

Brain Drain or Gain? Skilled Migration and Human Capital Accumulation in the Developing World

by

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Dissertation submitted in partial fulfillment of the requirements for the degree of
Doctor of Philosophy in the Department of Political Science
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ABSTRACT

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Abstract

Developing countries have long worried about the prospects of their “best and brightest” moving to the developed world. Some scholars have argued that massive emigration of highly-educated labor deprives these countries of much-needed human capital, leaving them “forever destitute.”¹ However, other scholars have questioned this argument, pointing out that high wages in migrant-receiving countries can serve as an incentive for potential migrants to invest more in human capital than they would otherwise. Some of these high-skilled workers will end up staying, raising the overall level of human capital in developing countries. This phenomenon is referred to as “brain gain.” One key underlying assumption of existing brain gain models is that migrant-receiving countries cannot distinguish high-skilled workers from low-skilled workers when deciding whether to grant them entry. This dissertation argues that while this assumption may have been valid in the past, it no longer reflects today’s world where high-income countries have developed a rigorous screening process and select only the best qualified immigrants. Thus, we need a new theoretical framework to reflect this new reality. Building a model of brain gain based on the “tournament model” introduced by Lazear and Rosen (1979), this dissertation shows that the wage difference between migrant-sending and migrant-receiving countries is the main motivation for potential migrants to acquire more education and compete for higher paying jobs in destination countries. This dissertation argues that two key factors determining this income gap are 1) the intensity of screening by migrant-receiving countries and 2) the wage level in migrant-sending countries. Utilizing two exogenous shocks including an increase in screening by the United States following the 9/11 ter-

¹ “The new slave trade: A poor country’s best workers,” *Toronto Globe and Mail*, November 2, 2015. Quoted in Easterly and Nyarko (2008).

rorist attacks and a series of affirmative action policies implemented in Malaysia, the dissertation finds that the intensity of screening by migrant-receiving countries has a positive effect on human capital accumulation in migrant-sending countries and a decrease in the wage level in migrant-sending countries has a positive impact on the educational outcomes of potential migrants.

To my family.

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List of Abbreviations and Symbols

Abbreviations

ASEAN	Association of Southeast Asian Nations
GDP	Gross Domestic Product
GNI	Gross National Income
IBC	International Branch Campus
ILO	International Labor Organization
IPUMS	Integrated Public Use Microdata Series
ISCO	International Standard Classification of Occupations
LPM	Linear Probability Model
MCS	Malay Civil Service
NAFTA	North American Free Trade Agreement
NEP	New Economic Policy
NIS	New Immigrant Survey
NOC	National Operations Council
OECD	Organisation for Economic Co-operation and Development
OWW	Occupational Wages Around the World
RM	Malaysian Ringgit
SAT	Scholastic Assessment Test
UMNO	United Malay National Organization
U.S.C	United States Code

USCIS United States Citizenship and Immigration Services

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1

Introduction

The number of international migrants in general and of skilled migrants in particular have been growing significantly in the last several decades. As shown in Figure 1.1, the total international migrant stock increased sharply in the late 1980s and continued to rise at an increasing rate. From 2000 to 2013, this number rose by a considerable 30 percent and stood at 232 million in 2013, approximately 3.3 percent of the world population (United Nations, 2013). This ongoing surge in international migration has triggered a fierce backlash in the West. It was featured heavily in the Trump campaign and was at the heart of the British push to leave the European Union. International migration is one of the most relevant and divisive issues of the 21st century.

At the forefront of the international migration debate is the significant increase in the number of high-skilled migrants. The proportion of high-skilled migrants (defined as persons who have completed college education) is rising across all regions with the largest share concentrated in North America (Figure 1.2). From 1961 to 1972, the number of highly educated South-North migrants were approximately 300,000 (Docquier and Rapoport, 2004). Twenty years later, there were more than 2.5 million

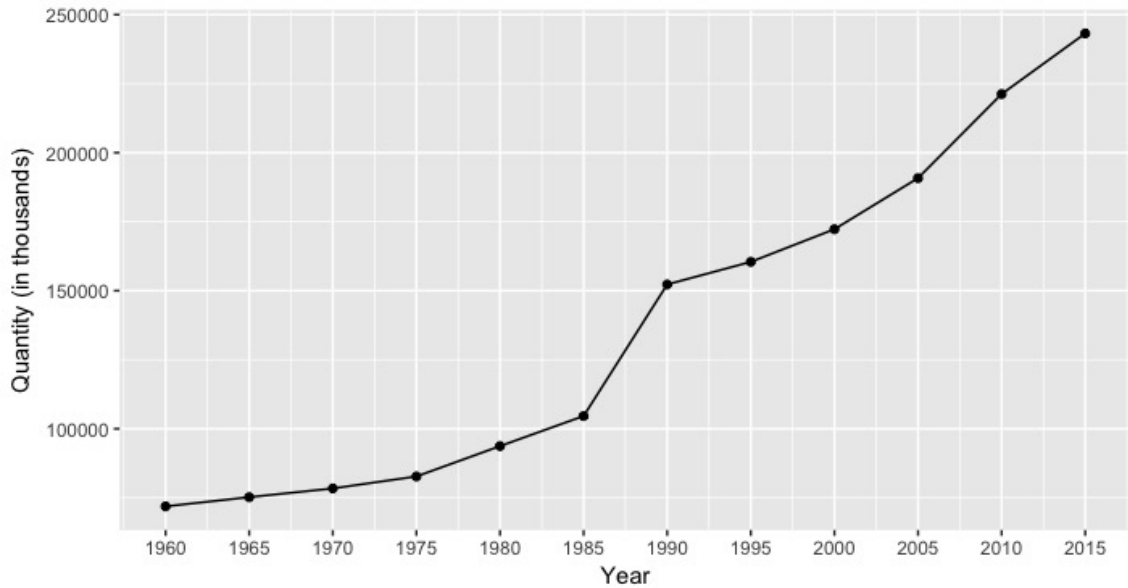


FIGURE 1.1: International Migrant Stock Over Time
Source: United Nations Population Division

in the U.S. alone (UNCTAD, 1975). This number in OECD countries¹ also shows an unprecedented increase in the past decade (70%), reaching 27.3 million in 2010 (United Nations, 2013).

According to the United Nations’ *World Migration in Figures* report (2013), one in every nine people born in Africa with more than a high-school education live in OECD countries. The corresponding numbers for Latin American and the Caribbean, and Asia are one in 13 and one in 30, respectively. This “brain drain” has created serious concerns for not only migrant-receiving countries but also for migrant-sending countries. The former worries about job loss for their native-born workers while the latter about losing their best and brightest to the developed world. Given the increasing rate of tertiary educated migration, there has been a renewed interest in the topic of brain drain in both policy discussions and in the economics literature.

¹ The Organisation for Economic Co-operation and Development (OECD) is an intergovernmental organisation with 36 member countries, most of which are developed countries.

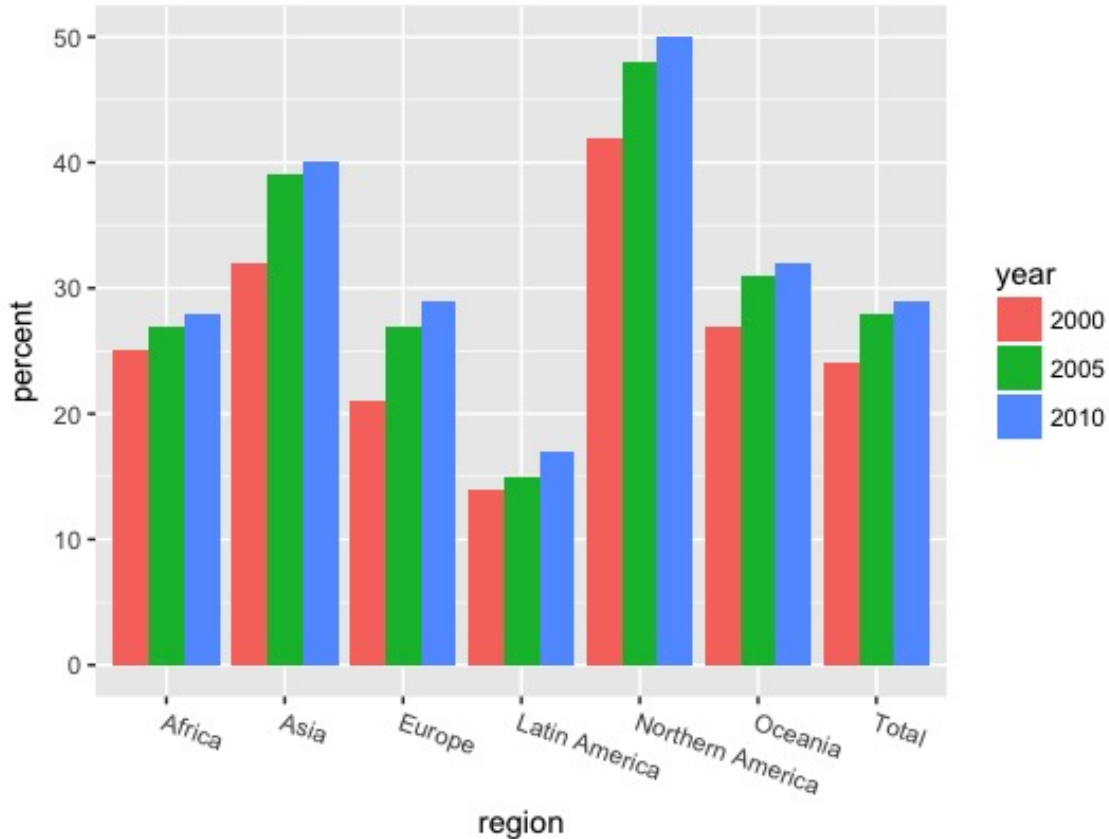


FIGURE 1.2: Share of Highly Educated Migrants by Region of Destination
Source: Database on Immigrants in OECD and non-OECD Countries

In the 1970s, economists argue that the emigration of highly skilled workers damages the long-term economic growth of developing countries (Hamada and Bhagwati, 1975). More recently, a number of important theoretical studies beginning with Stark et al. (1997) have cast doubt on this argument. They point out that higher returns to human capital abroad cause workers to migrate but also encourage workers in migrant-sending countries to invest more in human capital than they would otherwise. Some of these highly skilled individuals will end up staying, raising the overall level of human capital in migrant-sending countries. These models hinge on one key assumption that migrant-receiving countries cannot distinguish between high-skilled and low-skilled workers when deciding whether to grant them entry. This dissertation

argues that this assumption was reasonable in the past but is no longer valid in today's world where migrant-receiving countries have developed a meticulous screening process and select only the most qualified immigrants.

The increased effectiveness of screening means that it is now more competitive for potential migrants to move to the developed world. The probability of migrating no longer depends on each individual's *ability* but on their *relative ability* compared to other migrants. Given that the stark income gap between two average receiving and sending countries is one of the main drivers for emigration (World Bank, 2016), potential migrants are incentivized to compete for a limited number of visas available.

1.1 Preview of the Argument

This dissertation argues that in the presence of screening, the most relevant model that can help us understand the effect of high-skilled migration on human capital stock is the “tournament model” formulated by Lazear and Rosen (1979). Similar to how migrants are motivated by the wage gap between migrant-sending and migrant-receiving countries, employees in the tournament model are motivated by the difference in wages between the post-promotion and pre-promotion jobs. While a migrant gets a visa if he proves to be more skilled than his peers, an employee in the tournament model gets promoted by performing a better job than his colleagues. By adapting the “tournament model” to the context of high-skilled migration, this dissertation examines how actors make strategic decisions when motivated by higher wages and evaluated by relative performance. In other words, *relative performance* and *economic incentive* are the two main components that make the tournament model the best model for the main research question, which is “What is the effect of high-skilled migration on the level of human capital in migrant-sending countries?”.

Building a model of brain gain based on the “tournament model,” this dissertation shows that if an increase in the wage difference between the migrant-receiving

and migrant-sending countries is large, it is rational for workers from migrant-sending countries to acquire more education and compete for higher paying jobs in migrant-receiving countries. The wage gap depends on two key factors including 1) the intensity of screening by migrant-receiving countries and 2) domestic wages in migrant-sending countries.

1.2 Outline of Empirical Tests

In order to examine the effects of the two determining factors on the educational investment of potential migrants, this dissertation offers two main empirical tests.

First, in the wake of the 9/11 attacks, the United States began to implement various screening measures and reduced the H-1B visa quota, which was reserved for high-skilled labor. Among the five countries that were exempt from this reduction, Mexico was the only developing country which sent a large number of its citizens to the U.S. The dissertation will compare the SAT score of prospective students from Mexico and the score of students from other developing countries in Latin America who were subject to the visa cap reduction. This comparison will give us insight into the relationship between the intensity of screening and the educational outcome of potential migrants.

Second, a series of policy changes that happened in Malaysia in the 1970s offer an excellent empirical test regarding the second determining factor: domestic wages the country of origin. The Malays (also referred to as the *bumiputeras* or “sons of the soil”) are the predominant ethnic group in Malaysia which makes up half of the population. The second largest ethnic group is Chinese (22.6%) followed by Indians (6.7%). In the wake of the violent racial clashes between the Malays and the Chinese in 1969, the caretaker government passed the New Economic Policy (NEP) which comprises several preferential policies favoring the Malays at the expense of the Chinese, Indian and other ethnic minority groups. Malaysians of Chinese origin,

particularly the highly educated, saw this as a negative, and possibly permanent shock to their economic prospects in the country. They began to emigrate en masse to developed countries such as Singapore and Australia and gravitated toward occupations with the highest wage differential between the foreign and home countries. Because these migrant-receiving countries give strong preference to high-skilled labor, ethnic Chinese in Malaysia started to invest in higher education and moved abroad. Comparisons of the educational outcomes of the Malays and the Chinese will allow us to explore the effect of domestic wages in migrant-sending countries on the educational attainment of potential migrants.

1.3 Importance of the Study

This dissertation provides a number of both theoretical and empirical contributions. Theoretically, it points out a critical but outdated assumption which most current brain gain models are based on. It suggests an alternative theoretical model that sheds light on how skilled migration affects the level of human capital in migrant-sending countries. It aims to show that the *brain gain* effect can still offset the *brain drain* effect in the presence of *effective screening*, which is contrary to the implications of most current brain gain models.

