial Studies* 27: 301-46.

Adelson, S., W. Buffett, and B. Gates. 2014. Break the Immigration Impasse. *The New York Times*.

Ashraf, R., and R. Ray. 2016. Human Capital, Skilled Immigrants, and Innovation. *Working Paper*.

Audretsch, D. B., and M. P. Feldman. 1996. R&D Spillovers and the Geography of Innovation and Production. *The American Economic Review* 86: 630-40.

Balasubramanian, N., J. W. Chang, M. Sakakibara, E. P. Starr, and E. P. Starr. 2017. Locked In? The Enforceability of Covenants Not to Compete and the Careers of High-Tech Workers. *Working Paper*.

Belo, F., X. Lin, and S. Bazdresch. 2014. Labor Hiring, Investment, and Stock Return Predictability in the Cross Section. *Journal of Political Economy* 122: 129-77.

Belo, F., X. Lin, L. Jun, and X. Zhao. 2017. Labor Heterogeneity and Asset Prices: The Importance of Skilled Labor. *The Review of Financial Studies* Forthcoming.

Bhattacharya, S. 2015. How Are H-1b Holders Affected by the U.S. Green Card Application Flip Flop? *The Wall Street Journal*.

Borjas, G. J., and K. B. Doran. 2012. The Collapse of the Soviet Union and the Productivity of American Mathematicians. *The Quarterly Journal of Economics* 127: 1143-203.

Carlino, G., and W. Kerr. 2014. Agglomeration and Innovation. *Handbook of Regional and Urban Economics*.

Donangelo, A. 2014. Labor Mobility: Implications for Asset Pricing. *The Journal of Finance* 69: 1321-46.

Doran, K., A. Gelber, and A. Isen. 2016. The Effects of High-Skilled Immigration on Firms: Evidence from H-1b Visa Lotteries. *Working Paper*.

Dougal, C., C. A. Parsons, and S. Titman. 2015. Urban Vibrancy and Corporate Growth. *The Journal of Finance* 70: 163-210.

Favilukis, J., and X. Lin. 2016. Wage Rigidity: A Quantitative Solution to Several Asset Pricing Puzzles. *The Review of Financial Studies* 29: 148-92.

Fulghieri, P., and M. Sevilir. 2011. Mergers, Spinoffs, and Employee Incentives. *Review of Financial Studies* 24: 2207-41.

Garmaise, M. J. 2011. Ties That Truly Bind: Noncompetition Agreements, Executive Compensation, and Firm Investment. *Journal of Law, Economics, and Organization* 27: 376-425.

Ghaly, M., V. Anh Dang, and K. Stathopoulos. 2017. Cash Holdings and Labor Heterogeneity: The Role of Skilled Labor. *The Review of Financial Studies* 30: 3636-68.

Hanson, G., and M. J. Slaughter. 2017. High-Skilled Immigration and the Rise of Stem Occupations in Us Employment. *NBER Working Paper*.

Hart, O., and J. Moore. 1990. Property Rights and the Nature of the Firm. *Journal of Political Economy* 98: 1119-58.

Herbst, M. 2007. The Gandhi Protests. *Bloomberg Businessweek*.

Hira, R. 2007. Outsourcing America's Technology and Knowledge Jobs: High-Skill Guest Worker Visas Are Currently Hurting Rather Than Helping Keep Jobs at Home. *Economic Policy Institute Briefing Paper* 187.

Hoberg, G., G. Phillips, and N. Prabhala. 2014. Product Market Threats, Payouts, and Financial Flexibility. *The Journal of Finance* 69: 293-324.

Hunt, J. 2011. Which Immigrants Are Most Innovative and Entrepreneurial? Distinctions by Entry Visa. *Journal of Labor Economics* 29: 417-57.

———. 2015. Are Immigrants the Most Skilled Us Computer and Engineering Workers? *Journal of Labor Economics* 33: S39-S77.

Jeffers, J. 2017. The Impact of Restricting Labor Mobility on Corporate Investment and Entrepreneurship. *Working Paper*.

Kale, J. R., H. E. Ryan, and L. Wang. 2016. Outside Employment Opportunities, Employee Productivity, and Debt Discipline. *Journal of Corporate Finance*.

Kale, J. R., and H. Shahrur. 2007. Corporate Capital Structure and the Characteristics of Suppliers and Customers. *Journal of Financial Economics* 83: 321-65.

Kerr, S. P., and W. Kerr. 2011. Economic Impacts of Immigration: A Survey *Finnish Economic Papers* 24: 1-32.

Kerr, S. P., W. Kerr, Ç. Özden, and C. Parsons. 2016. Global Talent Flows. *Journal of Economic Perspectives* 30: 83-106.

Kerr, S. P., and W. R. Kerr. 2013. Immigration and Employer Transitions for Stem Workers. *American Economic Review* 103: 193-97.

Kerr, S. P., W. R. Kerr, and W. F. Lincoln. 2015. Skilled Immigration and the Employment Structures of Us Firms. *Journal of Labor Economics* 33: S147-S86.

Kerr, W. R., and W. F. Lincoln. 2010. The Supply Side of Innovation: H-1b Visa Reforms and U.S. Ethnic Invention. *Journal of Labor Economics* 28: 473-508.

Kerr, W. R., and S. E. Turner. 2015. Introduction: Us High-Skilled Immigration in the Global Economy. *Journal of Labor Economics* 33: S1-S4.

Klasa, S., H. Ortiz-Molina, M. A. Serfling, and S. Srinivasan. 2017. Protection of Trade Secrets and Capital Structure Decisions. *Journal of Financial Economics* Forthcoming.

Matloff, N. 2003. On the Need for Reform of the H-1b Nonimmigrant Work Visa in Computer-Related Occupations. *The Michigan Journal of Law Reform* 36: 815-914.

Oi, W. Y. 1962. Labor as a Quasi-Fixed Factor. *Journal of Political Economy* 70: 538-55.

Overman, H. G., and D. Puga. 2010. Labour Pooling as a Source of Agglomeration: An Empirical Investigation. In *Agglomeration Economics.* Eds. E. L. Glaeser. University of Chicago Press.

Pan, Y. 2017. The Determinants and Impact of Executive-Firm Matches. *Management Science* 63: 185-200.

Patrick, M. D. 2007. Immigration Law; News; the Employment-Based Green Card Rollercoaster. *New York Law Journal*.

Peri, G., K. Shih, and C. Sparber. 2015a. Foreign and Native Skilled Workers: What Can We Learn from H-1b Lotteries? *NBER Working Papers*.

———. 2015b. Stem Workers, H-1b Visas, and Productivity in Us Cities. *Journal of Labor Economics* 33: S225-S55.

Peters, R. H., and L. A. Taylor. 2017. Intangible Capital and the Investment-Q Relation. *Journal of Financial Economics* 123: 251-72.

Pinkowitz, L., R. M. Stulz, and R. Williamson. 2016. Do U.S. Firms Hold More Cash Than Foreign Firms Do? *Review of Financial Studies* 29: 309-48.

Png, I. P. L. 2015. Law and Innovation: Evidence from State Trade Secrets Laws. *Review of Economics and Statistics*.

Shapiro, M. D. 1986. The Dynamic Demand for Capital and Labor. *The Quarterly Journal of Economics* 101: 513-42.

