Human Capital, Skilled Immigrants, and Innovation

Rasha Ashraf

Georgia State University

Rina Ray

University of Colorado Denver

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Human capital Investment Policy

- **Firm's human capital investment policy involves:**
    - Whether to obtain human capital from the domestic and international labor market or to develop the human capital of existing employees
- Hiring workers from international labor market is expensive:
    - Costs associated with visa processing, advertising, administrative, legal, and the opportunity cost associated with delays in hiring.

- Tervio (2008): firms underinvest in the human capital – or talent – search process and bid excessively from the incumbent (existing) talent pool
    - results in higher talent rents, a reduction in the average level of talent, a low output level, and higher wage disparity

- We investigate the performance of firms which engage in costly talent discovery process by hiring high skilled labors from international labor market.

- Analyze the effectiveness of acquiring human capital (in the international market) as an alternative to making direct investments, e.g., training in the existing human capital and the host-country.

Investment Policy and Innovation Outcome

- **Human capital investment policy for large R&D-intensive firms that rely on high-skilled foreign workers :**
  - Innovative abilities of skilled foreign workers authorized to work in the U.S. on H-1B visas

  - Innovation outcomes of the firms that rely on the human capital of such workers.

- **Effectiveness of the policy**:
  - Innovation outcome: Patents

  - Quality of innovation: Citations

  - Adjusts investment in innovation, training and education of existing employees and overall employment to match the high skilled labor supply

  - Product market performance and capital market reaction to the policy choice made by the immigrant-dependent firms

H-1B Visa Program

- H-1B visa program allows U.S. employers to employ skilled temporary foreign workers in "specialty occupations," such as STEM

- A U.S. employer must file an H-1B petition with the U.S. Citizenship and Immigration Services (USCIS) before employing an H-1B temporary worker.

- Maximum number of petitions approved for initial employment is subject to a cap or quota.

- H-1B Quota:
  - Until 1997: 90,000 ;
  - 1998 and 1999: 115,000 ;
  - 2000 to 2003: 195,000
  - 2004: 90,000 ;
  - 2006: basic quota: 65,000 + 20,000 higher degrees exemptions

- Petitions for continued employment are not subject to the quota.

Methodology

- Identification strategy based on Quasi-random assignment – exploits US immigration policy shocks on H-1B quota in 2004 and 2006 which induced a negative supply shock in the non-incumbent H-1B worker pool.

  - Treatment group – firms dependent on skilled immigrants
    - if a firm hires at least 20 H-1B employees in the years 2002 and 2003 (prior to policy shock in 2004).
  - Control group (propensity score matched) – firms similar in characteristics to the treated firms but not dependent on skilled immigrants
    - Size, Industry, Financial Risk – Leverage, Market to Book Ratio, Investment in Innovation – R&D expenditure, Innovation outcome – Patents, Efficiency – SG&A

- Difference-in-Difference Estimate:
  - Measure the impact of decline in skilled immigrants hiring on innovation outcomes for the H-1B-dependent firms, after the shock, relative to the control group.
  - Observe the policy choice by H-1B dependent firms on investment in innovation, employment growth, and investment in training and education of existing employees in response to negative supply shock of skilled immigrants
  - Product market performance and capital market reaction to the policy choice made by the immigrant-dependent firms around the policy shock.

Econometric Specification

- $y_{it} = \alpha_0 + \mu_i + \tau_t + \beta \cdot 1_{H1B-Dependent} \cdot 1_{post} + \delta \cdot X'_{it} + \varepsilon_{it}$

- y_{it} : outcome variables for firm i in year t : R&D expenditure, patents, number of citations, revenue, number of employees, ROA, SG&A, return.

- μ_i and τ_t : firm- and year- fixed effects for firm i and year t.

- X'_{it} is a vector of relevant control variables.
- $1_{H1B-Dependent}$: 1 if the firm is dependent on H-1B employees, and 0 otherwise.
- 1_{post} : 1 in the period after the immigration policy shock (year = 2004 and later).

- Parameters of interest are β: provide the mean shift in innovation for H-1B-dependent firms relative to the non-dependent firms after the immigration policy change after controlling for other factors

Time Series Variation

- $y_{it} = \alpha_0 + \mu_i + \tau_t + \sum_{n=-4}^{5} (\beta_n \cdot 1_{H1B-Dependent} \cdot 1_{post} \cdot \boldsymbol{T}_{n,it}) + \delta \cdot \boldsymbol{X}'_{it} + \varepsilon_{it}$

- $\boldsymbol{T}_n$ consists of a separate indicator variable for each year beginning 1999.