Empirically, testing these models is challenging given the possibility of endogeneity. The emigration of high-skilled labor can be caused by factors that also affect the human capital stock of migrant-sending countries. To disentangle the effect of high-skilled migration, scholars have used past local migration rates as an instrument for current rates (Beine et al., 2008; McKenzie and Rapoport, 2006; Batista et al., 2012). However, factors such as cultural differences and geographic clustering by people of different types can affect both past and present migration rates as well as human capital formation (Chand and Clemens, 2008). This dissertation attempts to solve the problem of endogeneity by employing two exogenous shocks including the

9/11 attacks in the U.S. and a series of affirmative action policies favoring ethnic Malays implemented in Malaysia.

1.4 Outline of the Dissertation

The rest of this dissertation is organized as follows. Chapter 2 provides an overview of the literature on the effect of high-skilled migration on the migrant-sending countries and explains the need for a new theoretical model. Chapter 3 presents the “tournament model” in the context of international migration. Chapter 4 provides results from an analysis of the tightening of immigration controls in the U.S. post 9/11, demonstrating that the level of screening in migrant-receiving countries positively affects the human capital formation in migrant-sending countries. Chapter 5 features an analysis of major policy changes in Malaysia, illustrating the positive effect of a decrease in the wage level in migrant-sending countries on the educational outcomes of potential migrants. Chapter 6 concludes with a summary of the main findings.

2

Literature Review

The term “brain drain” was first coined by the British Royal Society to describe the emigration of British scientists to North America in the 1950s and 1960s (Cervantes and Guellec, 2002). The term later became widely used to refer to the outflow of high-skilled migrants from developing countries to the developed world. This origin of the term highlights one of the critical theoretical formulations articulated by this dissertation: what is critical is the nexus of skill, job opportunities and migration behavior which can be from the developing to the developed world but need not be, as underscored by high-skilled migration from the United Kingdom to North America. Accordingly, this dissertation’s theoretical framework has a broader scope than only global South-North migration. In line with this consideration as well as with Docquier and Marfouk (2006) and Docquier and Rapoport (2004, 2012), this dissertation defines “brain drain” as the emigration of working-age (25 and over) foreign-born individuals who have an academic or professional degree beyond high school.

It is worth noting that this definition has several limitations. First, it does not include undocumented immigration. However, even though undocumented immigra-

tion may distort the overall statistics, it is unlikely to affect the data for high-skilled migrants who are more willing and able to migrate through conventional and legal channels (World Bank, 2011). Second, this definition counts any foreign-born migrants with tertiary education regardless of where they obtained their degree. If they had acquired their degrees after emigrating, the brain drain problem may have been exaggerated. However, if these individuals arrived after having received their education at home, then this is a serious problem for migrant-sending countries because the home country has spent resources on educating these individuals without getting anything in return for their investment in human capital.

2.1 First Wave of Research

The topic of brain drain has generated a considerable amount of research since the early 1960s. The earlier literature was mostly theoretical; it focuses on the welfare implications of brain drain and how free movement of labor would benefit the world economy as a whole. Most of these studies are based on the neoclassical Hicks-Samuelson model with standard assumptions such as *perfectly competitive markets*, *no externalities* and *wages equal to marginal product* (Grubel and Scott, 1966; Johnson, 1967; Berry and Soligo, 1969). These scholars, particularly Grubel and Scott (1966), contend that in a *competitive* and *efficient* markets where workers are paid their marginal product, a migrant will only take away his marginal product and income, leaving the incomes of those left behind unchanged. Other studies went a step further, suggesting that migration could increase the welfare of those who remain in the source country through a variety of channels. First, migrants send home remittances which provides resources for those left behind to open up new businesses. Second, moving to advanced economies increases migrants' productivity which can lead to innovation and scientific discoveries - a public good that benefit both the sending and receiving countries. In addition, migration facilitates the transmission

of skill and knowledge across borders. Thus, these early studies conclude that the negative effect of brain drain on those left behind is negligible and can be offset by positive gains.

2.2 Second Wave of Research

The second wave of research on brain drain emerged a decade later with a more pessimistic view. Scholars such as Bhagwati and Hamada (1974) argue that the earlier studies are constrained by the theoretical assumptions they work with and any departures from the assumption of perfectly competitive markets would undermine their findings. Bhagwati and Hamada (1974; 1975) then incorporate into their models more realistic features of markets such as *asymmetric information* and *subsidies to education*. The general consensus in this line of research is that brain drain is a vicious circle where rich countries become richer at the expense of poor countries. This is because rich countries attract highly skilled persons from poor countries, who will immigrate and increase the level of productivity and wages in the rich country. Meanwhile, poor countries face significant losses in tax revenues from high-skilled workers with high earning potential. Another major concern is that while poor countries spend resources on the education of emigrants, it is the rich, migrant-receiving countries who benefit from this investment. In addition, an outflow of skilled workers would exacerbate the level of economic inequality between the rich and the poor in the countries of origin.

These theoretical conclusions had some supporting empirical evidence. According to Mishra (2007), the departure of high-skilled workers from Mexico to the U.S. increases wages for similarly high-skilled individuals who remain in the country. While Mishra (2007) found that the reduced supply of high-skilled workers in Mexico led to higher wages for a subset of the population, the dissertation also found that widened the wage gap between the skilled and unskilled workers and there was little impact on

aggregate welfare. Regarding the fiscal effect of high-skilled migration, Desai et al. (2009) show that India loses 2.5 percent of its total fiscal revenues (or one-half of 1 percent of its gross national income) as a result of forgone taxes from high-skilled workers who moved to the U.S.

In order to remedy the problems caused by the brain drain, scholars have proposed various policy solutions, the most notable of which is the Bhagwati tax - a tax levied on skilled migrants and transferred to the countries of origin in one form or another¹ to benefit those left behind (Bhagwati and Hamada, 1974; Bhagwati and Partington, 1976). Although this tax proposal was discussed extensively, it was not implemented due to legal and administrative concerns (Oldman and Pomp, 1975).

2.3 Recent Literature

A serious limitation of the preceding discussion is it assumes that the possibility of migrating does not affect human capital formation before migration takes place and even if it does, the additional human capital ends up in the destination (World Bank, 2011). Starting in the late 1990s, more recent research has examined how the stock of human capital is built up and how migration affects the incentive structure of people in developing countries when they make educational decisions (Mountford, 1997; Stark et al., 1997; Vidal, 1998). Scholars have formulated various theoretical models to explain the mechanism of “beneficial brain drain”, i.e. when labor is *homogenous* (Stark et al., 1998; Vidal, 1998), when labor is *heterogeneous* (Mountford, 1997) and in models with *imperfect information* and *return migration* (Stark et al., 1997). These models reach the same conclusion that migration can induce skill creation in the source country.

¹ Bhagwati and Hamada (1974) propose that the host country levy a tax on the income earned by immigrants and remit the tax revenue to the countries of origin. Alternatively, this tax should be collected by the United Nations which would then transfer the tax revenue to the migrant-sending countries or use it for general developmental aid to these countries.

The general argument is as follows. In a developing economy where returns to education are low, the incentive to acquire an education is also low. Thus, when there is a possibility to move to places which offer higher returns to education, workers are likely to invest more in developing their skill set in order to realize those returns to education in the receiving countries. However, for various reasons, some of these high-skilled workers will be unable to migrate, resulting in a net gain in human capital in the country of origin. According to these scholars, an outflow of high-skilled labor generates two main effects: an *ex ante* “brain effect” (the increase in education investment due to the possibility of emigration) and an *ex post* “drain effect” (the actual departure of high-skilled citizens) (Beine et al., 2003). Brain gain happens when the first effect dominates the second.

Although these scholars disagree on the conditions under which the *brain effect* trumps the *drain effect*, they all adopt one key assumption that migration is not certain and the probability of emigrating is exogenously given (Mountford, 1997; Stark et al., 1997; Beine et al., 2001; Vidal, 1998). This is because foreign firms cannot differentiate between high-skilled and low-skilled workers, at least in the beginning. As the argument goes, if screening were effective, foreign firms could select the top workers with a skill level above a certain threshold. Then the incentives for those with ability below that threshold would not be affected because they would have no possibility of emigrating. In other words, it is the *failure of screening* for high-skilled labor that makes “brain gain” possible (Commander et al., 2004). Since the seminal theoretical work of Stark et al. (1997); Mountford (1997) and Vidal (1998), the literature has largely taken the assumption of ineffective screening for granted and the resulting brain gain effect as a given and has since focused on providing more rigorous empirical tests of the effect (Beine et al., 2001, 2008; Batista et al., 2012; Chand and Clemens, 2008). In the next section, this dissertation will challenge the critical assumption of ineffective screening which underpins these important models

in the literature

2.4 Effective Screening in Practice

This dissertation contends that the assumption of ineffective screening was empirically valid in the past but is completely obsolete today. Developed countries have come up with effective ways to screen out less able foreign workers. The points-based immigration system pioneered by Canada in 1967² is a good example of effective screening. This system assesses migrants by their score on a test which includes the following categories:

1. Education: the highest points are awarded to those with a Master's or a Ph.D. degree;
2. Language proficiency in English or French;
3. Work experience measured by the number of years of full-time employment;
4. Age: the most points are given to the most productive age group of twenty-one to forty-nine;
5. Arranged employment in Canada;
6. A bonus category of "adaptability" which accounts for previous study and work experience in Canada.³

The maximum score is 100 and applicants must accumulate a minimum of 67 points to apply for a visa. Australia, New Zealand, and the United Kingdom have a similar talent-based system. An additional criterion in the UK's system is "high past earnings and achievement in their field" (Shachar, 2006, 192).

Although the United States does not have the same points-system, its screening

² Donald, Adam, "Immigration points-based systems compared," *BBC News*, June 1, 2016, accessed April 5, 2019, <https://www.bbc.com/news/uk-politics-29594642>.

³ Department of Immigration, Refugees and Citizenship, Government of Canada, accessed October 10, 2016, <http://www.cic.gc.ca/english/immigrate/skilled/apply-factors.asp>.

system is equally if not more selective. Most highly skilled migrants come to the U.S. under the H-1B program, which was created under the Immigration Act of 1990. First, a foreign-born worker must have “specialized knowledge” of a specific occupation and have attained “a bachelor’s or higher degree in the specific specialty as a minimum for entry into the US.”⁴ More importantly, the individual must have already secured a job offer from a U.S.-based company, which means they have already gone through a multi-step evaluation process by a U.S. firm. The prospective employer will then need to submit an H-1B petition on behalf of the new hire. As part of the petition process, the employer must submit a Labor Condition Application where it attests that:

- (a) The employer “has taken good faith steps to recruit [...] United States workers” for the position and rejected all U.S. workers who applied for the job for “lawful job-related reasons.”⁵
- (b) The hiring of the nonimmigrant will not negatively affect the wages of American workers in similar positions (Goodrich, 2007).
- (c) There are currently no labor disputes at the company.⁶

Each H1-B petition can cost the employer from \$5000 to \$5500⁷ depending on the size of the company. From 1991 to 2004, the number of new H-1B to be approved annually was capped at 195,000. The H-1B Visa Reform Act of 2004 reduced the

⁴ 8 U.S.C. 1101(a)(15)(H)(iii), 1184(i).

⁵ 20 C.F.R. 656.10(c)(9); “U.S. Department of Labor Wage and Hour Division (WHD) INA Section 212 (n) H-1B Labor Condition Application.” U.S. Department of Labor Wage and Hour Division (WHD) INA Section 212 (n) H-1B Labor Condition Application, accessed August 15, 2017, <https://www.dol.gov/whd/regs/statutes/0003.iana.htm>.

⁶ 8 U.S.C. 1184(i).

⁷ These numbers do not include attorney fees and optional fees such as premium processing fee. “Fee Increase for Certain H-1B and L-1 Petitions (Public Law 114-113),” U.S. Citizenship and Immigration Services, accessed November 18, 2018, www.uscis.gov/working-united-states/temporary-workers/fee-increase-certain-h-1b-and-l-1-petitions-public-law-114-113.

quota from 195,000 to 65,000 visas⁸ (where it remains today) but declared exemptions for individuals who have obtained a master's degree or higher from an accredited, non-profit U.S. university.

The H1-B visa selection process is as follows. The United States Citizenship and Immigration Services (USCIS) first identifies petitions eligible for the H-1B Masters quota. If the number of eligible applications exceeds 20,000, USCIS runs a lottery to select 20,000 petitions from the pool. The petitions that did not get selected will be transferred to the regular pool. If there are more than 65,000 applications in the regular pool, USCIS will run another lottery to select 65,000 petitions. USCIS will then notify individuals who are selected. The petitions that did not get selected in the regular or masters pool will be sent back to the lawyer's office.

The considerable costs of filing an H-1B petition in addition to the lengthy delays and uncertainty associated with the lottery make it much more difficult for U.S. companies to hire foreign nationals than to hire U.S. citizens. In fact, as demonstrated earlier, U.S. companies are required by law to consider U.S. workers for the position first and only if no U.S. applicants satisfy the job requirements can they petition to hire a foreign national. Thus, it is rational for U.S. companies to bear the extra costs of hiring a foreign worker if and only if he or she is better qualified for the job than all other U.S. applicants who also apply for the position. In other words, the U.S. H-1B petition system provides a strong incentive for U.S. firms to select and sponsor only the most qualified foreign workers available. Accordingly, the H-1B system leads to the selection of the most skilled foreign workers and screens out less able individuals. As a result, it is not surprising that more than 50% of H-1B approvals consistently go to those with the highest academic and professional degrees (a Masters degree or a Ph.D.) (Figure 2.1).

⁸ Note that 1,400 of the 65,000 cap is reserved for Chileans, while 5,400 is reserved for Singaporeans as part of the Free Trade Agreement (8 U.S.C 1184(8)(g)(B)(ii)).