Silicon Valley Community Foundation. 2017. Silicon Valley Competitiveness and Innovation Project Report.

Starr, E. P. 2015. Training the Enemy? Firm-Sponsored Training and the Enforcement of Covenants Not to Compete. *Working Paper*.

Starr, E. P., N. Bishara, and J. J. Prescott. 2017. Noncompetes in the U.S. Labor Force. *Working Paper*.

Stone, B. 2014. Apple, Google, and the Hubris of Silicon Valley's Hiring Conspiracy. *Bloomberg Businessweek*.

The Department of State. 2016. The Operation of the Immigrant Numerical Control System. *U.S. Department of State Announcement*.

Williamson, O. E. 1985. The Economic Insitutions of Capitalism.

Xu, S. 2016. Skilled Labor Supply and Corporate Investment: Evidence from the H-1b Visa Program. *Working Paper*.

Younge, K. A., and M. Marx. 2016. The Value of Employee Retention: Evidence from a Natural Experiment. *Journal of Economics & Management Strategy* 25: 652-77.

Younge, K. A., T. W. Tong, and L. Fleming. 2015. How Anticipated Employee Mobility Affects Acquisition Likelihood: Evidence from a Natural Experiment. *Strategic Management Journal* 36: 686-708.

Zingales, L. 2000. In Search of New Foundations. *The Journal of Finance* 55: 1623-53.

Figure 1 Visa Bulletin Example

This table presents a copy of visa bulletin and the time-series change in cut-off dates. Panel A presents the visa bulletin in April 2012. All foreign workers are classified into 10 preference categories based on the places of birth and job skills. Workers who previously petitioned for immigration before the cut-dates in the cell can obtain a green card. A cut-off date of "C" means that green cards are available for all foreign workers in that category. The percentage numbers in the bracket are the proportions of foreign worker applicants in that category. Panel B plots the time-series changes in cut-off dates in three populated preference categories: Professional Indians, Professional Chinese, and Skilled Indians. The x-axis is the effective date of the monthly visa bulletins. The y-axis is the cut-off date.

Panel A: Visa bulletin in April 2012

	China	India	Mexico	Philippine	Other
Professional workers	5/1/10	5/1/10	C	C	C
	(9.31%)	(36.19%)	(0.63%)	(0.39%)	(15.97%)
Skilled workers	4/22/03	9/1/02	4/8/06	4/8/06	4/8/06
	(3.18%)	(17.96%)	(0.82%)	(1.37%)	(14.17%)

Panel B Time-series variation in the visa bulletin cut-off dates for major preference categories

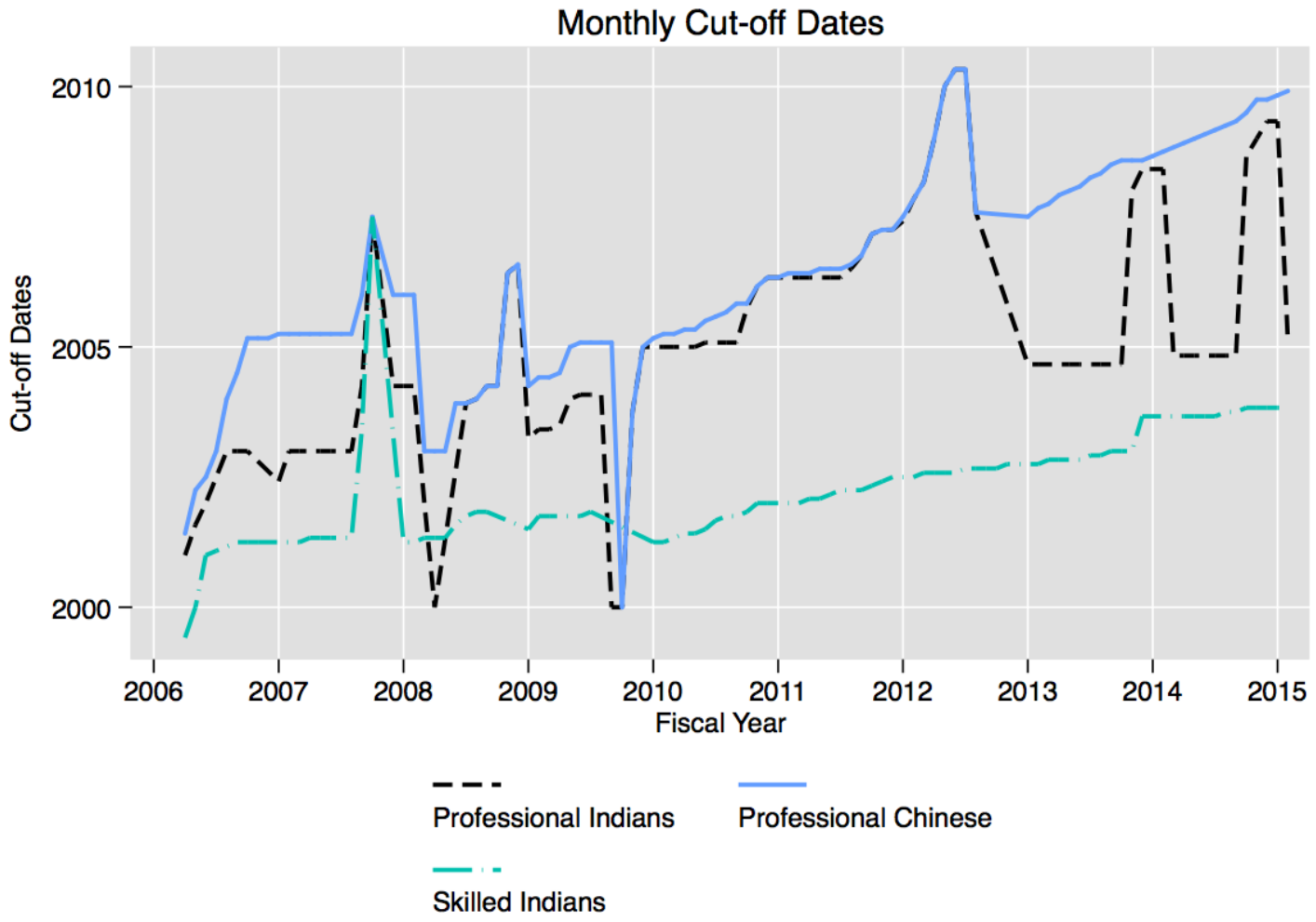

Figure 2 Time-series Variation in Professional Indian Worker Cut-off Dates
This figure plots the monthly changes in the visa bulletin cut-off dates for Professional Indian workers, the most populated preference category, for the fiscal years from 2012 to 2014.

