Human Capital, Skilled Immigrants, and Innovation

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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


- 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

- 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.

- \( \mu_i \) and \( \tau_t \): 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 \( \beta \): 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

\[ y_{it} = \alpha_0 + \mu_i + \tau_t + \sum_{n=-4}^{5} (\beta_n \cdot 1_{H1B-Dependent} \cdot 1_{post} \cdot T_{n, it}) + \delta \cdot X'_{it} + \varepsilon_{it} \]

- \( T_n \) 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 \( \beta_n \): 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

Year

Mean Number of Patents


Immigrant–Dependent Firms

Control Firms

Quota reduction to 90k

Quota 65k, 20k exemption
Time Series Trend in Citations
Adjustments of R&D to Match Skilled Labor

![Graph showing R&D expense over years with annotations for immigrant-dependent firms and control firms, along with changes in quota levels.]
Impact of Skilled Labor Shortage on Innovation

The graphs show the impact of skilled labor shortages on innovation over time. The left graph represents the natural logarithm of patents (\(\ln(\text{Patents})\)) and the right graph represents the ratio of patents to R&D (\(\text{Patents/R&D}\)).

- The left graph indicates a decrease in \(\ln(\text{Patents})\) starting from year 0, which corresponds to the year of the shock. The decrease is more pronounced for the Quota reduction to 90k (2004) compared to the Quota 65k, 20k exemption (2006).
- The right graph shows a decrease in \(\text{Patents/R&D}\) starting from year 0, with a steeper decline for the Quota reduction to 90k (2004) followed by a recovery and a slower decline for the Quota 65k, 20k exemption (2006).
Impact of Skilled Labor Shortage on Quality of Innovation

- Quota reduction to 90k (2004)
- Quota 65k, 20k exemption (2006)
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!