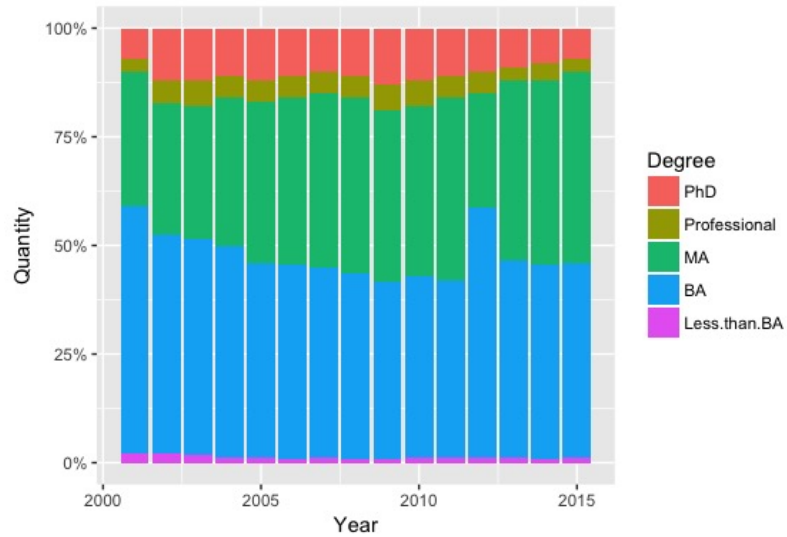


FIGURE 2.1: H-1B Approvals by Degree
Source: United States Citizenship and Immigration Services

These examples give us a glimpse of how rigorous screening in developed countries has become and fundamentally challenge the core assumption of ineffective screening in many previous models of brain gain in the literature.

3

The Argument

Given the increased efficacy of screening, this dissertation argues for the need to update the assumption of *ineffective screening* and to modify extant theoretical models of brain gain. The main argument is that on the contrary, higher expected wages in developed countries and the difficulty of migrating due to *effective screening* create a very competitive environment for workers from low-income countries. If the income gap between migrant-sending and migrant-receiving countries is sufficiently large, it is rational for individuals in the sending countries to acquire additional education and compete for a limited number of jobs in the destination countries. In the economics literature, this incentive scheme is known as a “tournament.” This section will briefly discuss and present the Nash equilibria of the tournament model both in its original form (an even tournament) and an important variant of the model (an uneven tournament). It will then argue that the wage level in the receiving country (w_H) is a function of screening (s) and show that the level of screening is positively related to the effort level (educational investment) of potential migrants.

3.1 Tournament Model

Initially formulated by Lazear and Rosen (1979), tournament models have been used to explain firm features such as job promotions and high CEO compensation. The tournament model formulated by Lazear and Rosen (1979) is a two-period game where firms offer a limited number of promotions and give rewards to the top performers. This dissertation will build its model of brain gain based on the theoretical framework provided by this model.

This is a two-period game where there are two identical workers whose utility function is given by:

$$U_k(w_k, e_k) = U(w_k) - c(e_k), \quad k = i, j \quad (3.1)$$

where:

w = the wage received.

e = the level of effort expended.

The output of each worker is:

$$y_k = f(e_k) + \epsilon_k, \quad k = i, j \quad (3.2)$$

where:

y_k = the observed output of each individual.

e_k = worker k 's effort level. For simplicity, assume that effort e_k lies in the interval $[0, 100]$.

ϵ_k = a stochastic term (luck). Assume that ϵ_k is distributed uniformly over the interval $[-\alpha, \alpha]$, $\alpha > 0$.

This dissertation assumes that both workers are from a developing country (country A) and both want to migrate to country B where wages are higher than wages in country A for all skill levels. Country B has a selective immigration system where all

potential migrants are subject to screening. The more skilled-worker (who produces more) can get a visa and migrate to country B where he or she earns a higher wage (w_H). Meanwhile, the less skilled person stays in country A and is paid a lower wage (w_L).

$C(e)$ represents the physical and psychological costs required to generate effort. In a *even* tournament, the cost for effort is the same for both contestants. One simple specification is given by:

$$C_k(e) = \frac{e_k^2}{c}, \quad k = i, j \quad (3.3)$$

where $C(e)$ is increasing and convex ($C' > 0$ and $C'' > 0$).

Meanwhile, in an *uneven* tournament - a variant of the original model - their cost functions are different, indicating that one worker has an advantage over the other worker. This model captures the reality that individuals, due to differences in talent and/or environment, have different costs for effort, with one worker facing higher costs and one worker facing lower costs for the same amount of effort.

This model assumes that worker i is the advantaged worker. The cost functions for i and j are defined as:

$$C_i(e) = \frac{e_i^2}{c} \quad (3.4)$$

$$C_j(e) = m \frac{e_j^2}{c}, \quad m > 1 \quad (3.5)$$

It can be shown that the Nash equilibrium for an even tournament is as follows:¹

$$e_i^* = e_j^* = \frac{(w_H - w_L) * c}{4\alpha} \quad (3.6)$$

¹ See Section A.1 in Appendix A for the solution to an even tournament.

Intuitively, the effort level of both workers in an even tournament is positively related to the wage differential between their home country and host country, meanwhile, it is negatively associated with the cost of effort ($1/c$) and the range of the uniform distribution of ϵ (Lazear and Rosen, 1979).

Similarly, the Nash equilibrium for a uneven tournament is defined as:²

$$e_j^* = \frac{c(w_H - w_L)/4m\alpha}{1 + [(1 - m)/4\alpha^2](c(w_H - w_L)/2\alpha)} \quad (3.7)$$

$$e_i^* = me_j^* \quad (3.8)$$

where i and j represent the advantaged and the disadvantaged workers and m denotes the ratio of the c values of i and j , respectively. Intuitively, the equilibrium effort level of both workers in a uneven tournament is determined by the following factors: the wage difference between migrant-sending and migrant-receiving countries [$w_H - w_L$], the cost of effort ($1/c$), the range of the stochastic term (α) and the differential in their cost of effort functions (m). In addition, the advantaged worker will expend more effort than the disadvantaged worker because the former bears less cost for the same amount of effort. The difference in effort between these two individuals is the same as the differential in their cost of effort functions.

The key insight from both even and uneven tournaments is that an increase in the wage spread [$w_H - w_L$] causes the equilibrium effort choice to rise. In other words, the difference between the wage offered in migrant-receiving countries and the domestic wage level in migrant-sending countries is a key driver of emigration. This conclusion is consistent with extant empirical evidence which shows that migration usually flows from low-wage to high-wage countries. As depicted in Figure 3.1, there is a strong positive correlation between immigration and the widening of the

² See Section A.2 in Appendix A for the solution to an uneven tournament.

income gap between migrant-receiving and migrant-sending countries. The slope of this linear regression line indicates that for every \$2,000 increase in the wage gap between receiving and sending countries, the probability of a migrant moving to a receiving country increases by 10 percent³ (World Bank, 2018).

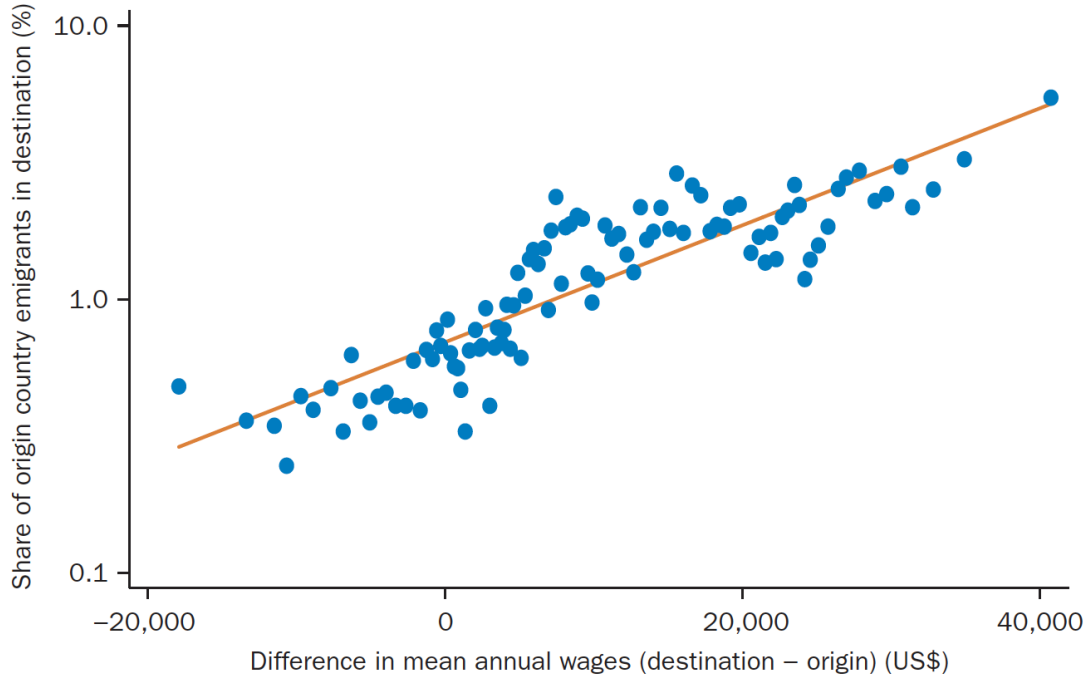


FIGURE 3.1: Wage Difference as a Key Driver of Migration
Source: World Bank (2018)

3.2 Wages in the Destination and Screening

This dissertation argues that the wage in the receiving country (w_H) is a function of screening (s) and that w_H and s are positively correlated with each other. Theoretically, less screening means a greater supply of foreign labor. Here the assumption is that immigrants are substitutes for domestic labor. Thus, a large influx of immi-

³ Control variables included in the regression are migrant-sending countries fixed effects, (log) distance, contiguity, linguistic similarity and (log) population of migrant-receiving countries (World Bank, 2018, 10).

grants generally decreases the wages of domestic workers. Conversely, more intense screening leads to a reduced supply of foreign labor and higher wages in migrant-receiving countries. Empirically, although there has not been a great deal of research concerning the direct relationship between screening and wages in migrant-receiving countries, scholars have found evidence that supports the proposed relationship between immigration and wages in migrant-receiving countries. For example, Borjas (2005) found that an increase in the number of foreign-born doctoral recipients has a significant adverse effect on the earnings of competing workers (native and foreign born) in migrant-receiving countries.

One simple specification for the relationship between w_H and s is the following:

$$w_H = as + b, \quad a > 0 \tag{3.9}$$

We will now look at how the intensity of screening affects the level of effort expended by each worker in both even and uneven tournaments.

For even tournaments:⁴

$$\frac{\partial e_k^*}{\partial s} = \frac{ac}{4\alpha}, \quad k = i, j \tag{3.10}$$

Recall that a is the coefficient of wage in the destination (w_H) on screening (s) (Equation 3.9), c is the cost for effort (Equation 3.3) and α is the width of the uniform distribution of ϵ_k - the stochastic term in both workers' output function (Equation 3.2). Given that $a > 0$, $c > 0$ and $\alpha > 0$:

$$\frac{\partial e_k^*}{\partial s} > 0, \quad k = i, j \tag{3.11}$$

⁴ See Section A.3 in Appendix A for the solution.

Similarly, for uneven tournaments:⁵

$$\frac{\partial e_i^*}{\partial s} = \frac{16ca\alpha^5}{[c(1-m)(as+b-w_L)+8\alpha^3]^2} \quad (3.12)$$

and

$$\frac{\partial e_j^*}{\partial s} = \frac{16ca\alpha^5}{m[c(1-m)(as+b-w_L)+8\alpha^3]^2} \quad (3.13)$$

Recall that m is the differential in the two workers' cost of effort functions (Equation 3.5). Because $a > 0$, $m > 0$ and $c > 0$:

$$\frac{\partial e_i^*}{\partial s} > 0 \quad (3.14)$$

and

$$\frac{\partial e_j^*}{\partial s} > 0 \quad (3.15)$$

Equations 3.11, 3.14 and 3.15 show that in both even and uneven tournaments, the more intense screening is, the more effort (educational investment) an individual is willing to expend in order to increase their chance to emigrate and earn higher wages. This yields the first proposition:

Proposition 1: More intense screening by migrant-receiving countries encourages potential migrants from migrant-sending countries to invest more in education.

Recall that for both even and uneven tournaments, the wage spread $[w_H(s) - w_L]$ is positively related to the equilibrium effort level (Equations 3.6, 3.7 and 3.8). This means a decrease in w_L will lead to an increase in the equilibrium effort level, which leads to the second proposition:

⁵ See Section A.4 in Appendix A for the solution.

Proposition 2: A decrease in the wage level in migrant-sending countries incentivizes potential emigrants to acquire a higher level of education.

Chapters 4 and 5 will describe in detail the two empirical tests used to evaluate *Proposition 1* and *Proposition 2* respectively.

Increase in screening post 9/11

This chapter tests the first proposition drawn from the theoretical discussion in Chapter 3:

Proposition 1: More intense screening by migrant-receiving countries encourages potential migrants from migrant-sending countries to invest more in education.

The main argument of this chapter (illustrated in Figure 4.1) is as follows. In the wake of the 9/11 terrorist attacks, U.S. Congress decided to tighten its visa control system as part of its broader efforts to combat terrorism. This led to fewer high-skilled immigrants coming into the country. As a result, average wages for high-skilled occupations in the U.S. increased, raising the wage differential for these professions between the U.S. and developing countries. This higher wage gap created an incentive for potential migrants from developing countries to move to the U.S. for better employment prospects. Because an undergraduate degree usually serves as a ticket to long-term employment in the U.S. (Rosenzweig et al., 2006; Bhagwati and Rao, 1999), it is rational for international students from developing countries to put efforts into gaining admission to an American college and leverage their degree to

get a high-paying job in the United States.