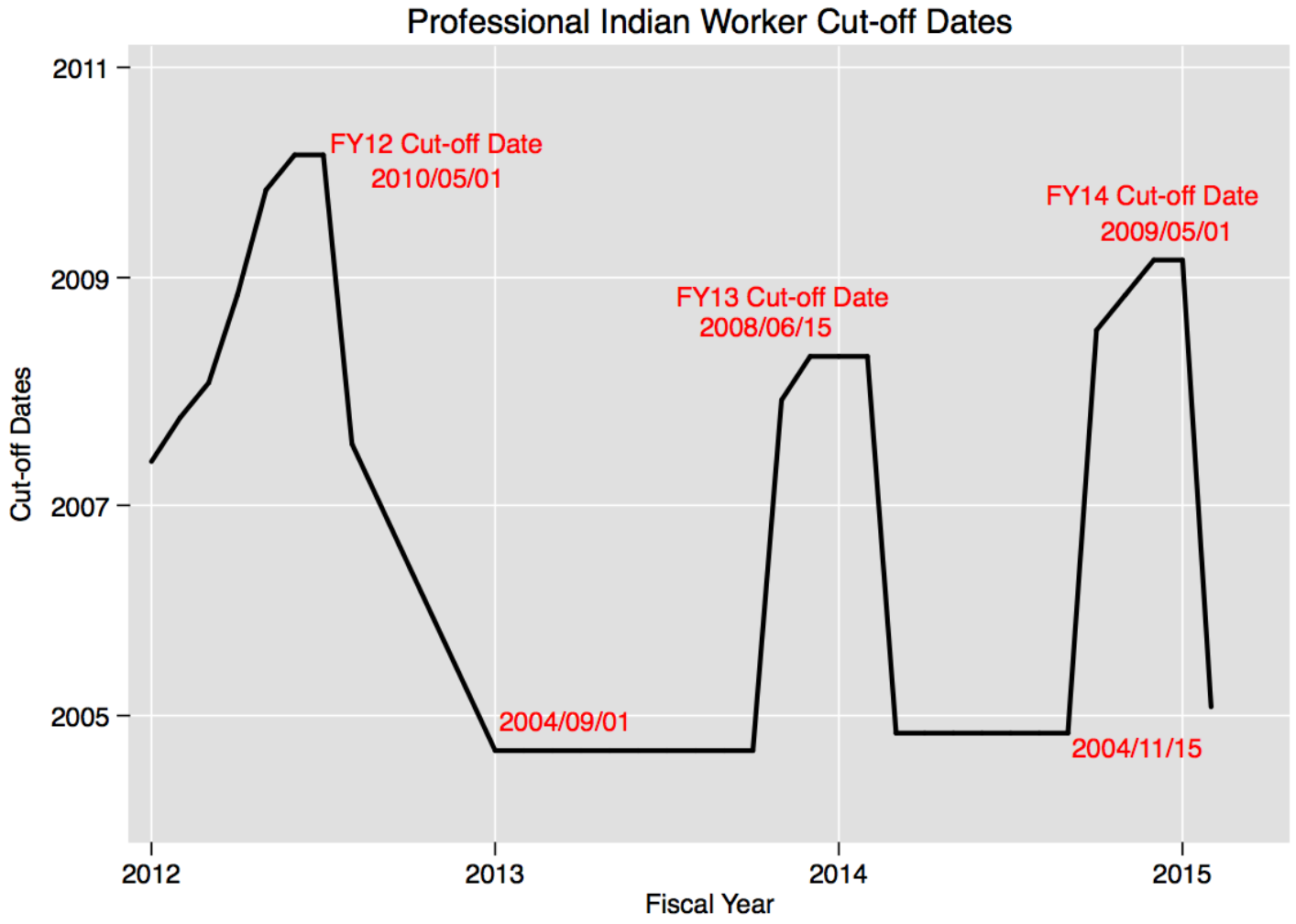

Figure 3 Stock returns around the 2007 shock

This figure plots the equally-weighted cumulative daily returns from June 1, 2007 to August 31, 2007 for portfolios of firms affected by the green card misallocation event. Firms with relatively higher (above sample median) changes in skilled worker mobility are in the high group (blue); firms with relatively lower (below sample median) changes in mobility are in the low group.

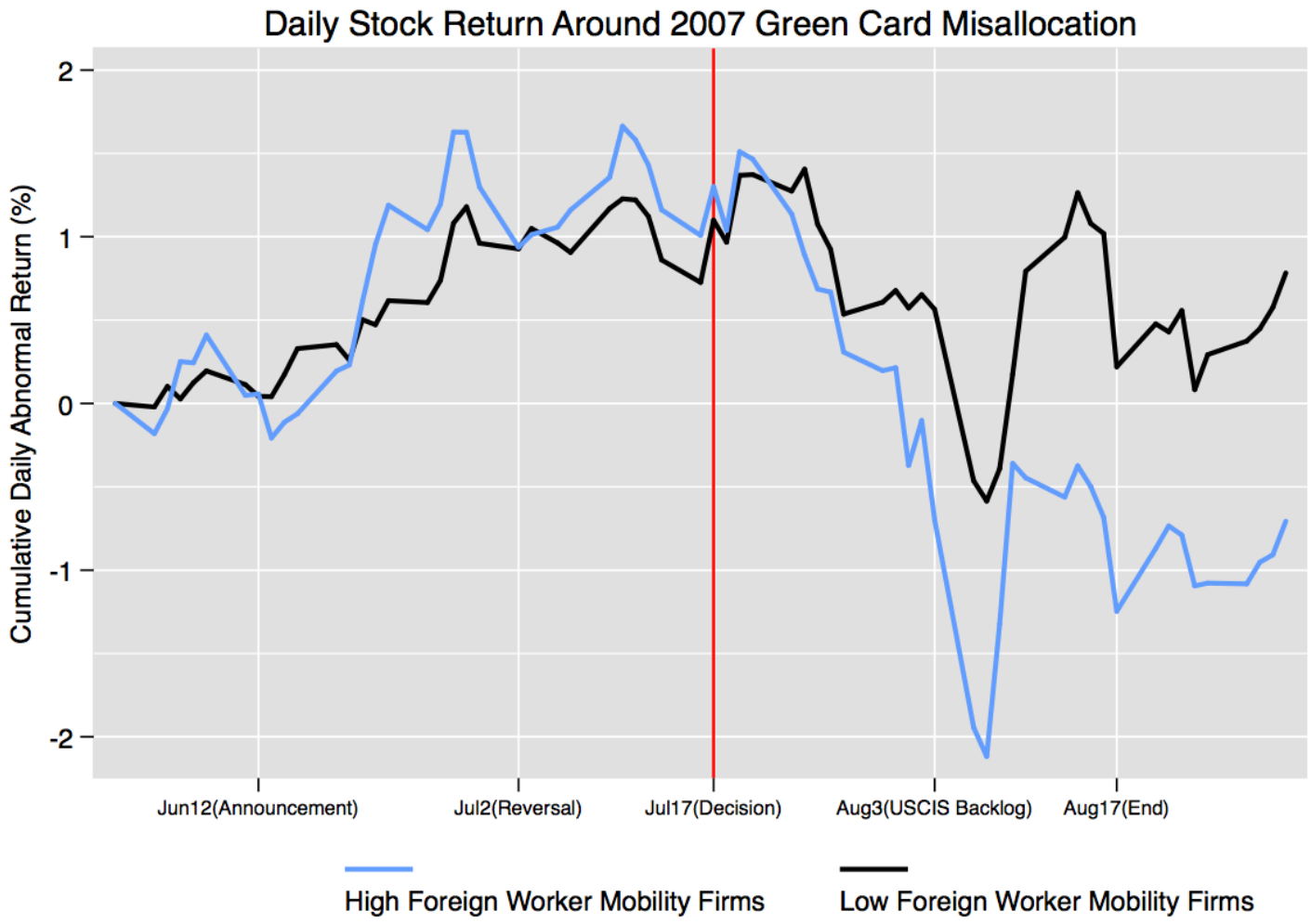

Figure 4 Changes in Q around the 2007 shock

This figure plots the changes in quarterly Tobin's Q around the green card misallocation even in the third quarter of 2007. The data points are coefficients from the following model, where $Quarter[n]_{i,t}$, n=-3,…,+3 equals to one for firms with above-median STEM worker mobility in quarter n. The dashed lines are the 90th percentile of the point estimates.