- n is normalized such that it equals zero in 2004, the year the new immigration policy is implemented.

- The coefficient of interest is β_n: measures the change in innovation in the year n after the immigration policy shock for firms dependent on H-1B workers relative to the firms that are not dependent on such workers.

Summary of Main Results

- Firm-level innovation outcomes decline for H-1B dependent firms after policy shock

- Before 2004: Compared to control firms H-1B dependent firms had
  - Twice as many patents
  - 65% more citations

- By the fourth year after the shock:
  - Quantity – 20%-51% decline in number of patents each year
  - Quality – 44%-62% decline in number of citations each year and 16% - 29% decline in citations per patent

- No evidence of immigrants substituting host-country workers.
  - Preemptive reduction of investment in R&D and immediate 7%-8% decline of employment

- Alternative channel to invest in existing human capital: Third year after the shock: H-1B dependent firms increase 10%-20% of SG&A investment:

- No evidence for the alternative hypothesis of "it's hard work and employee exploitation"
  - The policy shock does not affect firm's product market performance and profitability
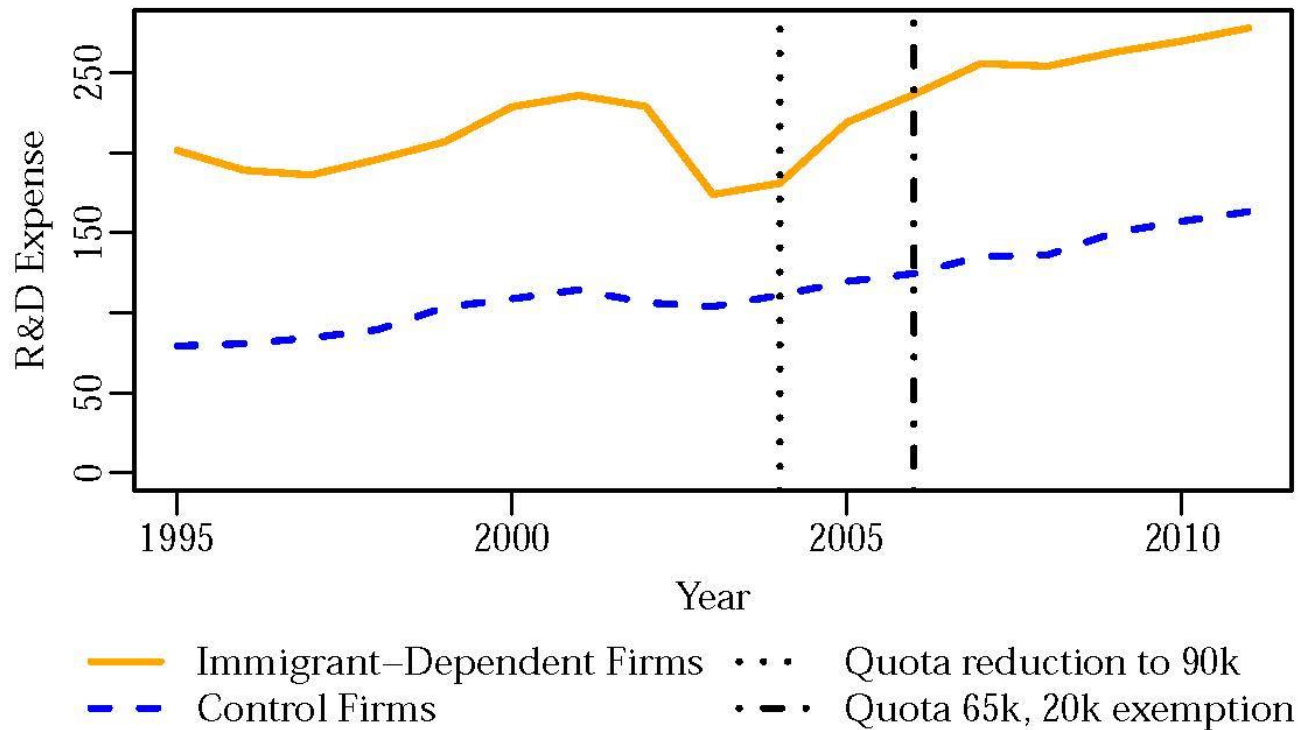 - After policy shock real wages declined for both the immigrant and host-country workers
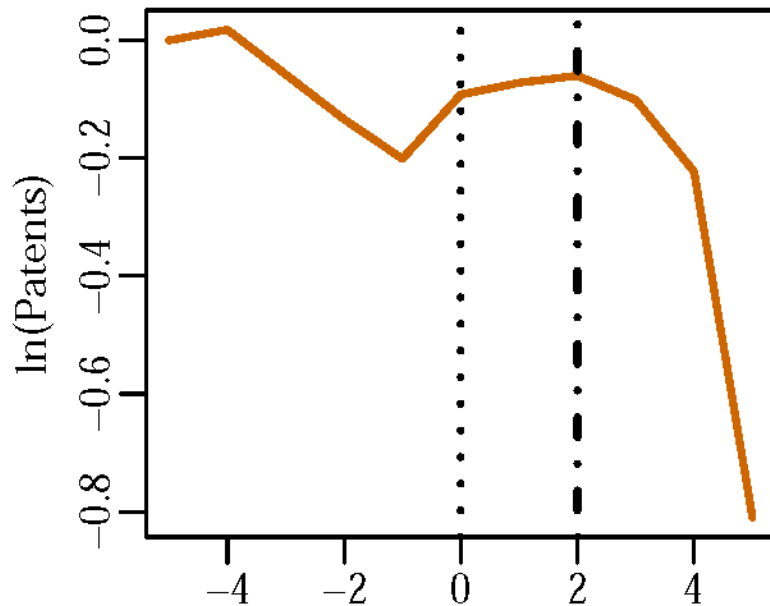
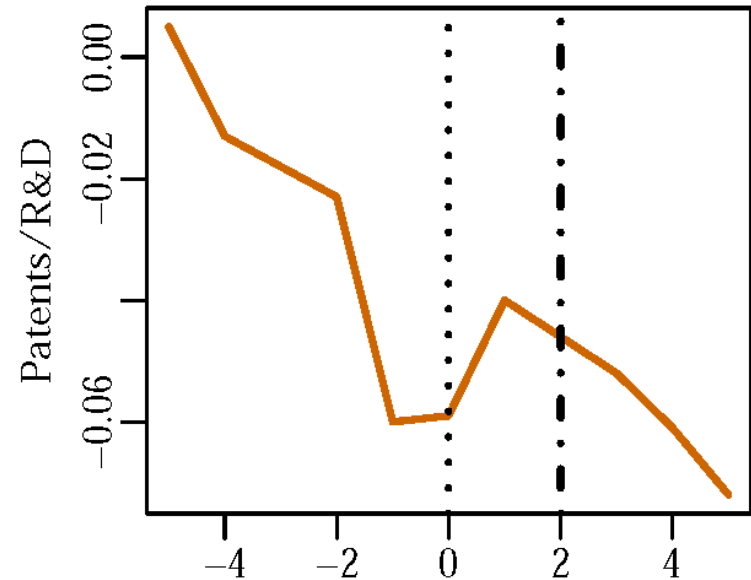# Time Series Trend in Patents
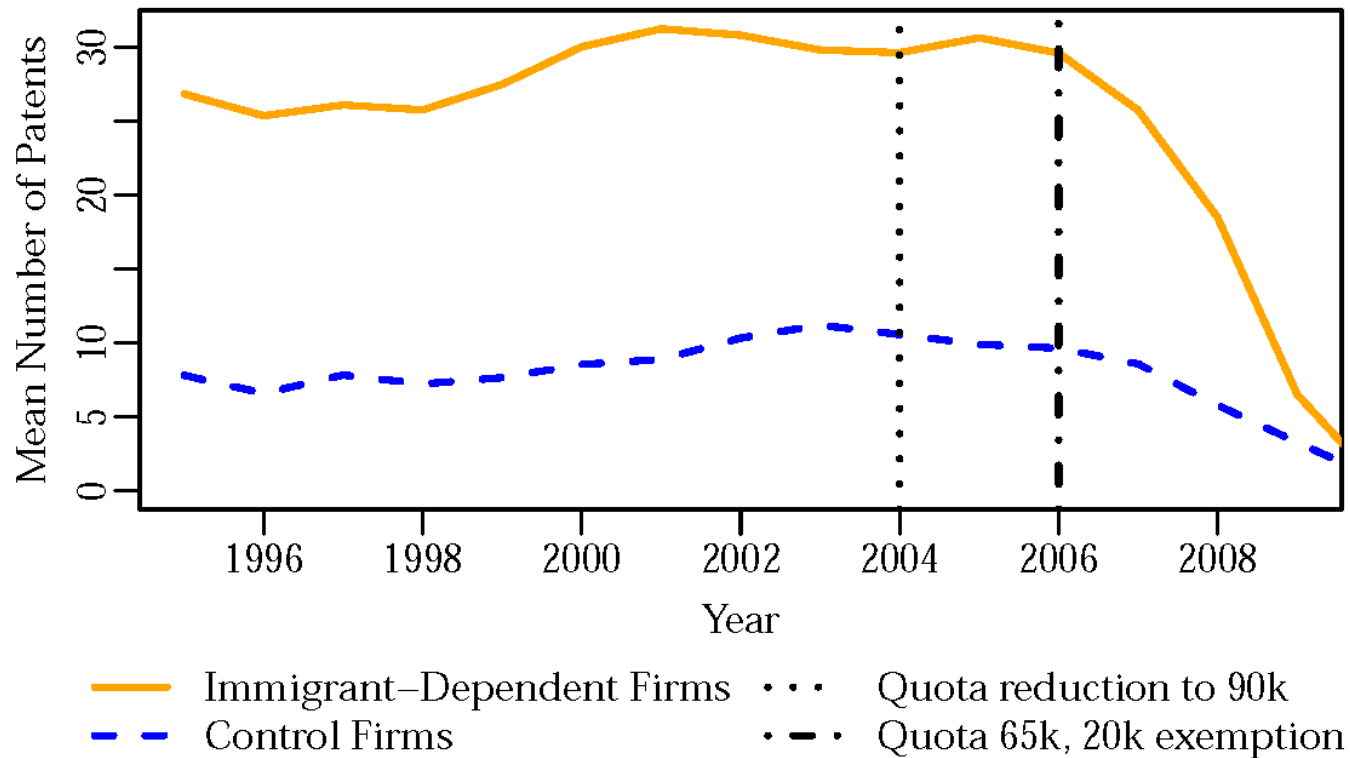
Time Series Trend in Citations
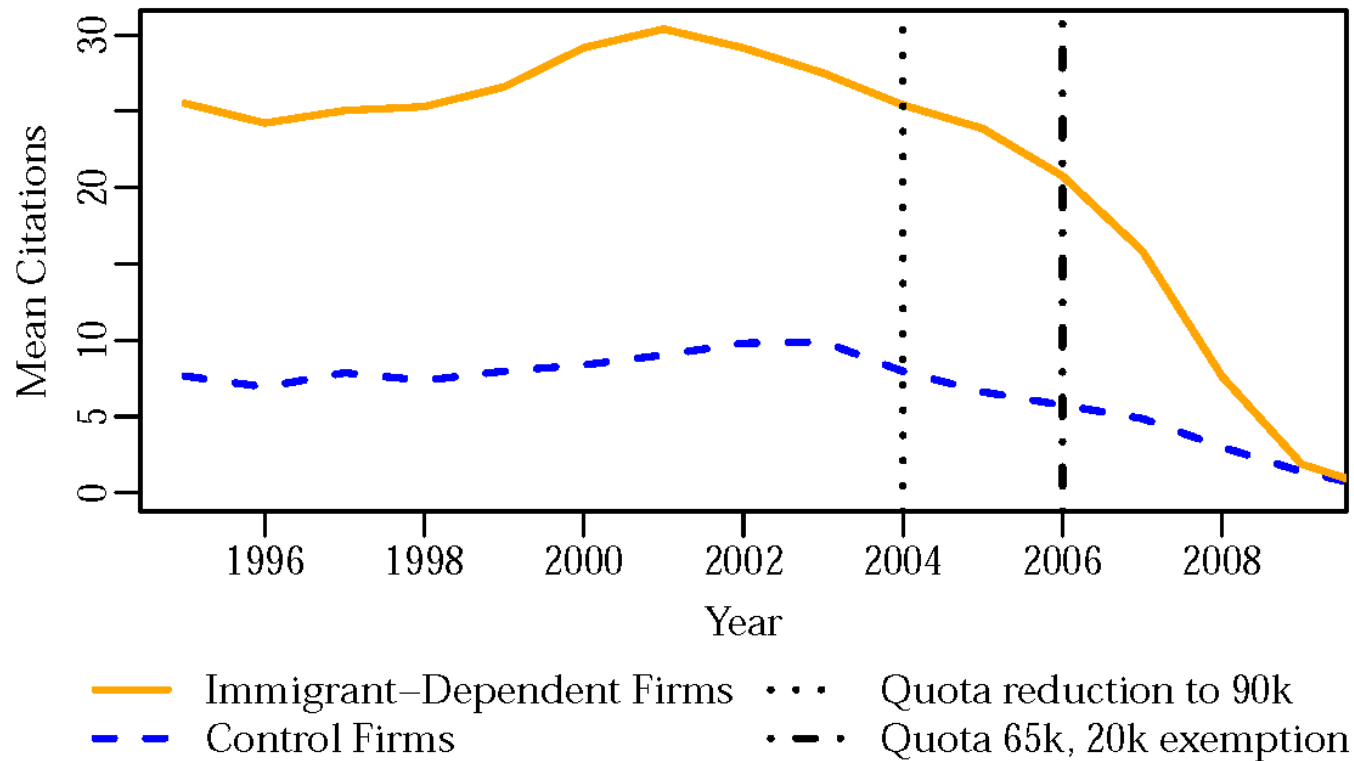
Adjustments of R&D to Match Skilled Labor