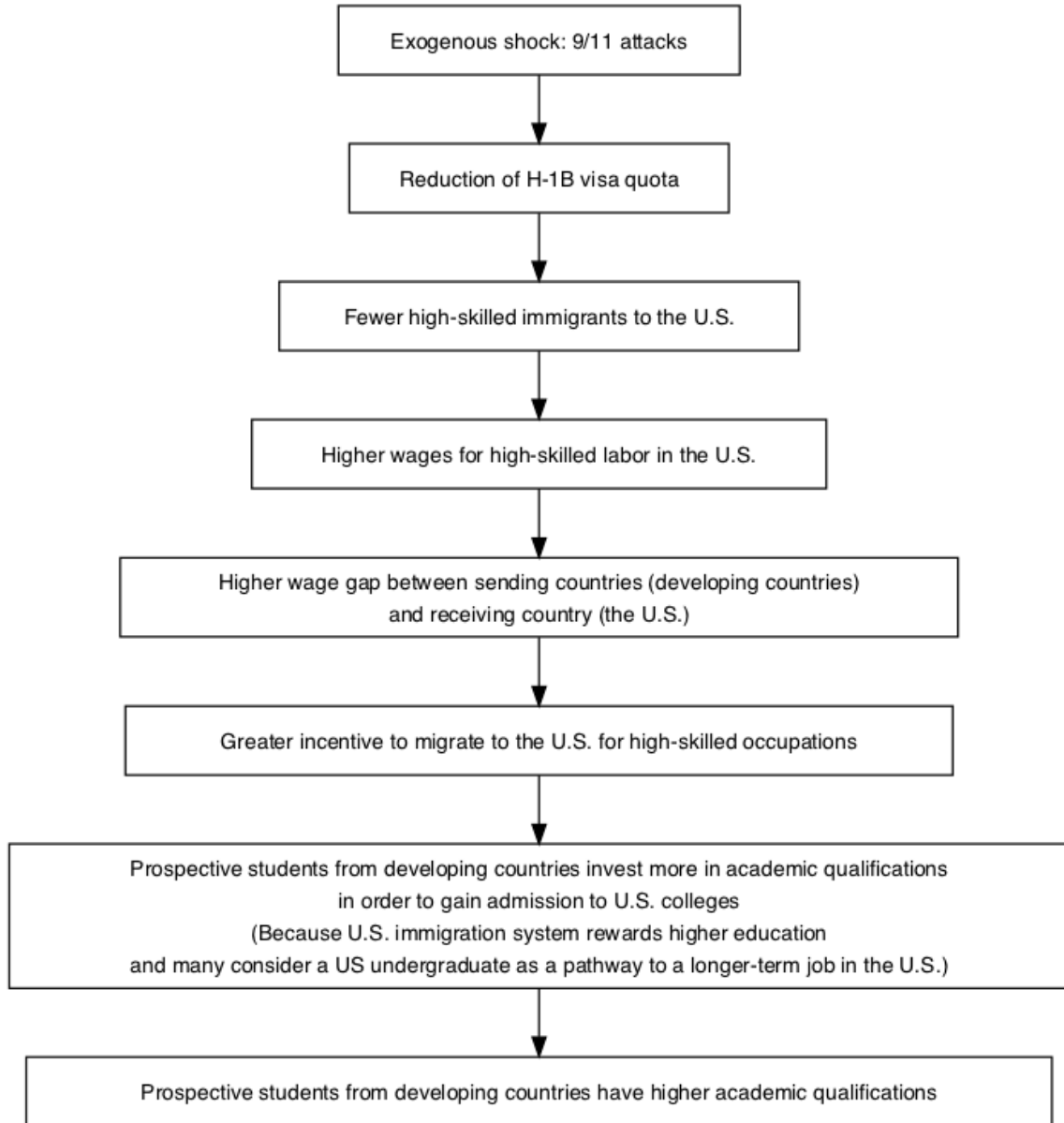


FIGURE 4.1: Causal Chain

The rest of this chapter is structured as follows. Section 4.1 provides a brief overview of the U.S. visa system and major changes post 9/11. Section 4.2 describes the identification strategy. Section 4.3 discusses data sources. Section 4.4 presents major empirical results. Section 4.5 provides robustness tests. Section 4.6 discusses a

potential response by migrant-sending countries to the new U.S. visa quota. Section 4.7 addresses an alternative explanation for the empirical findings of the chapter. Section 4.8 examines the generalizability of the main argument and Section 4.9 concludes.

4.1 Background Information

This section offers an overview of the U.S. immigration system and discusses significant policy changes post 9/11 with a focus on the H-1B visa.

4.1.1 U.S. Visa System

The two major U.S. visa categories are immigrant and nonimmigrant visas. The former gives immigrants the right to work and live permanently in the U.S. while the latter only allows foreign-born individuals to stay in the U.S. for a specific purpose and limited time.¹ There are five main types of immigrant visas. The first two are family-based and granted to foreign-born individuals who are “immediate relatives”² of U.S. citizens or lawful permanent residents.³ Designed to promote diversity in the U.S., the third type of immigrant visa is distributed through a lottery system to citizens of “low-admission states” who have sent few immigrants to the U.S. in the previous five years.⁴ The fourth immigrant visa type is reserved for refugees and asylees who have a “well-founded fear of persecution” in their home country.⁵ The last visa category is an employment-based visa which is divided into five sub-

¹ 8 U.S.C. 1101(a)(15).

² The term “immediate relatives” means the children, spouses, and parents of a U.S. citizen or permanent resident. 8 U.S.C. 1151(b)(2)(A)(i), 1153(a).

³ *Id.*

⁴ 8 U.S.C. 1151, 1153(c).

⁵ 8 U.S.C. 1101(a)(42).

categories including 1) priority workers⁶ 2) professionals holding advanced degrees⁷ or of exceptional ability⁸ 3) skilled workers, professionals and needed unskilled workers⁹ 4) special immigrants¹⁰ and 5) employment creation immigrants¹¹ (Goodrich, 2007).

While there are only five types of immigrant visas, there are at least twenty-five nonimmigrant visa categories.¹² Nonimmigrant visas are granted to individuals such as students,¹³ tourists¹⁴ and diplomats¹⁵ who seek to enter the U.S. temporarily.¹⁶ The H-visa is the main nonimmigrant visa type that allows foreign-born workers to work in the U.S.¹⁷ The H-visa is further divided into six types including 1) the H-1B

⁶ Priority workers are those whose “extraordinary ability in the sciences, arts, education, business, or athletics has been demonstrated by sustained national or international acclaim and whose achievements have been recognized in the field through extensive documentation” (8 U.S.C. 1153(b)(1)).

⁷ According to 8 U.S.C. 1153(b)(2), advanced degree means “any United States academic or professional degree or a foreign equivalent degree above that of baccalaureate.”

⁸ Exceptional ability in the sciences, arts, or business means “a degree of expertise significantly above that ordinarily encountered in the sciences, arts, or business” (8 C.F.R. 204.5(k)).

⁹ According to 8 U.S.C. 1153(b)(3), skilled workers are “qualified immigrants who are capable [...] of performing skilled labor (requiring at least 2 years training of experience); professionals are “qualified immigrants who hold baccalaureate degrees and who are members of the professions”; and needed unskilled workers are “qualified immigrants who are capable [...] of performing unskilled labor, for which qualified workers are not available in the United States.”

¹⁰ Examples of special immigrants are religious workers and employees of the U.S. government abroad (Goodrich, 2007). See 8 U.S.C. 1153(b)(1) for the definition and more examples of “special immigrants.”

¹¹ This type of visa is granted to individuals who has invested or is in the process of investing capital in an amount not less than \$1,000,000 which will “benefit the United States economy and create full-time employment for not fewer than 10 United States citizens or aliens lawfully admitted for permanent residence or other immigrants lawfully authorized to be employed in the United States” (8 U.S.C. 1153(b)(1)).

¹² “Directory of Visa Categories,” U.S. Department of State, Bureau of Consular Affairs, accessed November 18, 2018, <https://travel.state.gov/content/travel/en/us-visas/visa-information-resources/all-visa-categories.html>.

¹³ 8 U.S.C. 1101(a)(15)(F)(i).

¹⁴ 8 U.S.C. 1101(a)(15)(B).

¹⁵ 8 U.S.C. 1101(a)(15)(A).

¹⁶ 8 U.S.C. 1101(a)(15)(F).

¹⁷ 8 U.S.C. 1101(a)(15)(H).

for professionals¹⁸ 2) the H-1C for nurses¹⁹ 3) the H-2A for temporary agricultural workers²⁰ 4) the H-2B for temporary non-agricultural workers²¹ 5) the H-3 for individuals seeking training in the U.S.²² and 6) the H-4 for the spouse and children of individuals who hold a H-1, H-2 or H-3 visa²³ (Goodrich, 2007). This chapter will focus on the H1-B visa which is the major visa type through which foreign-born professionals gain entry into the United States.²⁴ As discussed in Chapter 2, the H-1B visa petition system is an effective screening tool for choosing the most qualified foreign-born workers by imposing considerable costs for hiring non-U.S. citizens on U.S. companies. This means U.S. companies are highly likely to hire non-U.S. citizens only if they surpass all U.S. applicants who apply for the same job. The next section will discuss how the 9/11 terrorist attacks affected the U.S. immigration system in general and the H-1B visa in particular.

4.1.2 Changes in U.S. Visa System Post 9/11

The 9/11 attacks were a series of coordinated airplane hijackings and suicide attacks by Islamist terrorist group Al-Qaeda against the United States. On September 11, 2001, nineteen terrorists hijacked four commercial planes flying out of the U.S. East Coast, two of which crashed into the Twin Towers of the World Trade Center in New York and the third hit the Pentagon in Virginia. The last plane was flown toward Washington DC but crashed into a field in Pennsylvania. Nearly 3,000 people died

¹⁸ 8 U.S.C. 1101 (a)(15)(H)(i)(b).

¹⁹ 8 U.S.C. 1101 (a)(15)(H)(i)(c).

²⁰ 8 U.S.C. 1101(a)(15)(H)(ii)(a).

²¹ 8 U.S.C. 1101(a)(15)(H)(ii)(b).

²² 8 U.S.C. 1101(a)(15)(H)(iii).

²³ Id.

²⁴ See Chapter 2 for information on the selection process of the H-1B visa.

and 6,000 others were injured in the attacks.²⁵ In the wake of the attacks, President George W. Bush declared “a war on terror” and made counter-terrorism a top policy priority.²⁶

Given that all 19 terrorists were foreign nationals who entered the U.S. with legally issued visas, the Bush administration decided to strengthen the visa control system as part of its expansive national security policy. In 2003, U.S. Congress reduced the number of H-1B visas for highly-skilled foreign-born workers from 195,000 to 65,000 for fiscal year 2004 and beyond. This new H-1B quota has been binding since 2004 and remains in effect today. Because many international students consider an American undergraduate degree as a pathway to a long-term job in the U.S. (Rosenzweig et al., 2006; Bhagwati and Rao, 1999), prospective students who were considering enrolling in a U.S. college in Fall 2004 expected a more competitive labor market in the U.S. and adjusted their level of resource investment into the U.S. college application process accordingly.

Those who were not affected by the H-1B policy change were applicants from five countries including Australia, Canada, Chile, Mexico and Singapore. This is because their free trade agreements with the U.S. created visa categories similar to the H-1B visa but were not subject to a fixed number of visa issued. As previously stated, this dissertation will focus on Mexico because, of these countries, it sends the largest number of migrants to the U.S. The North American Free Trade Agreement (NAFTA) created the TN visa (trade NAFTA) for Mexican citizens which serves as a substitute for the H-1B visa because there is no limit to the number of TN visas that can be issued. As shown in Figure 4.2, applicants from Mexico have indeed chosen

²⁵ “September 11 Terror Attacks Fast Facts,” *CNN*, September 3, 2018, accessed October 17, 2018, <https://www.cnn.com/2013/07/27/us/september-11-anniversary-fast-facts/index.html>.

²⁶ Thrall, A. Trevor and Erik Goepner. “Step Back: Lessons for U.S. Foreign Policy from the Failed War on Terror,” *CATO Institute*, June 26, 2017, accessed November 20, 2018: <https://www.cato.org/publications/policy-analysis/step-back-lessons-us-foreign-policy-failed-war-terror>.

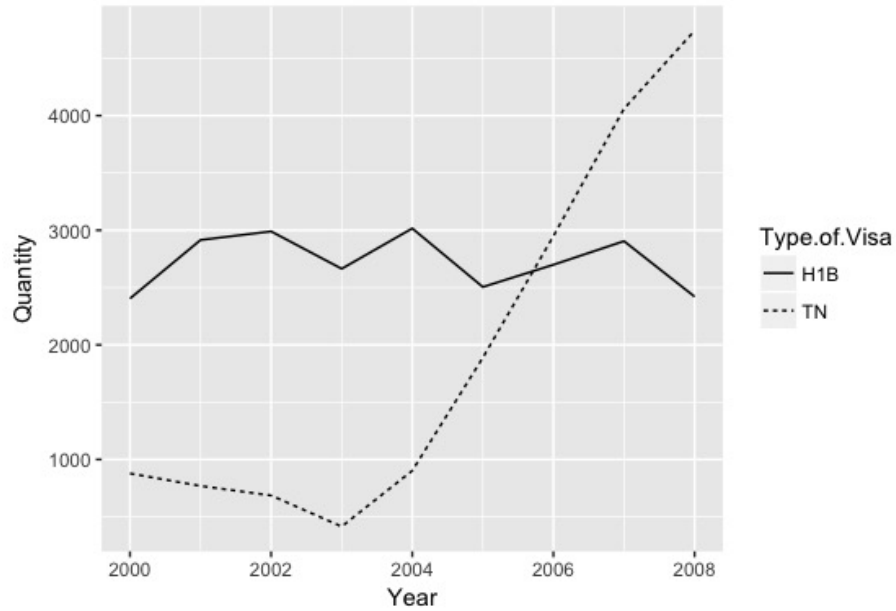


FIGURE 4.2: H-1B Issuances and Undergraduate Enrollment
Source: U.S. Department of State

this alternative visa type after the implementation of the H-1B quota reduction in 2003. Thus, Mexican citizens were largely unaffected by the H-1B policy changes. In this dissertation’s research design, potential migrants from Mexico form the control group and those from all other developing countries make up the treatment group.

This chapter will utilize a synthetic case control approach to estimate the effect of the H-1B cap reduction on the academic achievement of prospective students from migrant-sending countries. From the above, I expect that:

H1: Limits on H-1B visas led to an increase in the academic qualifications of prospective students from migrant-sending countries.

4.2 Research Design

4.2.1 Synthetic Control Method

The main challenge in studying the effect of the H-1B cap reduction on the academic qualifications of prospective students is finding a credible counterfactual. The proper

comparison would be between a Mexico which was exempt from the policy change and a Mexico that was not. Unfortunately, we cannot observe the latter. One option would be to select a single country that shared many of Mexico’s characteristics prior to the U.S. decision to tighten H-1B immigration and was subject to the visa quota reduction. If the outcome variable of interest was similar in both countries prior to the policy change, then we might infer that the difference in the academic ability of prospective students between the treated country and Mexico was indeed caused by the treatment. However, no single country is an obvious counterfactual of Mexico - a middle-income country which shares a long border with the U.S. and is the source country of the largest foreign-born group in the U.S., and sends among the most number of students to American colleges.²⁷ Some countries share some of these relevant characteristics (China, India, Vietnam, Cuba, El Savador, Dominican Republic), but no country shares all of them.