$$Q_{k,t} = \beta_0 + \sum_n \beta_n Quarter[n]_{i,t} + \beta\gamma_{k,t} + \alpha_k + \alpha_t + \varepsilon_{k,t},$$

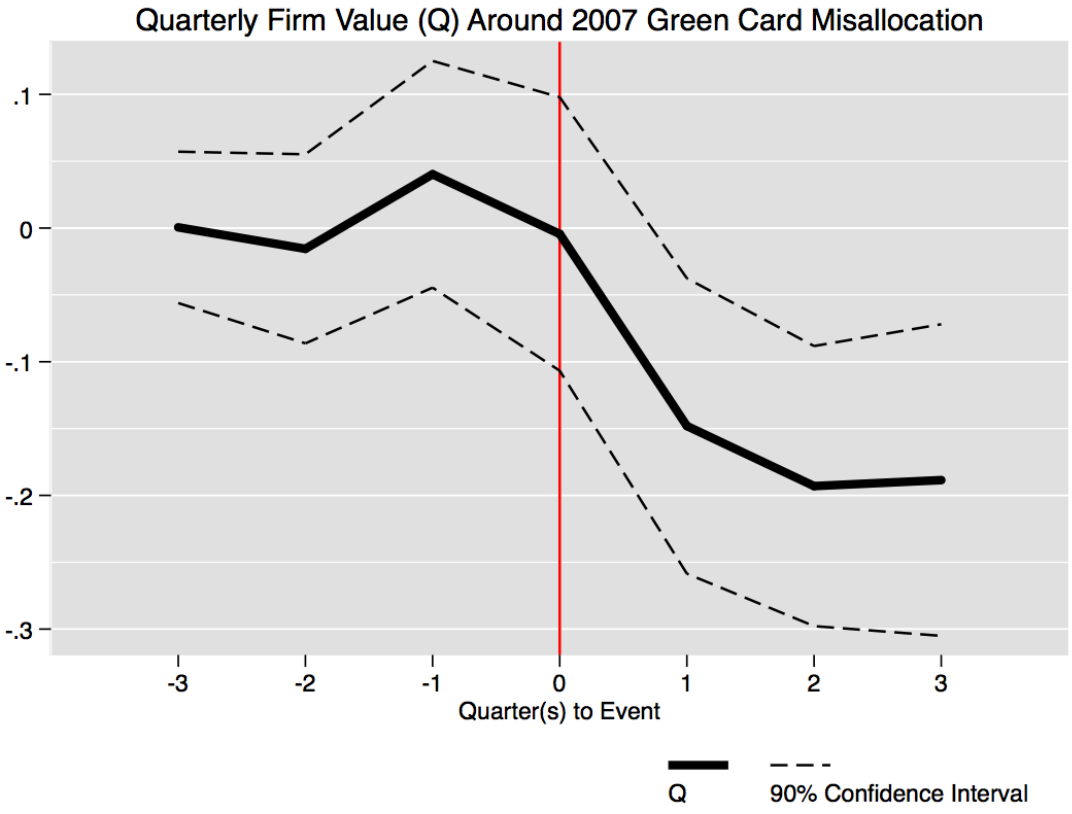

Table 1: Panel Summary Statistics

This table provides the descriptive statistics for variables in the study. Panel A and Panel B report the distribution of measures of skilled worker mobility and other variables constructed based on annual COMPUSTAT dataset from 2007 to 2015. Panel C reports variables based on the quarterly COMPUSTAT around the 2007 green card misallocation event. Panel D reports aggregated annual state-level information in the H1B file from 2007 to 2014. Panel E reports foreign worker's wage information form PERM labor certification files maintained by the Office of Foreign Labor Certification from 2007 to 2015. Each observation is a petition from a foreign employee. All variables are winsorized at 1% and 99%. I define the variables in the Appendix. All dollar items are deflated to 2009 dollars.

Panel A: Mobility Variables Summary Statistics

	Obs.	Mean	Std. Dev.	P25	Median	P75
Mobility_STEM (Years)	6,679	0.11	0.75	-0.02	0.00	0.07
Mobility_HESTEM (Years)	6,679	0.14	0.96	-0.03	0.00	0.09
Mobility_RD (Years)	6,679	0.16	1.03	-0.03	0.00	0.12
%Foreign STEM	6,679	20.73%	58.70%	0.72%	3.17%	12.30%
%Foreign HESTEM	6,679	26.70%	75.31%	0.86%	3.79%	14.94%
%Foreign RD	6,679	27.34%	70.94%	1.17%	5.52%	19.60%

Panel B: Annual Sample Statistics

	Obs.	Mean	Std. Dev.	P25	Median	P75
Q	6,679	2.21	1.46	1.28	1.74	2.57
CAPXR&D	6,674	0.13	0.13	0.05	0.09	0.16
Total Asset($ Millions)	6,679	11261.29	37890.95	384.79	1615.50	6798.43
Firm Age(Years)	6,679	24.46	18.20	11.00	18.00	36.00
R&D	6,679	0.09	0.12	0.00	0.04	0.12
ROA	6,679	0.10	0.15	0.06	0.12	0.17
Cash Holdings	6,679	0.25	0.21	0.08	0.19	0.37
Leverage	6,679	0.18	0.19	0.00	0.15	0.29
Sales Growth	6,679	0.10	0.31	-0.03	0.05	0.17
Cash Flow	6,676	0.06	0.16	0.03	0.09	0.13

Panel C: Quarterly Sample Summary Statistics

	Obs.	Mean	Std. Dev.	P25	Median	P75
Qtr Q	5,486	2.35	1.45	1.40	1.88	2.80
Qtr CAPXR&D	5,479	0.03	0.03	0.01	0.02	0.04
Qtr Total Asset ($Millions)	5,486	8130.45	20977.13	334.08	1359.52	5675.40
Qtr R&D	5,486	0.02	0.03	0.00	0.01	0.03
Qtr ROA	5,486	0.02	0.04	0.01	0.03	0.05
Qtr Cash Holdings	5,486	0.25	0.23	0.06	0.18	0.40
Qtr Leverage	5,486	0.14	0.16	0.00	0.09	0.23
Qtr Sales Growth	5,486	0.04	0.20	-0.04	0.02	0.09
Qtr Cash Flow	5,456	0.02	0.05	0.01	0.02	0.04