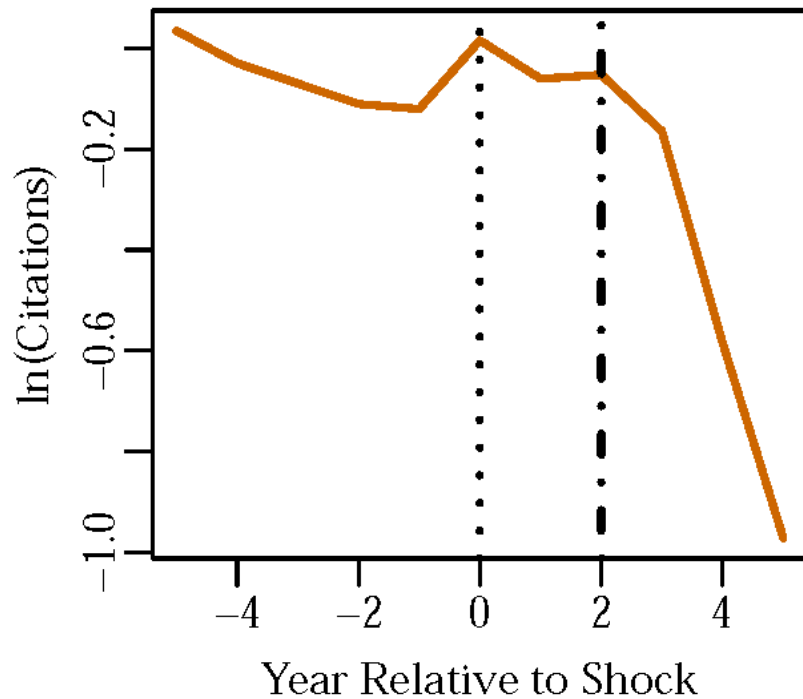# Impact of Skilled Labor Shortage on Innovation