To solve this problem, this dissertation adopts a synthetic case control strategy introduced by Abadie and Gardeazabal (2003). The main idea of this methodology is that a weighted average of all other developing economies can form a “synthetic” Mexico that is more similar to Mexico than any single country across all important pre-treatment characteristics. In other words, this approach does not require any control unit to be “the perfect counterfactual,” which makes it an appealing method given that convincing counterfactuals rarely exist (Pepinsky and Wihardja, 2011, 343). In addition, it provides a “data-driven procedure” to construct a counterfactual from all possible control cases and shows the relative contribution of each control unit to the synthetic counterfactual (Abadie et al., 2010). Furthermore, while a simple difference-in-difference method assumes that the effect of unobservable confounders on the main variable of interest is time-invariant, the synthetic control method allows

²⁷ “Mexican Immigrants in the United States,” *Migration Policy Institute*, October 11, 2018, accessed November 23, 2018, <https://www.migrationpolicy.org/article/mexican-immigrants-united-states>.

for this effect to vary over time (Abadie et al., 2010).

Let Y_1 stand for the post-treatment outcome in the treated case. Let X_1 stand for the determinants of that outcome in the treated case. Let Y_0 stand for the outcome in the control case (Mexico) and let X_0 stand for the determinants of Y_0 in the control case (Mexico). A weighted average of them form a synthetic Mexico. The weights W^* are chosen from all possible weights in order to minimize the difference between the synthetic unit and Mexico prior to the intervention. In this chapter, this means choosing W^* to produce a synthetic Mexico whose determinants of prospective students' academic qualifications is as similar as possible prior to the visa quota reduction. The prospective students' level of academic achievement in synthetic Mexico after 2003 simulates the counterfactual of Mexican students' academic qualifications had Mexico been subject to the H-1B restriction.

When studying the effect of a specific policy, it is common for researchers to include a time lag which consists of two components: an *inside lag* and an *outside* or *response lag*. An *inside lag* refers to the time it takes to 1) identify the nature and sources of the problem 2) estimate the magnitude of the problem 3) determine an appropriate policy and 4) implement the policy (Dwivedi, 2005). An *outside lag* refers to the time period between the moment when a policy is implemented and when individuals, households and firms start to react to the policy. Outside and inside lags are usually applied in the context of monetary and fiscal policy. To the best of my knowledge, no studies to date have examined the average length of either the inside or outside lag of immigration policies. Only the outside lag is relevant to this study because we are looking at how perspective foreign students responded to the H1-B policy change *after* the change was implemented.

Following the adoption of the new visa cap, it is reasonable to assume that it took some time for prospective international students to become aware of the new legislation and realize the U.S. labor market had become more competitive. As a

result, less talented students were likely to stay in their home countries or apply elsewhere. Meanwhile, those who were more academically prepared would invest more in their SAT preparation in the hope of leveraging an American college degree to enter the U.S. labor market and earn high wages. Thus, these students would be motivated to take action to enhance their chances of admission. Studies show that most students who took the SAT used some form of SAT preparation, whether it is taking a course offered by a test preparation company or receiving private one-on-one tutoring or using test preparation books and computer software (Powers, 1988; Powers and Rock, 1998). Roughly half of the students take the SAT multiple times because their scores usually improve when they retake the exam (Vigdor and Clotfelter, 2003). Given that:

- a) the new visa cap was introduced in October 2003,
- b) most of the students take the exam twice, once each in their junior and senior years,²⁸
- c) there are only four SAT test dates offered annually outside of the U.S.,²⁹ and
- d) the average preparation time for the SAT is 3-6 months,³⁰

I expect to see the effect of the new policy on international prospective students' SAT score in 2005. Thus, a two-year lag for the SAT score variable will be included in the model.

²⁸ "Multiple choice for SAT takers," *LA Times*, June 21, 2008, accessed December 27, 2017: <http://articles.latimes.com/2008/jun/21/local/me-sat21>.

²⁹ Every year the SAT is offered internationally in October, December, March and May. "International Registration," *College Board*, accessed December 26, 2017, <https://collegereadiness.collegeboard.org/sat/register/international>.

³⁰ Test preparation companies usually advise students to start preparing for the SAT 3 to 6 months in advance. I gathered this information from conversations with consultants at Kaplan and the Princeton Review, two of the most well-known SAT test preparation companies in the U.S. and globally.

4.2.2 Multiple Imputation

In order to construct a synthetic Mexico, I selected a set of macro-economic variables that have been shown to be reliable predictors of educational achievement/SAT score such as GDP per capita, GDP growth rate and educational expenditures. A list of all predictors used in the model appears in Table B.1 in Appendix C.

From the World Bank's World Development Indicators database (The World Bank, 2018), I collected information on 15 predictors for 217 countries over a time period of 9 years between 2000 and 2008. Due to the spotty reporting of macro-economic variables of a number of countries, there are 15,053 missing cells out of 29,295 (51.3%) in the country-year matrix. To address this issue, I formulated an imputation model and created five imputed datasets of predictors of SAT score. This process predicts the missing values using the observed information in the dataset. I then used the imputed datasets to test my hypotheses.

One potential concern is that multiple imputation can introduce bias. While this is plausible, I argue that other alternatives to multiple imputation would lead to even greater bias. For example, listwise deletion (excluding an entire record from the analysis if any single value is missing) would produce more bias because countries which were not able to produce basic macro-economic data such as GDP per capita and educational expenditures are likely to have characteristics directly correlated with their level of human capital/SAT score. For example, these are likely low-income countries with poorly educated populations and lower SAT score. In general, multiple imputation has been shown to reduce bias and increase efficiency compared to other approaches to data with missing values such as listwise deletion and mean imputation (Honaker et al., 2011).

The relatively smaller bias produced by multiple imputation in the empirical findings of this chapter is that it reduces the actual variation and weights of the

predictors in the model. This means some predictors had less influence in driving the selection of countries that form the synthetic Mexico than they would have if we had the actual data.

4.3 Data and Model Specifications

4.3.1 *Dependent Variable*

This dissertation uses the Scholastic Assessment Test (SAT) score to measure investment in education for several reasons. First, because most U.S. colleges require the SAT for international students, investment in SAT preparation (studying for the SAT, taking multiple practice tests, hiring a SAT tutor, etc.) is crucial for a foreign-born student who wants to gain admission to an American college. Furthermore, their SAT score should be highly correlated with their level of SAT preparation. In addition, although some scholars have argued that GPA is a preferred measure of educational outcome, the use of the SAT is more useful when comparing students from very different countries and grading systems (Kato and Sparber, 2013). The SAT has three sections - math, verbal and writing - and the maximum score on each section is 800. Note that the dataset provided by the College Board only reports the SAT math, verbal and total scores.

4.3.2 *Data*

The data are from the College Board's Annual Survey of Colleges³¹ which provides a sample of 67,735 foreign-national high school seniors who took the SAT outside the U.S. between 2000 and 2008. Even though students can take the SAT multiple times, this dataset only records the score of the last SAT exam that the students took. The dataset also includes demographic information of the students. Summary statistics

³¹ I wish to thank Drs. Takao Kato and Chad Sparber for their help in obtaining the data from the College Board.

of all variables included in the model are shown in Table 4.1.

Table 4.1: Descriptive Statistics

Statistic	N	Mean	St. Dev.	Min	Max
SAT Total Score	67,735	1,156.5	191.2	410	1,600
SAT Verbal Score	67,735	534.3	103.2	200	800
SAT Math Score	67,735	622.2	114.7	200	800
Bound by H1-B Visa Cap	67,735	0.7	0.5	0	1
White	67,735	0.1	0.3	0	1
Black	67,735	0.1	0.3	0	1
Asian	67,735	0.4	0.5	0	1
Hispanic	67,735	0.1	0.3	0	1
Other Nonwhite Race	67,735	0.1	0.3	0	1
Female	67,723	0.5	0.5	0	1
GPA	58,677	3.5	0.6	0.0	4.3
Mother's Education: \geq Bachelor's Degree	58,854	0.7	0.5	0	1
Father's Education: \geq Bachelor's Degree	58,694	0.8	0.4	0	1

4.4 Empirical Results

This dissertation chooses a sample of 35 developing countries³² for which SAT data are available for the time period between 2000 and 2008.

Table 4.2 displays data on pre-treatment predictors for Mexico and its synthetic unit as well as the average of all treatment cases and the weights of each treated country to the synthetic unit. This table shows that a weighted average of all treated countries (in the ‘Synthetic’ column) is an improvement over a simple average of all of them (in the ‘Sample Mean’ column) for more than half of the predictors. This further confirms that the synthetic control method provides a more accurate estimates than a simple difference-in-difference analysis.

³² According to the World Bank’s country classification, developing countries are defined as those with a gross national income (GNI) per capita, calculated using the World Bank Atlas Method, between \$1,005 and \$12,235.

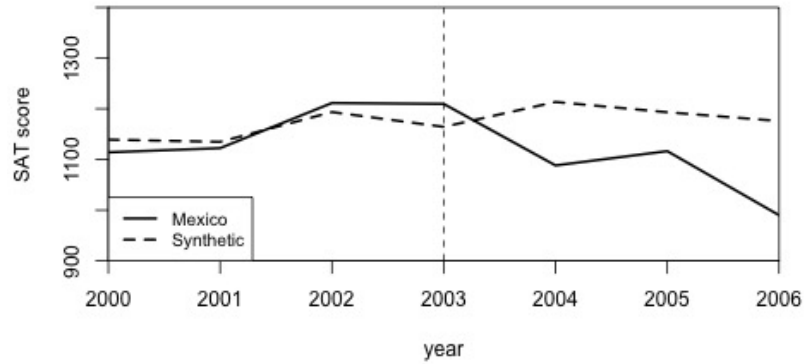
Table 4.2: Pre-Treatment Predictors Balance and Relative Contributions of Countries

Predictors	Mexico	Model 1		Model 2	
		<i>Synthetic</i>	<i>Sample Mean</i>	<i>Synthetic</i>	<i>Sample Mean</i>
Expenditure on Education	20.914	17.037	16.445	16.959	15.637
Expenditure on Primary Education	8.178	7.155	6.502	8.567	6.342
Expenditure on Post-Secondary Education	0.359	0.608	0.547	0.667	0.534
Expenditure on Secondary Education	6.340	4.230	5.183	3.398	4.703
Expenditure on Tertiary Education	3.931	3.539	3.331	3.077	3.082
Gross Domestic Product (GDP)	11909.663	27196.983	9758.403	6599.622	9243.168
GDP Growth Rate	2.569	3.151	4.994	4.032	4.125
Population	107315682.9	9982009.125	111104253.1	25649449.299	11758080.980
Pupil-Teacher Ratio in Primary Education	27.609	25.538	28.425	30.182	25.235
Pupil-Teacher Ratio in Secondary Education	17.49	15.37	20.397	18.808	17.673
Pupil-Teacher Ratio in Tertiary Education	9.536	10.665	18.255	13.969	15.641
Expenditure per Primary Student	2045.239	4487.331	2107.118	1003.064	1960.425
Expenditure per Post-Secondary Student	13438.762	12030.180	9413.499	11368.291	9210.889
Expenditure per Secondary Student	2270.952	6070.265	2746.218	927.906	2530.824
Expenditure per Tertiary Student	6667.654	17470.429	6004.427	3187.878	5112.522
Relative Weight			Model 1		Model 2
		Guatemala	0.082	Colombia	0.43
		Haiti	0.417	Guatemala	0.57
		Honduras	0.005		
		Malaysia	0.331		
		Trinidad and Tobago	0.164		

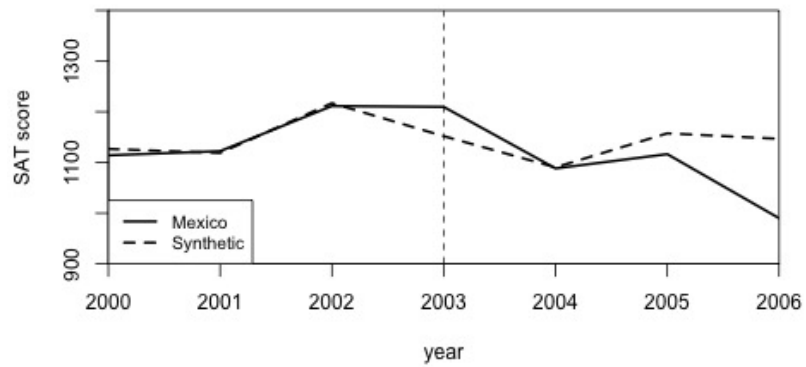
Model 1 uses all 35 developing countries for which SAT data are available while Model 2 includes only those in Latin America (11 in total). The weights reported in this table indicate that SAT trends in Mexico prior to 2003 is best reproduced by a combination of five countries in Model 1 (Guatemala, Haiti, Honduras, Malaysia and Trinidad and Tobago) and two countries in Model 2 (Colombia and Guatemala). All other countries in the sample received zero weights. A list of countries used in Model 1 and 2 is included in Table B.2 in Appendix C.

The main results appear in Figure 4.3 which shows the two-year lagged SAT scores from 2000 to 2008 of foreign applicants from Mexico (solid line) and from the synthetic case (dashed line). The vertical line at 2003 marks the beginning of the H-1B cap reduction. There are two important conclusions one can draw from this figure. First, the synthetic SAT score prior to 2003 tracks closely to that of prospective students from Mexico in both Model 1 and 2. The estimate of the effect of the H-1B quota reduction is the difference between the average SAT score of prospective Mexican students and its synthetic version after the policy change. As depicted in this figure, immediately after the policy change went into effect, the two lines started to diverge noticeably. More importantly, after 2004, while the synthetic SAT score was on a slightly downward trend, the real SAT score of prospective students from Mexico experienced a sharp decrease. The discrepancy between the two lines suggest a positive effect of the new visa quota on the academic achievement of prospective international students in visa-capped countries.