Panel D: Mobility Summary Statistics

	Obs.	Mean	Std. Dev.	P25	Median	P75
State Moving Rate (%)	400	5.03	1.83	3.75	4.90	6.25
Mobility_State	400	0.28	1.71	-0.84	0.36	1.02
Num H1B Workers	400	12609.43	22008.27	1431.00	3309.00	15329.50
GDP Growth (%)	400	1.09	2.95	-0.29	1.11	2.46
Income Per Capita	400	40153.59	6931.46	35063.42	38963.84	43172.27
Unemployment Rate (%)	400	6.71	2.31	4.75	6.67	8.30

Panel E: Wage Summary Statistics

	Obs.	Mean	Std. Dev.	P25	Median	P75
Wage	323,621	88594.06	31495.82	68047.41	84157.20	103191.95
Prevailing Wage	323,621	76360.13	24749.57	59706.10	74678.82	90437.31
Wage/Prevailing Wage	323,621	1.18	0.32	1.00	1.04	1.24
Mobility_Worker	323,621	0.38	2.16	-0.93	0.64	0.92
Prevailing Wage Level	323,621	2.35	1.05	2.00	2.00	3.00

Table 2: Industry Distribution

This table reports the distributions of two-digit NAICS industry for firms in the sample and firms in COMPUSTAT during the sample period. The third and fourth columns from the left report the number of firms in a two-digit NAICS industry. The rightmost column reports time-series averages of the sample firms' total market capitalization as a proportion of the total industry market capitalization.

NAICS Code	NAICS Industry Name	# Sample	# COMPUSTAT	# Sample / # COMPUSTAT	Market Value Sample / Market Value COMPUSTAT
11	Agriculture, Forestry, Fishing and Hunting	3	47	6.4%	5.7%
21	Mining, Quarrying, and Oil and Gas Extraction	14	1585	0.9%	18.3%
23	Construction	4	154	2.6%	12.0%
31-33	Manufacturing	471	4394	10.9%	44.9%
42	Wholesale Trade	22	324	7.1%	39.6%
44-45	Retail Trade	53	395	13.4%	60.1%
48-49	Transportation and Warehousing	12	318	3.8%	18.9%
51	Information	209	1397	15.0%	42.3%
54	Professional, Scientific, and Technical Services	79	540	14.6%	43.5%
56	Administrative and Support and Waste Management and Remediation Services	24	223	10.8%	32.3%
61	Educational Services	3	52	5.8%	27.0%
62	Health Care and Social Assistance	10	165	6.1%	25.7%
71	Arts, Entertainment, and Recreation	2	87	2.3%	18.9%
72	Accommodation and Food Services	10	163	6.1%	52.6%
81	Other Services (except Public Administration)	1	32	3.1%	4.0%
	All Industries	925	9,876	9.3%	39.5%

Table 3: Mobility Analysis

This table reports the OLS regressions of moving rate of H1B worker and state-level H1B worker mobility variable constructed based on changes in green card availability. Each observation is a state-year. Model (2) includes year fixed effects and Model (3) includes state and year fixed effects. The sample period is from 2007 to 2014. All variables are defined in the Appendix. I report robust standard errors clustered by state. ***, **, and * indicate significance at 1%, 5%, and 10%, respectively.

	(1)	(2)	(3)
	State Moving Rate	*State Moving Rate*	*State Moving Rate*
Mobility_State	0.1856***	0.2024**	0.1136*
	(7.54)	(2.34)	(1.87)
Log(Num H1B Workers)	0.2875**	0.3186**	-1.8428***
	(2.36)	(2.59)	(-2.93)
GDP Growth	0.1383***	0.0615**	0.1194***
	(4.48)	(2.05)	(4.59)
Log(Income Per Capita)	0.3137	0.0265	3.5948
	(0.32)	(0.03)	(1.42)
Unemployment Rate	0.0398	0.0049	-0.1779
	(1.09)	(0.05)	(-1.51)
State Fixed Effects	No	No	Yes
Year Fixed Effects	No	Yes	Yes
Adj. R-Squared	0.141	0.331	0.744
Observations	400	400	400

Table 4: Wage Analysis

This table reports the OLS regressions of green card petitioner wages and a mobility variable based on individual foreign worker's country of birth. The dependent variables are petitioners' wages in Panel A and the wages relative to the local prevailing wage (*Wage/Prevailing Wage*) in Panel B. The sample period is from 2007 to 2015. I report robust standard errors clustered by firm. ***, **, and * indicate significance at 1%, 5%, and 10%, respectively.

Panel A: Wages and Mobility

	(1) *Wage*	(2) *Wage*	(3) *Wage*	(4) *Wage*	(5) *Wage*
Mobility_Worker	164.1420***	173.5678***	169.9245**	220.6370***	234.3507***
	(2.80)	(2.95)	(2.54)	(9.96)	(4.98)
Prevailing Wage Level	8299.5381***	8272.3658***	8426.6079***	10607.5810***	10624.9594***
	(11.47)	(14.54)	(15.47)	(18.94)	(20.58)
Nationality Fixed Effects	Yes	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	No	Yes	No
Occupation Fixed Effects	No	No	No	Yes	No
Occupation-Year Fixed Effects	No	No	No	No	Yes
State Fixed Effects	No	Yes	No	No	No
State-Year Fixed Effects	No	No	Yes	No	No
Adj. R-Squared	0.162	0.215	0.227	0.448	0.453
Observations	323,621	323,621	323,621	323,621	323,621

Panel B: Relative Wage and Mobility

	(1) *Wage/Prevailing Wage*	(2) *Wage/Prevailing Wage*	(3) *Wage/Prevailing Wage*	(4) *Wage/Prevailing Wage*	(5) *Wage/Prevailing Wage*
Mobility_Worker	0.0006	0.0010***	0.0011***	0.0010***	0.0017***
	(1.44)	(3.06)	(3.67)	(3.75)	(4.80)
Prevailing Wage Level	-0.0824***	-0.0797***	-0.0783***	-0.0516***	-0.0510***
	(-13.40)	(-13.57)	(-13.58)	(-29.93)	(-29.55)
Nationality Fixed Effects	Yes	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	No	Yes	No
Occupation Fixed Effects	No	No	No	Yes	No
Occupation-Year Fixed Effects	No	No	No	No	Yes
State Fixed Effects	No	Yes	No	No	No
State-Year Fixed Effects	No	No	Yes	No	No
Adj. R-Squared	0.124	0.149	0.158	0.246	0.251
Observations	323,621	323,621	323,621	323,621	323,621

Table 5: Tobin's Q and Skilled Labor Mobility

This table reports the OLS fixed effect regressions in which the main dependent variable is *Tobin's Q* and the main independent variables are skilled labor mobility: *Mobility_STEM, Mobility_HESTEM, and Mobility_RD.* The sample period is from 2007 to 2015. I report robust standard errors clustered by firm. ***, **, and * indicate significance at 1%, 5%, and 10%, respectively. All variables are described in the Appendix.