Impact of Skilled Labor Shortage on Quality of Innovation
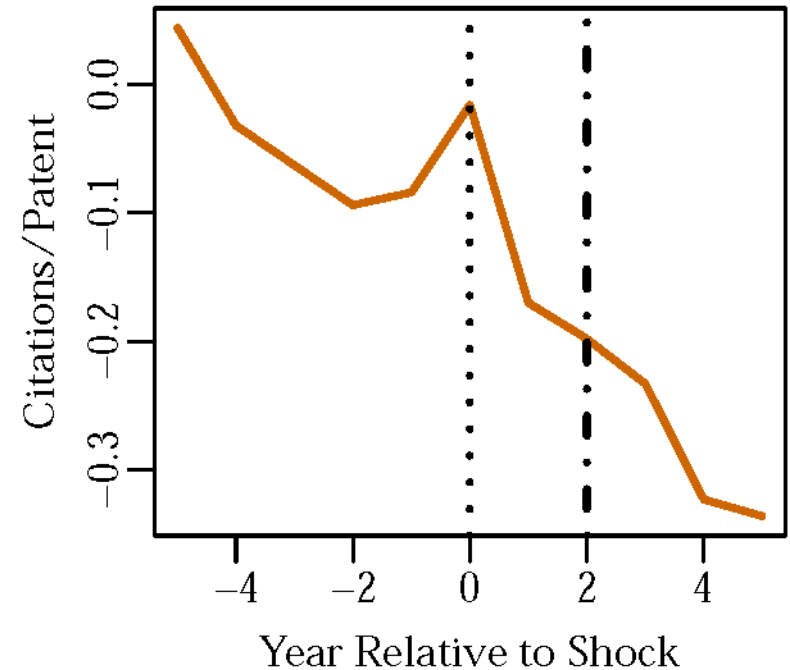
Conclusions

- Innovation outcomes and quality are impacted due to the supply shock of high skilled immigrants workers on immigrant-dependent firms

- H-1B dependent firms respond to an immigration policy shock:
  - by adjusting R&D investment, investing in training and education of existing employees, and slowing down hiring.

- Support the argument that high skilled immigrants make significant contributions directly and through spillover effects and do not crowd out or substitute host country workers.

- Investment in costly talent discovery process results in higher performance: Acquiring human capital from the international labor market is effective

THANK YOU!