Instead of tracking the average scores over time, Figure 4.4 plots the yearly estimates of the impact of the new H-1B visa cap, that is, the yearly gaps between the SAT score of Mexican applicants and its synthetic version over time. In both Model 1 and 2, the scores between the two groups were similar in the pre-treatment period (the line is very close to the horizontal line at 0). This suggests the H-1B restrictions had a considerable impact on the SAT scores of prospective international students



(a) Model 1: All Developing Countries



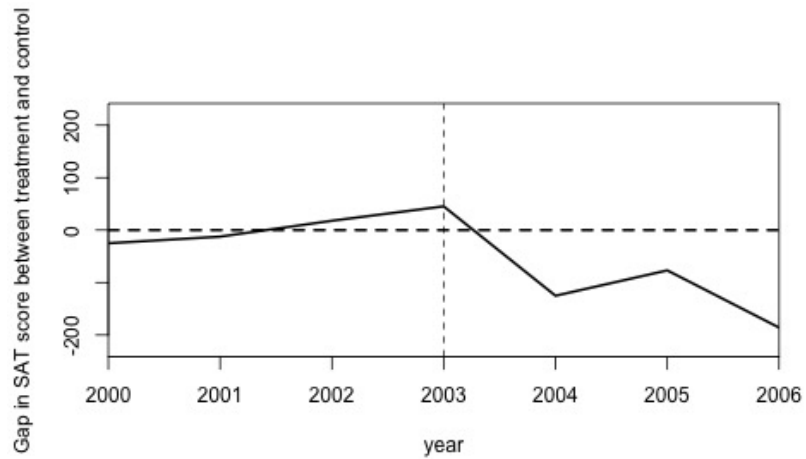
(b) Model 2: Latin America

FIGURE 4.3: Average SAT Score of Prospective Students: Mexico vs. Synthetic Mexico

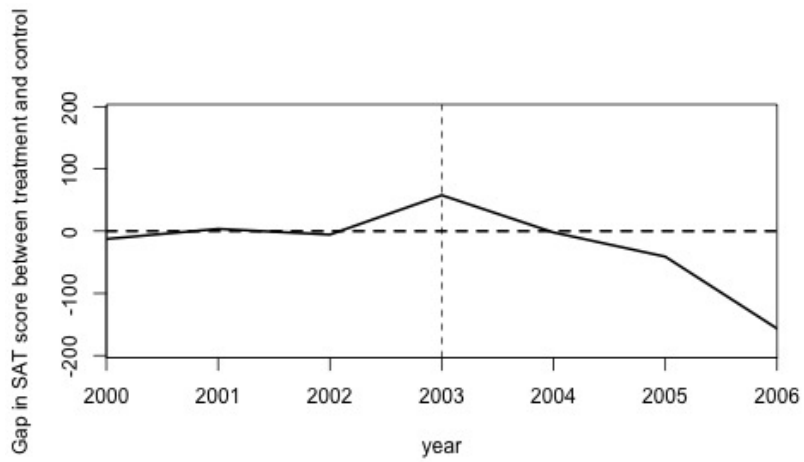
and that this effect increased over time.

4.5 Robustness Tests

This section presents several robustness checks including placebo tests and two difference-in-difference analyses.



(a) Model 1: All Developing Countries



(b) Model 2: Latin America

FIGURE 4.4: Difference in Average SAT Score of Prospective Students: Mexico vs. Synthetic Mexico

4.5.1 Placebo Tests

Following Abadie and Gardeazabal (2003), I run placebo tests by constructing a synthetic unit for each treated state in the sample. If these placebo tests produce

gaps similar to the one estimated for Mexico, then the analysis fails to provide evidence for the effect of the H-1B visa reduction. On the other hand, if the placebo tests show that the gaps for Mexico are very small before 2003 and become unusually large afterward, then we can trust that the positive effect of the new quota on the SAT score of prospective students is significant.

Figure 4.5 shows the results of the placebo tests for both Model 1 and 2. The thick blue line is the difference between the synthetic SAT score and the average score of Mexican applicants over time (also shown in Figure 4.4). Each thin blue line represents a similar estimate for each country in the sample. The thick line associated with the synthetic unit differentiates itself from the rest with small gaps prior to the treatment (before 2003) and large gaps afterward. These results suggest that the reduction of H1-B visa cap had a considerable positive effect on the academic qualifications of foreign-born prospective students.

4.5.2 *Difference-in-Difference Analysis: Mexico vs. Other Developing Countries*

In this section, I compare the 2000-to-2008 change in the SAT score of prospective students from Mexico and that of prospective students from other developing countries, using the following specification:

$$Y_{it} = \alpha + T_t\beta + X_{it}\delta + \gamma_c + \epsilon_{it} \quad (4.1)$$

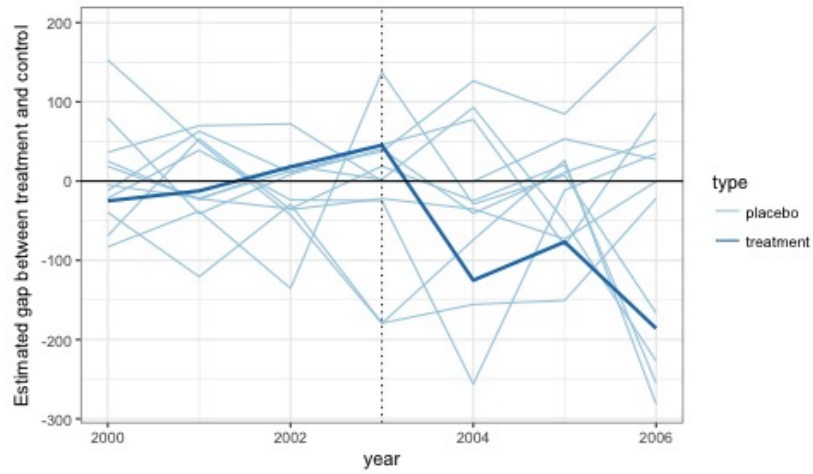
where:

Y_{it} = the average SAT score at time t .

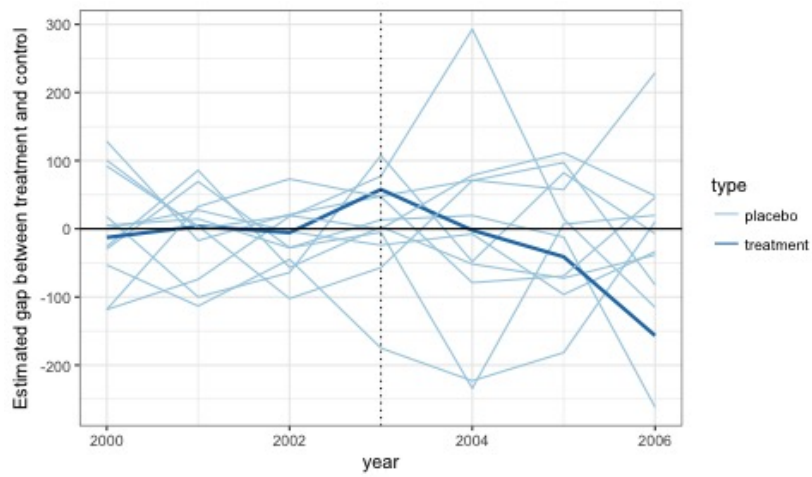
T_t = a dummy variable which equals 0 for students who took the exam on or before October 2003 and those from Mexico in any year. This variable equals 1 for all other observations.

X_{it} = a vector of control variables such as gender, race and parental education.

γ_c controls for country fixed effects.



(a) Model 1: All developing Countries



(b) Model 2: Latin America

FIGURE 4.5: Placebo Test Results

Baseline results for total SAT scores, verbal and math scores are presented in columns 1, 4 and 7 in Table 4.3, respectively. The estimated coefficients on the main independent variable (whether the H-1B visa cap reduction applies) are positive and statistically significant at the 95% level. The results indicate that the new limit on

H1-B visas increased the average SAT score for prospective international students by 16 points, verbal score by 7 points and math score by 9 points.

Columns 2, 5 and 8 depict the results when we control for country and year fixed effects and for applicant characteristics which may correlate with the applicants' academic quality. Added controls include applicant's gender, race, GPA and parental education. The estimated coefficients remains positive and statistically significant. The size of the coefficients on the total score and verbal score increases by 1 and 4 points respectively when additional controls are included. Meanwhile, the coefficient on the math score decreases by 3 points.

Columns 3, 6 and 9 show the results when we include a two-year lag for all three dependent variables while controlling for country and year fixed effects. The sign and size of the coefficients change little and remain statistically significant. Both the coefficients on the total score and verbal score increase by 1 point and that on the math score increases by less than half a point.

Table 4.4 presents the results of the analysis with log scores as the dependent variables. Similar to Table 4.3, columns 1, 3 and 5 depict baseline results while columns 2, 4 and 6 present the OLS estimates when country and year fixed effects are included. The coefficients continue to be positive and significant, indicating that a lower H-1B cap boosts prospective students' SAT total score by 0.6%, verbal score by 0.6% to 0.9% and math score by 0.4% to 0.7%.

Table 4.3: Difference-in-Difference Results: Mexico vs. Other Developing Countries

	<i>Dependent variable:</i>								
	SAT Total Score			SAT Verbal Score			SAT Math Score		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Bound by H1B Visa Cap	16.795*** (1.528)	17.398*** (1.424)	18.856*** (1.527)	7.001*** (0.825)	11.281*** (0.877)	12.331*** (0.919)	9.795*** (0.915)	6.117*** (0.799)	6.525*** (0.851)
Asian		2.785 (4.215)	-4.062 (4.518)		-4.644* (2.594)	-6.586** (2.720)		7.428*** (2.364)	2.523 (2.519)
Black		-30.175*** (4.921)	-32.167*** (5.275)		-8.501*** (3.029)	-11.974*** (3.176)		-21.674*** (2.760)	-20.193*** (2.941)
Hispanic		-56.364*** (5.687)	-45.419*** (6.097)		-17.999*** (3.500)	-17.259*** (3.671)		-38.366*** (3.190)	-28.160*** (3.399)
Other Nonwhite Race		-21.031*** (4.365)	-21.236*** (4.678)		-10.326*** (2.686)	-11.199*** (2.816)		-10.705*** (2.448)	-10.037*** (2.608)
White		-12.786*** (4.764)	-17.448*** (5.106)		0.913 (2.932)	-4.647 (3.074)		-13.699*** (2.672)	-12.801*** (2.847)
Female		-30.484*** (1.295)	-22.918*** (1.389)		2.923*** (0.797)	1.116 (0.836)		-33.407*** (0.726)	-24.034*** (0.774)
GPA		116.251*** (1.112)	82.640*** (1.193)		55.362*** (0.684)	39.417*** (0.718)		60.889*** (0.624)	43.223*** (0.665)
Mother's Education: B.A.		26.006*** (1.583)	21.163*** (1.697)		16.990*** (0.974)	13.624*** (1.022)		9.016*** (0.888)	7.539*** (0.946)
Father's Education: B.A.		40.544*** (1.859)	31.382*** (1.993)		25.166*** (1.144)	19.230*** (1.200)		15.378*** (1.043)	12.152*** (1.111)
Constant	1,145.355*** (1.211)	542.206*** (6.323)	638.967*** (6.778)	529.389*** (0.654)	267.640*** (3.891)	318.609*** (4.081)	615.966*** (0.725)	274.565*** (3.546)	320.357*** (3.779)
Country FE	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes
Year FE	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes
Observations	67,735	51,753	51,694	67,735	51,753	51,694	67,735	51,753	51,694
R ²	0.002	0.446	0.370	0.001	0.276	0.210	0.002	0.515	0.454
Adjusted R ²	0.002	0.446	0.369	0.001	0.275	0.209	0.002	0.515	0.454

Notes: Regressions employ OLS (* $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$). Data are from the College Board's Annual Survey of Colleges from 2000 to 2008. Data before 2003 serve as the pretreatment data for the analysis.

Table 4.4: Difference-in-Difference Results: Mexico vs. Other Developing Countries

	<i>Dependent variable:</i>					
	ln(SAT Total Score)		ln(SAT Verbal Score)		ln(SAT Math Score)	
	(1)	(2)	(3)	(4)	(5)	(6)
Bound by H1B Visa Cap	0.006*** (0.001)	0.006*** (0.001)	0.006*** (0.001)	0.009*** (0.001)	0.007*** (0.001)	0.004*** (0.001)
Asian		0.001 (0.002)		-0.003 (0.002)		0.005*** (0.002)
Black		-0.013*** (0.002)		-0.008*** (0.003)		-0.018*** (0.002)
Hispanic		-0.022*** (0.002)		-0.014*** (0.003)		-0.027*** (0.002)
Other Nonwhite Race		-0.009*** (0.002)		-0.008*** (0.002)		-0.009*** (0.002)
White		-0.004** (0.002)		0.002 (0.003)		-0.009*** (0.002)
Female		-0.012*** (0.001)		0.003*** (0.001)		-0.025*** (0.001)
GPA		0.046*** (0.0004)		0.047*** (0.001)		0.047*** (0.0005)
Mother's Education: B.A.		0.010*** (0.001)		0.014*** (0.001)		0.007*** (0.001)
Father's Education: B.A.		0.017*** (0.001)		0.023*** (0.001)		0.013*** (0.001)
Constant	3.052*** (0.0005)	2.803*** (0.003)	2.715*** (0.001)	2.488*** (0.003)	2.781*** (0.001)	2.506*** (0.003)
Country FE	No	Yes	No	Yes	No	Yes
Year FE	No	Yes	No	Yes	No	Yes
Observations	67,735	51,753	67,735	51,753	67,735	51,753
R ²	0.002	0.449	0.001	0.276	0.001	0.512
Adjusted R ²	0.002	0.449	0.001	0.275	0.001	0.512

Notes: Regressions employ OLS (* $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$). Data are from the College Board's Annual Survey of Colleges from 2000 to 2008. Data before 2003 serve as the pretreatment data for the analysis.

4.5.3 Difference-in-Difference Analysis: Mexico vs. Brazil

In this section, I will compare the change in the SAT score of prospective students from Mexico and the SAT score of prospective students from Brazil. Brazil was selected for this analysis because, like Mexico, it is in the top ten of sender countries of students to U.S. universities³³ I will use the following specification for this analysis:

$$Y_{it} = \alpha + T_t\beta + X_{it}\delta + \gamma_c + \epsilon_{it} \quad (4.2)$$

where:

Y_{it} = the average SAT score at time t .

T_t = a dummy variable which equals 0 for students who took the exam on or before October 2003 and those from Mexico in any year. This variable equals 1 for all other observations.

X_{it} = a vector of control variables such as gender, race and parental education.

γ_c controls for country fixed effects.