	(1)	(2)	(3)
	Q	*Q*	*Q*
Mobility_STEM	-0.0401***		
	(-2.99)		
Mobility_HESTEM		-0.0330***	
		(-3.07)	
Mobility_RD			-0.0418***
			(-3.65)
Log(Total Asset)	-0.6043***	-0.6044***	-0.6017***
	(-10.84)	(-10.84)	(-10.78)
R&D	1.1492***	1.1505***	1.1509***
	(2.66)	(2.66)	(2.66)
ROA	0.8459**	0.8477**	0.8459**
	(2.53)	(2.54)	(2.53)
Cash Holdings	0.1047	0.1046	0.1078
	(0.47)	(0.47)	(0.48)
Leverage	0.2497	0.2496	0.2493
	(1.51)	(1.50)	(1.50)
Sales Growth	0.1547*	0.1545*	0.1559*
	(1.78)	(1.78)	(1.80)
Log(Firm Age)	-0.3198**	-0.3189**	-0.3163*
	(-1.97)	(-1.96)	(-1.95)
Firm Fixed Effects	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes
Adj. R-Squared	0.765	0.765	0.765
Observations	6,679	6,679	6,679

Table 6: Firm Value and Skilled Labor Mobility: Subsample Analysis

This table reports the relation between skilled labor mobility and firm value in various subsamples. The sample period is from 2007 to 2015. The baseline regression is Model (1) in Table 5 in which the dependent variable is *Tobin's Q* and the independent variable is STEM worker mobility (*Mobility_STEM*). I interact the skilled labor mobility variable with dummy variables formed by the sample medians of R&D intensity (*High R&D*), sales growth (*High Sales Growth*), the extent of product market competition (*High Product Market Risk*), the high skill dummy (*High Labor Skill*) defined in Belo et al. (2017), and worker's outside labor market opportunities (*High Outside Opportunities*) defined in Donangelo (2014). I include all control variables used in the baseline model except for subsamples formed by R&D intensity and sales growth, in which I exclude the variables defining the subsample. I omit the control variables for brevity and report robust standard errors clustered by firm. ***, **, and * indicate significance at 1%, 5%, and 10%, respectively.

	(1)	(2)	(3)	(4)	(5)
	Q	*Q*	*Q*	*Q*	*Q*
Mobility_STEM	-0.0157	0.0015	-0.0193	-0.0259	-0.0079
	(-0.92)	(0.11)	(-1.04)	(-1.47)	(-0.41)
High R&D	0.0578				
	(0.89)				
Mobility_STEM X *High R&D*	-0.0598**				
	(-2.48)				
High Sales Growth		0.1119***			
		(4.08)			
Mobility_STEM X *High Sales Growth*		-0.0923***			
		(-3.90)			
High Product Market Risk			0.0377		
			(1.24)		
Mobility_STEM X *High Product Market Risk*			-0.0422*		
			(-1.71)		
High Outside Opportunities				0.0120	
				(0.17)	
Mobility_STEM X *High Outside Opportunities*				-0.1200**	
				(-2.25)	
High Labor Skill					0.0520
					(0.46)
Mobility_STEM X *High Labor Skill*					-0.0672**
					(-2.48)
Control Variables	Yes	Yes	Yes	Yes	Yes
Firm Fixed Effects	Yes	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes
Adj. R-Squared	0.764	0.766	0.773	0.792	0.785
Observations	6,604	6,604	5,477	4,190	5,273

Table 7: Quarterly Firm Value and the 2007 Green Card Misallocation

This table reports the difference-in-differences (DiD) regressions with quarter and firm fixed effects over the three quarters surrounding the green card misallocation in the third quarter of 2007. The dependent variable is Tobin's Q computed based on quarterly COMPUSTAT. In Models (1) to (3), the main independent variables are the interaction terms between the cross-sectional changes in worker mobility in 2007 (*Mobility_STEM_2007*, *Mobility_HESTEM_2007*, and *Mobility_RD_2007*) and an indicator set to one for three quarters after the green card misallocation (*Post*). In Models (4) to (6), I discretize *Mobility_STEM_2007*, *Mobility_HESTEM_2007*, and Mobility*_RD_2007* by the sample medians and interact the resulting indicator variables (*Hi Mobility_STEM_2007*, *Mobility_HESTEM_2007*, and *Hi Mobility_RD_2007*) with the *Post* variable. All variables are described in the Appendix. I report robust standard errors clustered by firm. ***, **, and * indicate significance at 1%, 5%, and 10%, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)
	Qtr Q	*Qtr Q*	*Qtr Q*	*Qtr Q*	*Qtr Q*	*Qtr Q*
Mobility_STEM_2007 X *Post*	-0.0763***					
	(-3.21)					
Mobility_HESTEM_2007 X *Post*		-0.0566***				
		(-3.16)				
Mobility_RD_2007 X *Post*			-0.0741***			
			(-4.48)			
Hi Mobility_STEM_2007 X *Post*				-0.1812***		
				(-4.02)		
Hi Mobility_HESTEM_2007 X *Post*					-0.1492***	
					(-3.31)	
Hi Mobility_RD_2007 X *Post*						-0.2458***
						(-5.42)
Log(Total Qtr Asset)	-0.7061***	-0.7060***	-0.7090***	-0.7052***	-0.7014***	-0.7028***
	(-6.63)	(-6.62)	(-6.75)	(-6.48)	(-6.44)	(-6.53)
Qtr R&D	3.1324**	3.1350**	3.0755**	3.0803**	3.0948**	2.9501**
	(2.09)	(2.09)	(2.07)	(2.05)	(2.06)	(1.99)
Qtr ROA	4.6154***	4.6128***	4.7245***	4.5454***	4.5675***	4.6067***
	(6.16)	(6.17)	(6.23)	(6.13)	(6.13)	(6.21)
Qtr Cash Holdings	0.5041**	0.5012**	0.4779**	0.4787**	0.4890**	0.4448**
	(2.32)	(2.30)	(2.20)	(2.20)	(2.24)	(2.07)
Qtr Leverage	-0.1051	-0.1038	-0.1296	-0.1299	-0.1321	-0.1455
	(-0.46)	(-0.45)	(-0.56)	(-0.56)	(-0.57)	(-0.62)
Qtr Sales Growth	-0.0175	-0.0172	-0.0213	-0.0151	-0.0151	-0.0152
	(-0.40)	(-0.39)	(-0.49)	(-0.34)	(-0.34)	(-0.35)
Firm Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Quarter Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Adj. R-Squared	0.896	0.896	0.897	0.896	0.896	0.897
Observations	5,486	5,486	5,486	5,486	5,486	5,486

Table 8: Announcement Days in the Event Study

This table reports the eight visa bulletin announcements made by the Department of State (DOS) that significantly delayed the green card filings of foreign workers. The table lists the changes in cutoff days for five major categories of foreign workers in the paper. A negative number means that foreign worker's cut-off dates are dialed back by DOS. The numbers are in the unit of a year. The rightmost column reports the percentages of workers whose green card filing were delayed by the visa bulletin announcements.

Announcement Date	Δ Professional Chinese Cut-Off (Years)	Δ Professional Indian Cut-Off (Years)	Δ Skilled Chinese Cut-Off (Years)	Δ Skilled Indian Cut-Off (Years)	Δ Other Skilled Workers Cut-Off (Years)	%Employees Delayed
September 8, 2005	-5.08	-5.58	-2.08	-4.42	-4.25	99.0%
September 6, 2007	-1.50	-3.25	-5.83	-6.25	-4.92	98.8%
November 11, 2007	-3.00	-2.25	0.08	0.08	0.08	62.6%
December 10, 2007	0.00	-2.00	0.08	0.00	0.08	52.4%
September 10, 2008	0.00	-1.00	-1.42	-0.33	-1.17	88.4%
April 6, 2012	-2.75	-2.75	0.08	0.00	0.08	62.8%
September 10, 2012	-0.08	-2.92	0.83	0.08	0.42	56.9%
November 8, 2013	0.08	-3.58	1.00	0.00	1.00	51.6%

Table 9: Event Studies on Green Card Availability Announcements

This table reports the OLS regression on the announcement returns in months when USCIS retrogresses the cut-off dates. Each observation is a firm-month. The dependent variables in Panel A and Panel B are the market-adjusted returns and the Fama-French-Carhart factor model adjusted returns in event windows (-1, +1) and (-2, +2). The key dependent variables are skilled worker mobility variables constructed based on the monthly changes in green card availability. In Panel C, I scale the aggregate changes in firm's labor mobility by the market capitalization (in thousand U.S. dollars) at days -2 and -3 relative to the announcement dates, respectively. All models include event fixed effects and firm fixed effects. I report robust standard errors clustered by firm. ***, **, and * indicate significance at 1%, 5%, and 10%, respectively.

Panel A: Announcement: Market Adjusted Returns

	Mkt Adj (-1, +1)			*Mkt Adj (-2, +2)*		
	(1)	(2)	(3)	(4)	(5)	(6)
Mobility_STEM_Month	-0.0022***			-0.0032***		
	(-2.64)			(-2.90)		
Mobility_HESTEM_Month		-0.0014**			-0.0021***	
		(-2.36)			(-2.70)	
Mobility_RD_Month			-0.0018***			-0.0024***
			(-2.85)			(-2.81)
Control Variables	Yes	Yes	Yes	Yes	Yes	Yes
Firm Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Event Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Adj. R-Squared	0.154	0.154	0.154	0.163	0.163	0.163
Observations	6,245	6,245	6,245	6,245	6,245	6,245

Panel B: Announcement: Four Factor Adjusted Returns

	FFM CAR (-1, +1)			*FFM CAR (-2, +2)*		
	(1)	(2)	(3)	(4)	(5)	(6)
Mobility_STEM_Month	-0.0023***			-0.0027**		
	(-2.69)			(-2.42)		
Mobility_HESTEM_Month		-0.0014**			-0.0017**	
		(-2.31)			(-2.14)	
Mobility_RD_Month			-0.0020***			-0.0020**
			(-3.09)			(-2.33)
Control Variables	Yes	Yes	Yes	Yes	Yes	Yes
Firm Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Event Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Adj. R-Squared	0.146	0.146	0.146	0.157	0.157	0.157
Observations	6,156	6,156	6,156	6,156	6,156	6,156

Panel C: Announcement: Economic Magnitudes

	(1)	(2)	(3)	(4)
	Mkt Adj (-1, +1)	*Mkt Adj (-2, +2)*	*FFM CAR (-1, +1)*	*FFM CAR (-2, +2)*
Mobility_MKV(-2)	-15.1121**		-22.8322***	
	(-2.14)		(-3.20)	
Mobility_MKV(-3`)		-14.4586		-18.1244**
		(-1.58)		(-1.96)
Control Variables	Yes	Yes	Yes	Yes
Firm Fixed Effects	Yes	Yes	Yes	Yes
Event Fixed Effects	Yes	Yes	Yes	Yes
Adj. R-Squared	0.154	0.162	0.147	0.157
Observations	6,245	6,245	6,156	6,156

Table 10: Investments and Skilled Labor Mobility.

This table reports the OLS fixed effect regressions in which the main dependent variable is capital expenditure and R&D expense scaled by beginning-of-year assets (*CAPXR&D*) and the main independent variables are variables capturing skilled labor mobility: *Mobility_STEM*, *Mobility_HESTEM*, and *Mobility_RD*. The sample period is from 2007 to 2015. I report robust standard errors clustered by firm. ***, **, and * indicate significance at 1%, 5%, and 10%, respectively. All variables are described in the Appendix.

	(1) *CAPXR&D*	(2) *CAPXR&D*	(3) *CAPXR&D*
Mobility_STEM	-0.0020**		
	(-2.01)		
Mobility_HESTEM		-0.0015**	
		(-1.96)	
Mobility_RD			-0.0020**
			(-2.33)
Log(Total Asset)	-0.0895***	-0.0895***	-0.0894***
	(-16.47)	(-16.47)	(-16.46)
Cash Flow	-0.0623***	-0.0622***	-0.0623***
	(-3.52)	(-3.52)	(-3.53)
Cash Holdings	-0.0607***	-0.0607***	-0.0605***
	(-4.00)	(-4.00)	(-4.00)
Leverage	-0.0455***	-0.0456***	-0.0456***
	(-2.94)	(-2.94)	(-2.95)
Firm Fixed Effects	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes
Adj. R-Squared	0.859	0.859	0.859
Observations	6,674	6,674	6,674

Table 11: Investments Around 2007 Green Card Misallocation

This table reports the Difference-in-Differences (DiD) regressions with quarter and firm fixed effects over the three quarters surrounding the green card misallocation in the third quarter of 2007. The dependent variable is quarterly investment (*Qtr CAPXR&D*). In Models (1) to (3), the main independent variables are the interaction terms between the cross-sectional changes in worker mobility in 2007 (*Mobility_STEM_2007*, *Mobility_HESTEM_2007*, and *Mobility_RD_2007*) and an indicator set to one for three quarters after the green card misallocation (*Post*). In Models (4) to (6), I discretize *Mobility_STEM_2007*, *Mobility_HESTEM_2007*, and *Mobility_RD_2007* by the sample medians and interact the resulting indicator variables (*Hi Mobility_STEM_2007*, *Mobility_HESTEM_2007*, and *Hi Mobility_RD_2007*) with the *Post* variable. All variables are described in the Appendix. I report robust standard errors clustered by firm. ***, **, and * indicate significance at 1%, 5%, and 10%, respectively

	(1) *Qtr CAPXR&D*	(2) *Qtr CAPXR&D*	(3) *Qtr CAPXR&D*	(4) *Qtr CAPXR&D*	(5) *Qtr CAPXR&D*	(6) *Qtr CAPXR&D*
Mobility_STEM_2007 X *Post*	-0.0006**					
	(-2.12)					
Mobility_HESTEM_2007 X *Post*		-0.0005**				
		(-2.12)				
Mobility_RD_2007 X *Post*			-0.0004*			
			(-1.84)			
Hi Mobility_STEM_2007 X *Post*				-0.0017**		
				(-2.15)		
Hi Mobility_HESTEM_2007 X *Post*					-0.0017**	
					(-2.07)	
Hi Mobility_RD_2007 X *Post*						-0.0015*
						(-1.86)
Log(Total Qtr Asset)	-0.0305***	-0.0305***	-0.0305***	-0.0305***	-0.0305***	-0.0305***
	(-11.66)	(-11.66)	(-11.65)	(-11.65)	(-11.64)	(-11.65)
Qtr Cash Flow	-0.0858***	-0.0858***	-0.0856***	-0.0858***	-0.0858***	-0.0858***
	(-3.95)	(-3.95)	(-3.94)	(-3.95)	(-3.95)	(-3.95)
Qtr Cash Holdings	-0.0129**	-0.0129**	-0.0129**	-0.0132**	-0.0131**	-0.0132**
	(-2.21)	(-2.22)	(-2.22)	(-2.26)	(-2.25)	(-2.26)
Qtr Leverage	-0.0031	-0.0031	-0.0033	-0.0033	-0.0034	-0.0034
	(-0.42)	(-0.42)	(-0.45)	(-0.45)	(-0.46)	(-0.46)
Firm Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Quarter Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Adj. R-Squared	0.865	0.865	0.865	0.865	0.865	0.865
Observations	5,447	5,447	5,447	5,447	5,447	5,447