The results of this analysis are presented in Table 4.5. Baseline results for total SAT scores, verbal and math scores are shown in columns 1, 4 and 7, respectively. The estimated coefficients on the main explanatory variable (bound by H-1B visa quota) are positive and statistically significant at the 95% level. The new visa cap increased the SAT total score, verbal and math scores for prospective students from Brazil by 28, 15 and 12 points, respectively.

Columns 2, 5 and 8 present the results when we include applicant characteristics and country and year effects in the regression. The results remain positive and statistically significant. The coefficients on the total score and verbal score both decrease by 6 points while the coefficient on the math score increases by 1 point.

³³ Jackson, Abby. "The 10 foreign countries that send the most students to American colleges," *Business Insider*, November 20, 2016, assessed February 20, 2019, <https://www.businessinsider.com/countries-send-most-students-american-colleges-2016-11>.

Columns 3, 6 and 9 depict the regression results when I include a two-year lag for all three dependent variables while controlling for country and year fixed effects. The coefficients remain positive and statistically significant. The coefficient on the total score and verbal score decrease by 1 and 2 points, respectively while the coefficient on the math score slightly increases by less than half a point.

These findings are consistent with the main results of the synthetic control analysis and provide additional empirical evidence for the central argument of this chapter.

Table 4.5: Difference-in-Difference Results: Mexico vs. Brazil

	<i>Dependent variable:</i>								
	SAT Total Score			SAT Verbal Score			SAT Math Score		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Bound by H1B Visa Cap	28.089*** (6.580)	22.877*** (7.572)	21.516*** (8.194)	15.729*** (3.767)	9.555** (4.617)	7.853 (4.818)	12.360*** (3.828)	13.321*** (4.402)	13.663*** (4.787)
Asian		99.299*** (19.979)	92.329*** (21.649)		-1.959 (12.184)	2.817 (12.728)		101.258*** (11.615)	89.512*** (12.648)
Black		-5.159 (18.055)	9.587 (19.548)		-16.980 (11.011)	-7.412 (11.493)		11.821 (10.497)	16.998 (11.421)
Hispanic		-11.810 (23.973)	13.181 (25.948)		-33.427** (14.620)	-11.626 (15.256)		21.617 (13.937)	24.807 (15.160)
Other Nonwhite Race		5.721 (18.667)	18.162 (20.207)		-17.981 (11.384)	-8.829 (11.881)		23.702** (10.853)	26.991** (11.806)
White		-31.314*** (5.552)	-11.177* (6.010)		-1.961 (3.386)	1.756 (3.534)		-29.353*** (3.228)	-12.933*** (3.511)
Female		118.630*** (5.296)	79.511*** (5.733)		61.306*** (3.230)	42.978*** (3.371)		57.324*** (3.079)	36.533*** (3.350)
GPA		23.250*** (6.698)	21.047*** (7.251)		9.897** (4.085)	7.426* (4.263)		13.354*** (3.894)	13.621*** (4.237)
Mother's Education: B.A.		8.983 (9.581)	5.103 (10.369)		3.737 (5.843)	-1.276 (6.096)		5.246 (5.570)	6.379 (6.058)
Father's Education: B.A.	1,135.092*** (3.381)	621.400*** (33.045)	759.149*** (35.763)	543.906*** (1.935)	308.998*** (20.152)	374.153*** (21.027)	591.186*** (1.967)	312.401*** (19.212)	384.997*** (20.894)
Country fixed effects	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes
Observations	2,974	2,450	2,446	2,974	2,450	2,446	2,974	2,450	2,446
R ²	0.006	0.331	0.214	0.006	0.229	0.150	0.003	0.329	0.213
Adjusted R ²	0.006	0.325	0.207	0.005	0.222	0.142	0.003	0.323	0.206

Notes: Regressions employ OLS (* $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$). Data are from the College Board's Annual Survey of Colleges from 2000 to 2008. Data before 2003 serve as the pretreatment data for the analysis.

4.6 Addressing a Supply Response to the New H1-B Visa Quota

A potential “supply response” to the new H-1B visa quota is the opening of international branch campuses (IBC) which offers a cheaper alternative for foreign students who wish to acquire a U.S. degree without being subject to U.S. visa requirements. An international branch campus is defined as “an entity that is owned, at least in part, by a foreign higher education provider; operated in the name of the foreign education provider; and provides an entire academic program, substantially on site, leading to a degree awarded by the foreign education provider.”³⁴ Examples of IBCs are Duke Kunshan University, New York University Abu Dhabi and Georgetown University School of Foreign Service in Qatar. As the leading exporter of higher education, the U.S. currently has 77 overseas campuses in total, mostly in Asia and the Persian Gulf area.³⁵ One may argue that enrolling in IBCs is a cost-effective way for international students to circumvent the new visa restrictions.

However, this dissertation claims that IBCs are not a perfect substitute for an American education experience for several reasons. First, overseas campuses only offer a limited selection of programs such as business, science and engineering³⁶ and a degree earned through overseas programs can be considered less prestigious than one earned at a university in the U.S. In addition, studying in the U.S. improves international students’ English skill, helps them experience American culture and gain access to internship and job opportunities in the U.S., all of which are highly valued by foreign-born students (Kim and Zhu, 2010, 170). Furthermore, IBCs are relatively new and their scale is relatively small. All 249 IBCs enrolled only 180,000

³⁴ Cross-Border Education Research Team (2019, February 17). C-BERT Branch Campus Listing. [Data originally collected by Kevin Kinser and Jason E. Lane]. Available: <http://cbert.org/resources-data/branch-campus/>. Albany, NY: Author.

³⁵ Id.

³⁶ Lewin, Tamar. “U.S. Universities Rush to Set Up Outposts Abroad,” *New York Times*, February 10, 2008, assessed February 20, 2019, <https://www.nytimes.com/2008/02/10/education/10global.html>.

students as of 2016³⁷ - a tiny fraction of the number of international students studying in the U.S. which reached 1,078,822 during the 2016-2017 academic year.³⁸ More importantly, this dissertation finds strong evidence for the positive effect of screening on the educational achievement of prospective migrants *despite* the presence of IBCs, which, if anything, should attenuate the impact found by this dissertation's empirical test. Consequently, these findings, in conjunction with the existence of IBCs, further strengthens this dissertation's theoretical framework.

4.7 Addressing the Domestic Competition Alternative

A remaining concern is that developing countries such as China and India have undergone an expansion of higher education in the last several decades, thus, students in these countries are likely to invest more in education in order to compete for admission into universities at home rather than to get admitted to universities abroad. This is potentially a valid concern given the growing demand for higher education in the developing world. For example, in China, the number of people between the ages of 20 and 24, its youth population, rose from 97 million in 2000 to 130 million in 2010 (Bloom et al., 2016). Similarly, India's youth population grew from 96 million in 2000 to 119 million in 2015 (Bloom et al., 2016). This means the competition for spots at domestic universities has become more intense and requires greater investment in education.

To address this concern, the dissertation specifically selected SAT score as the main dependent variable in all of its empirical tests because students would only take the SAT test if they wish to gain admission into U.S. universities, effectively

³⁷ Garrett, Richard, Kevin Kinser, Jason E. Lane, and Rachael Merola. *International Branch Campuses: Trends and Developments*, 2016. The Observatory on Borderless Higher Education (OBHE) and Cross-Border Research Team (C-BERT).

³⁸ "Open Doors Report on International Educational Exchange," *Institute of International Education*, 2017, assessed February 20, 2019, <https://www.iie.org/Research-and-Insights/Open-Doors/Data/International-Students/Enrollment>.

eliminating this alternative explanation for the main findings of this chapter.

4.8 Generalizability of the Argument

Due to present limitations in extant data, this chapter could only test the main hypothesis on a subset of potential migrants who entered the U.S. through an F-1 student visa. Although there is no direct path for an F-1 student visa holder to become a U.S. permanent resident, I will use the New Immigrant Survey (NIS) to demonstrate that obtaining an American degree significantly increases one's chance of gaining permanent residence status in the U.S. Thus, acquiring admission into a U.S. institution is highly desirable to potential migrants from other countries, which is likely one of the reasons for the substantial increase in the number of foreign-born students in the U.S. from 110,000 in 2001 to 524,000 in 2012.³⁹

Conducted in 2003, the New Immigrant Survey⁴⁰ samples 4.3% of 289,478 U.S. permanent resident aliens who were 18 years old or older at admission (Rosenzweig et al., 2006). This survey records all of their trips to the U.S. and the legal status they held each time they entered the U.S., making it possible to identify those who first came to the U.S. on an F-1 student visa. Figure 4.6 depicts the percentage of former students and nonstudents who gained permanent residency status through four main pathways including 1) marriage 2) employment 3) the diversity lottery and 4) sponsorship by immediate relatives. Notice that those who first came to the U.S. on an F-1 student visa were much more likely to obtain a green card by marrying a U.S. citizen or by getting a job in the U.S. While 20% of former students successfully landed a job in the U.S and became permanent residents, only 4% of nonstudents

³⁹ Ruiz, Neil G. "The Geography of Foreign Students in U.S. Higher Education: Origins and Destinations," *Brookings*, August 29, 2014, accessed February 27, 2019, <https://www.brookings.edu/interactives/the-geography-of-foreign-students-in-u-s-higher-education-origins-and-destinations/>.

⁴⁰ Jasso, Guillermina, Douglas S. Massey, Mark R. Rosenzweig and James P. Smith. "The New Immigrant Survey 2003 Round 2 (NIS-2003-2) Public Release Data." April 2014. Retrieved February 28, 2019. Funded by NIH HD33843, NSF, USCIS, ASPE & Pew. <http://nis.princeton.edu>.

managed to do so (Rosenzweig et al., 2006). In addition, Borjas (2002) found that the probability of obtaining a green card was 26 times higher for former student visa holders than for those who applied through the green card lottery, which shows that an American degree considerably increases the probability of gaining permanent residence status in the United States. This is consistent with Bhagwati's argument (1999) that obtaining an F-1 visa is the easiest route to immigrate to the U.S. In a recent survey of international students in the U.S., 44% of the respondents cited "opportunities to stay in the U.S. long-term or permanently" as a key factor for their decision to enroll in a U.S. institution.⁴¹

This evidence indicates that students who seek to enter the U.S. through an F-1 visa is an important sub-group of potential migrants who wish to relocate to the U.S. Admittedly this group may not be representative of all potential migrants who wish to relocate to the U.S. as they are more likely to be from advantageous socioeconomic backgrounds with sufficient financial resources to cover tuition and living costs abroad. Although the chapter's empirical scope is limited to this group, the theoretical framework of the chapter also applies to other groups of potential high-skilled migrants. Accordingly, future empirical advances and research are needed to assess the validity of these theoretical expectations and observable implications of the theoretical framework.

⁴¹ "Career Expectations, Experiences, and Outcomes of U.S.-Educated International Students: What We Learned," *World Education News and Reviews*, October 12, 2017, assessed February 20, 2019, <https://wenr.wes.org/2017/10/career-expectations-experiences-and-outcomes-of-u-s-educated-international-students-what-we-learned>.

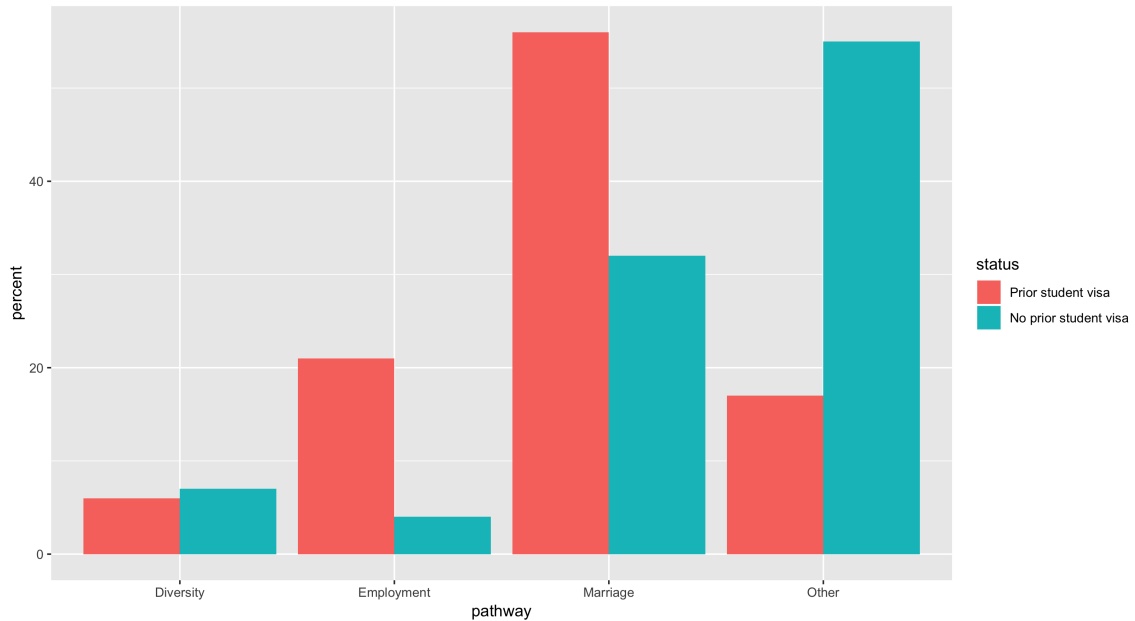


FIGURE 4.6: Permanent Residence Status for Prior Students and Nonstudents
Source: Reproduced from Rosenzweig et al. (2006)

4.9 Chapter Summary

The main argument of this chapter is that greater screening by migrant-receiving countries causes the supply of foreign labor to drop and domestic wages to rise in the migrant-receiving countries. This, in turn, increases the wage gap between migrant-sending and migrant-receiving countries and motivates potential migrants to invest more in their skills and education. Some of these high skilled workers will end up being unable to migrate, which in turn, raises the level of human capital in their country of origin. In other words, more screening can lead to brain gain. By utilizing an exogenous shock that caused an increase in screening in the U.S., this chapter found that more rigorous screening did indeed raise the academic qualifications of potential immigrants. This finding is significant because it shows that not only can brain gain happen *in the presence of screening* (which is contrary to the implication of most current brain gain models), it happens *as a result of* screening. This raises

the question of which migrant-sending countries would benefit the most from brain gain. Perhaps these are countries with such limited human capital that the additional brain gain would help boost their economic growth. For example, low and middle income countries with a relatively unskilled labor force should benefit the most from international migration.