Skilled Labor Mobility and Firm Value: Evidence from a Natural Experiment

Internet Appendix

Internet Appendix Table 1: Regressions using Total Q defined by Peters and Taylor (2017)

Internet Appendix Table 2: Tobin's Q regression using alternative definitions of the main variables

Internet Appendix Table 3: Annual difference-in-differences (DiD) tests on the 2007 green card misallocation

Appendix Table 1: Total Q

This table reports the OLS fixed effect regressions in which the main dependent variable is *Total's Q* defined in Peters and Taylor (2017) and the main independent variables are skilled labor mobility: *Mobility_STEM*, *Mobility_HESTEM*, and *Mobility_RD*. The sample period is from 2007 to 2015. I report robust standard errors clustered by firm. ***, **, and * indicate significance at 1%, 5%, and 10%, respectively. All variables are described in the Appendix.

	(1) *Total Q*	(2) *Total Q*	(3) *Total Q*
Mobility_STEM	-0.0570***		
	(-3.51)		
Mobility_HESTEM		-0.0434***	
		(-3.44)	
Mobility_RD			-0.0527***
			(-3.48)
Log(Total Asset)	-0.6476***	-0.6476***	-0.6443***
	(-5.67)	(-5.67)	(-5.65)
R&D	1.4823*	1.4834*	1.4828*
	(1.94)	(1.94)	(1.94)
ROA	1.2290***	1.2308***	1.2267***
	(3.13)	(3.13)	(3.12)
Cash Holdings	0.1553	0.1562	0.1587
	(0.45)	(0.46)	(0.46)
Leverage	0.0960	0.0956	0.0939
	(0.38)	(0.38)	(0.37)
Sales Growth	0.4302***	0.4300***	0.4318***
	(2.83)	(2.83)	(2.84)
Log(Firm Age)	-1.5898***	-1.5888***	-1.5851***
	(-4.49)	(-4.48)	(-4.47)
Firm Fixed Effects	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes
Adj. R-Squared	0.738	0.738	0.738
Observations	6,597	6,597	6,597

Appendix Table 2: Alternative Construction of the Mobility Variables

This table reports the OLS fixed effect regressions in which the main dependent variable is Q and the main independent variables are two alternative versions of skilled labor mobility. In Panel A, the independent variables are *Abn Mobility_STEM*, *Abn Mobility_HESTEM*, and *Abn Mobility_RD*, calculated as the main mobility variables (*Mobility_STEM*, *Mobility_HESTEM*, and *Mobility_RD*) subtracting their time-series averages for the past three years. In Panel B, the independent variables are *Log Mobility_STEM*, *Log Mobility_HESTEM*, and *Log Mobility_RD*, constructed similar to the main variables but using the natural logarithm of the percentages of foreign workers. The sample period is from 2007 to 2015. I report robust standard errors clustered by firm. ***, **, and * indicate significance at 1%, 5%, and 10%, respectively. All variables are described in the Appendix.

Panel A: Abnormal Mobility and Q

	(1)	(2)	(3)
	Q	*Q*	*Q*
Abn Mobility_STEM	-0.0423***		
	(-3.17)		
Abn Mobility_HESTEM		-0.0344***	
		(-3.26)	
Abn Mobility_RD			-0.0336***
			(-3.44)
Control Variables	Yes	Yes	Yes
Firm Fixed Effects	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes
Adj. R-Squared	0.765	0.765	0.765
Observations	6,679	6,679	6,679

Panel B: Log Mobility and Q

	(1)	(2)	(3)
	Q	*Q*	*Q*
Log Mobility_STEM	-0.0578***		
	(-2.89)		
Log Mobility_HESTEM		-0.0486***	
		(-3.10)	
Log Mobility_RD			-0.0534***
			(-3.22)
Control Variables	Yes	Yes	Yes
Firm Fixed Effects	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes
Adj. R-Squared	0.762	0.762	0.763
Observations	6,507	6,507	6,507

Appendix Table 3: Annual Regressions around the 2007 Green Card Misallocation

This table reports the Difference-in-Differences (DiD) regressions from years 2006 to 2009. The main dependent variables are *Q* and *CAPXR&D*, calculated based on the COMPUSTAT Annual database. The main independent variables are the cross-sectional changes in worker mobility in 2007 (*Mobility_STEM_2007*, *Mobility_HESTEM_2007*, and Mobility*_RD_2007*) and discretized versions of these variables (*Hi Mobility_STEM_2007*, *Mobility_HESTEM_2007*, and *Hi Mobility_RD_2007*). *Post_Year* is an indicator set to one for the fiscal year 2008 onwards. I report robust standard errors clustered by firm. ***, **, and * indicate significance at 1%, 5%, and 10%, respectively.

Panel A: Annual DiD regressions on Q

	(1) *Q*	(2) *Q*	(3) *Q*	(4) *Q*	(5) *Q*	(6) *Q*
Mobility_STEM_2007 X *Post_Year*	-0.0787***					
	(-2.60)					
Mobility_HE_2007 X *Post_Year*		-0.0608***				
		(-2.65)				
Mobility_RD_2007 X *Post_Year*			-0.0771***			
			(-3.43)			
Hi Mobility_STEM_2007 X *Post_Year*				-0.1357**		
				(-2.40)		
Hi Mobility_HESTEM_2007 X *Post_Year*					-0.1227**	
					(-2.19)	
Hi Mobility_RD_2007 X *Post_Year*						-0.1453**
						(-2.49)
Control Variables	Yes	Yes	Yes	Yes	Yes	Yes
Firm Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Adj. R-Squared	0.829	0.829	0.830	0.828	0.828	0.828
Observations	3,232	3,232	3,232	3,232	3,232	3,232

Panel B: Annual DiD regressions on investments

	(1) *CAPXR&D*	(2) *CAPXR&D*	(3) *CAPXR&D*	(4) *CAPXR&D*	(5) *CAPXR&D*	(6) *CAPXR&D*
Mobility_STEM_2007 X *Post_Year*	-0.0058***					
	(-3.15)					
Mobility_HE_2007 X *Post_Year*		-0.0048***				
		(-3.38)				
Mobility_RD_2007 X *Post_Year*			-0.0051***			
			(-3.96)			
Hi Mobility_STEM_2007 X *Post_Year*				-0.0146***		
				(-3.35)		
Hi Mobility_HESTEM_2007 X *Post_Year*					-0.0142***	
					(-3.23)	
Hi Mobility_RD_2007 X *Post_Year*						-0.0141***
						(-3.20)
Control Variables	Yes	Yes	Yes	Yes	Yes	Yes
Firm Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Adj. R-Squared	0.890	0.890	0.890	0.890	0.890	0.890
Observations	3,366	3,366	3,366	3,366	3,366	3,366