This research project has several important policy implications for both migrant-sending and migrant-receiving countries. First, when a country which is a major migrant-receiving country and an exporter of higher education like the U.S. decides to impose greater visa restrictions, migrant-sending countries should make it easier for students to acquire high-quality education at home. Migrant-sending countries should devote more of their GDP to educational expenditure and invest in their own higher education institutions. In addition, they should encourage local universities to collaborate with reputable universities abroad through study abroad programs, visiting scholar programs and joint research initiatives. They can also offer incentives for world-class universities to open international branch campuses in country by providing funding and/or facilities for the sending universities. For example, Qatar covers all costs for six American campuses in its Education City.⁴² Meanwhile, China published the National Medium and Long-term Plan for Education Reform and Development (2010–2020) where one of the stated objectives is to increase the quality of Chinese higher education institution by encouraging high-ranking universities to establish IBCs in China (Hou et al., 2018). It currently hosts 32 IBCs and has overtaken the United Arab Emirates as the top host country of international branch

⁴² “U.S. Universities and International Branch Campuses,” Association of International Educators, April 2017, assessed February 20, 2019, https://www.nafsa.org/Professional_Resources/Browse_by_Interest/International_Students_and_Scholars/Network_Resources/International_Enrollment_Management/U.S._Universities_and_International_Branch_Campuses/.

campuses.⁴³

Regarding policy recommendation for migrant-receiving countries, we should not jump to the conclusion that a more restrictive immigration policy is needed because it can lead to a better-educated pool of immigrants. This is because if a country keeps increasing the level of screening and adopts an extremely restrictive immigration policy, potential immigrants may turn to other developed countries which may not offer such high-paying jobs but have more welcoming immigration policy. This can actually hurt the economy of the country in question if it loses its ability to attract the best and brightest from the rest of the world. Thus, future researchers should find a threshold after which screening can no longer increase the educational qualifications of potential immigrants but can hurt the quality of foreign labor and the economy of the migrant-receiving countries.

⁴³ O'Malley, Brendan. "China overtakes UAE as top host of branch campuses," *University World News*, November 10, 2016, assessed February 20, 2019, <https://www.universityworldnews.com/post.php?story=20161110144407523>.

Affirmative Action Policies in Malaysia

5.1 Affirmative Action around the World

Affirmative action is a set of policies which give special consideration for a group - usually identified by gender, ethnicity, religion or geography - which has been disadvantaged or discriminated against in the past. These programs go by various names: “affirmative action” in the U.S., “reservation” in India, “standardization” in Sri Lanka and “positive discrimination” in Britain (Sowell, 2004); however, they generally serve the same purpose of correcting past inequality, leveling the playing field and increasing the representation of a specific group in areas such as education, employment and government contracting. Affirmative action distinguishes itself from other non-discrimination policies in that it requires “pro-active steps” to increase opportunity for an under-represented group, as opposed to laws which only prevent universities and employers from discriminating against members of minority groups such as not admitting or not hiring someone on the basis of race or gender (Holzer and Neumark, 2000, 2).

5.1.1 *Temporary or Permanent Preferences*

Affirmative action policies are usually designed to be limited in *scope* and *time*; however, these policies tend to expand and last for much longer than initially planned (Sowell, 2004). For example, affirmative action in the U.S. traces back to Executive Order 10925 issued by President John F. Kennedy in 1961, which requires government contractors to “take affirmative action to ensure that applicants are employed, and employees are treated during employment, without regard to their race, creed, color, or national origin.”¹ This executive order signaled the U.S. government’s commitment to take active steps to erase discrimination and provide equal opportunity for all. However, this executive order only requires employers to make sure minority groups are not discriminated against in the hiring process. It was later superseded by Executive Order 11246 issued by President Lyndon B. Johnson in 1965, which included women as another group to be protected from discrimination. It further requires federal contractors employing more than 50 workers or having a contract of \$50,000 or more to not only enforce non-discrimination policy in its hiring practices but to also establish a written affirmative action plan including concrete “goals and timetables” (Holzer and Neumark, 2000).

Affirmative action in the U.S. has also spilled over to academia where most universities and colleges decided to enact admission policies which give admission preferences to minority applicants (Arcidiacono and Lovenheim, 2016). In short, within the last several decades, affirmative action in the U.S. has evolved from a general non-discrimination policy regulating only the hiring of federal contractors to a numerical concept with concrete “numeral yardsticks” in both the labor market and the higher education sector (Sowell, 2004).

Similarly, India which has the world’s oldest affirmative action program reserves

¹ Exec. Order No. 10925, 26 Fed. Reg. 1977 (1961).

government jobs and places in public universities for members of the “scheduled castes and scheduled tribes.”² These are historically disadvantaged groups in Indian society including tribes that live in remote areas and the Dalits, formerly known as the “untouchables.” This policy which was supposed to be a short-term measure to advance the social standing of caste minorities has become a permanent feature of Indian politics since 1950.³

The New Economic Policy in Malaysia, which is the focus of this chapter, was also put in place as a temporary measure to end violence between ethnic Malays and Chinese following the 1969 general elections. However, the NEP has become embedded in Malaysia’s political and economic system for the last five decades.

5.1.2 Impact on Preferred and Non-Preferred Groups

Affirmative action induces different incentives for the protected/preferred group and the non-preferred group. Research has shown that individuals from both groups respond to affirmative action by changing their effort levels, update their views of members of the other group and migrating to different countries.

The preferred group may feel entitled to and depend heavily upon affirmative action to gain admission into higher education or gain employment. For example, in Malaysia, Prime Minister Mahathir Mohamad who was a staunch supporter of preferential policy favoring ethnic Malays lamented that affirmative action disincentivizes Malays from working hard: “Getting scholarships and places in the universities at home and abroad is considered a matter of right and is not valued any more.”⁴

The effect of affirmative action on the non-preferred group is more inconclusive.

² A.R. “Indian reservations,” *The Economist*, June 29, 2013, accessed March 5, 2019, <https://www.economist.com/banyan/2013/06/29/indian-reservations>.

³ Id.

⁴ “Mahathir’s Change of Heart?” *Bloomberg Businessweek*, July 29, 2002, accessed February 20, 2019, <https://www.bloomberg.com/news/articles/2002-07-28/mahathirs-change-of-heart>.

They may not work hard because there is no point in trying or they may work very hard to migrate to a different country where they could compete on a more level playing field. In many cases, the non-preferred groups successfully migrated to another country. For example, Fijians of Indian descent left Fiji in massive numbers after a series of policies were implemented which disadvantage them relative to indigenous Fijians (Chand and Clemens, 2008).

Preferential policies have also been shown to worsen intergroup relations (Maio and Esses, 1998). For example, resentment over admission places reserved for the untouchables in a medical school in Gujarat, India led to riots (Joshi, 1982). In neighboring Sri Lanka, resentment and violence between ethnic groups were so high that the Tamils - the non-preferred group - wanted to secede.

Malaysia is an interesting case because its affirmative action policy protects an ethnic majority instead of an ethnic minority and one main contribution of this chapter to the affirmative action literature is that it studies the effect of affirmative action on the non-preferred group while most studies focus on the effect of affirmative action on the protected group.

5.2 Main Argument

The main argument of this chapter (illustrated in Figure 5.1) is that the New Economic Policy (NEP) negatively affected wage outcomes for the Chinese through 1) the preferential hiring and promotion in the public sector and 2) the imposition of employment quota in the private sector. This resulted in less demand and lower expected wages for Chinese labor in both the public and private sectors, raising the wage difference between Malaysia and neighboring Singapore across occupations. This higher wage gap created an incentive for Chinese Malaysians to migrate to Singapore for better employment opportunities. Drawing from the formal model presented in Chapter 3, I expect potential migrants among Chinese Malaysians to

gravitate toward professional occupations which had the largest Singapore-Malaysia wage spread compared to other professions. In addition, Singapore uses a talent-based immigration system which rewards higher education. Thus, achieving tertiary education would significantly increase the likelihood of obtaining a work visa to Singapore for Chinese Malaysians. Thus, I expect:

Hypothesis 1: A decrease in the wage level in migrant-sending countries leads to an increase in the educational qualifications of individuals in occupations with a high wage difference between migrant-sending and migrant-receiving countries.

The remainder of the chapter is structured as follows. Sections 5.3 and 5.4 provides a brief overview of the origin and major components of the NEP. Section 5.5 offers information on the wage spread across occupation between Malaysia and Singapore. Section 5.6 discusses Singapore's immigration system. Section 5.7 describes data sources and the identification strategy. Section 5.8 reports the regression results. Section 5.9 presents robustness tests and Section 5.10 offers concluding remarks.

5.3 Origin of the New Economic Policy

The origin of ethnic tension which culminated in the New Economic Policy (NEP) dates back to the British colonization period (1786-1957). During this period, Indian immigrants were imported to British Malaya to work on rubber and oil palm plantations while Chinese workers were employed as miners and merchants around tin mines and ports. Meanwhile, most Malays were farmers and fishermen who lived in rural areas.

The colonial government recognized the Malays as the "rightful owners of Malaya" and regarded the Indians and Chinese as merely "temporary residents" (Ong, 2012, 3, 4). Improving the position of ethnic Malays in *education* and *public service* were major policy goals of the British colonial administration (Puthuchery, 1978). The British provided free primary education in Malay and free secondary education in

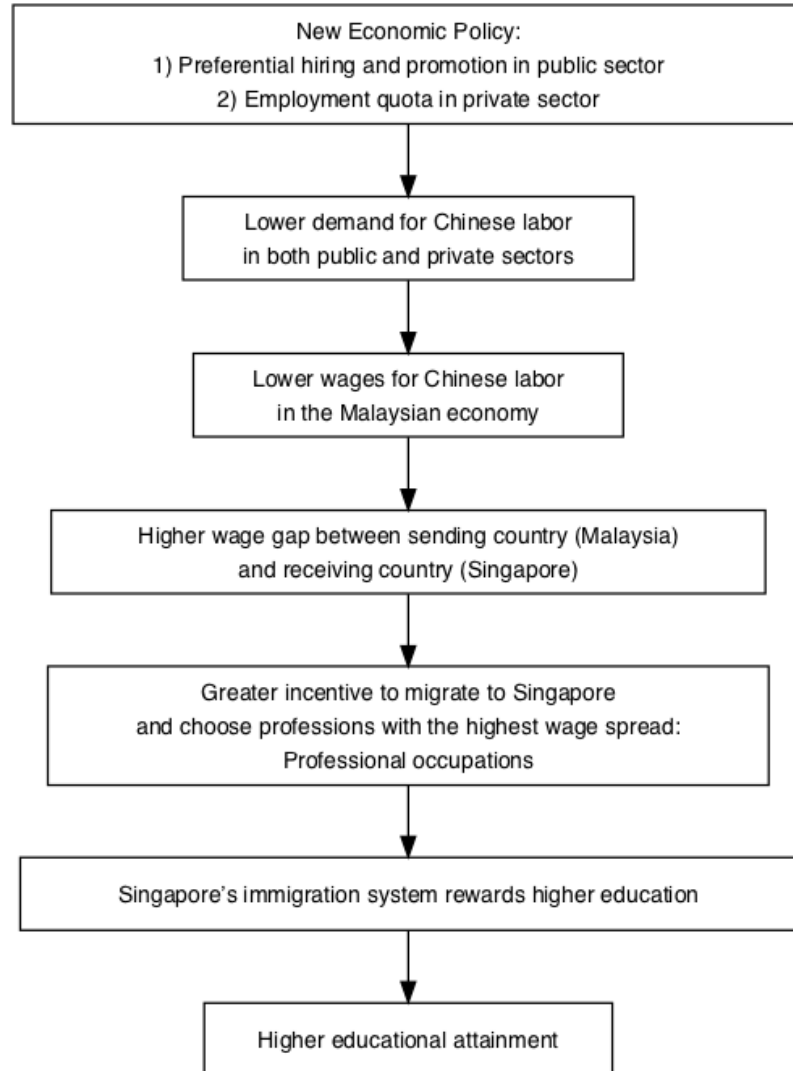


FIGURE 5.1: Causal Chain

English for children of the Malay elite (Ong, 2012). Meanwhile, the Chinese had to found their own schools and imported curricula and textbooks from China, and the Indians had to rely on their employers - plantation owners - to provide education in Tamil for their children (Ong, 2012). In public service, 80% of Malay Civil Service (MCS) were reserved for Malays and the Malay Administrative Service (which was subordinate to the MCS) created in 1910 was closed to non-Malays till 1952 (World Bank, 2004).

Under British rule, the number of Chinese immigrants in Malaya rose from a hundred thousand in 1881 to more than half a million in 50 years (Limlingan, 1986). Although the first wave of Chinese immigrants arrived poor and started from the bottom of the social ladder, they managed to rise economically. In 1911, half of all Chinese immigrants in Malaya were laborers working in mines or in agriculture, 20 years later, only 11% were still in those occupations (Snodgrass, 1980). By 1920, Chinese-owned mines produced nearly two-thirds of the tin in Malaya (Samarasinghe, 1984) and the Chinese owned 85% of all retail outlets in the country (Kondapi, 1951), their income rose more than double the average income of the Malays (Sowell, 2004).

Throughout this period, the Chinese and the Malays remained geographically separated. They spoke different languages and practiced different religions. Malays were predominantly Muslim while most Chinese were Buddhists, Taoists, or Christians. The former spoke Malay while the latter spoke various Chinese dialects.⁵ The Malays envied the Chinese for their economic success while the Chinese resented preferential treatment for the Malays. Ethnic tension simmered as the country advanced toward its independence in 1957.

Independent Malaysia was made up of Malaya, Singapore and the North Borneo states of Sabah and Sarawak. The Chinese and Indians were allowed citizenship while the Malays were granted a continuation of special treatment. The constitution defines “Malay” as a person who “professes the religion of Islam, habitually speaks the Malay language, conforms to Malay custom, and was born in the Federation or in Singapore or born of parents one of whom was born in the Federation or in Singapore before Independence Day”⁶ (World Bank, 2004, 41). Article 153 of the

⁵ These include Mandarin, Cantonese, Hokkien, Teochew, Hakka, Hainanese.

⁶ This definition is used to define “ethnic Malay” in all the censuses and databases employed by this chapter.

constitution reserves 80% of positions for the *bumiputeras*⁷ at all levels of civil service (World Bank, 2004). In addition, the Constitution weighs votes in rural areas where Malays resided more heavily than votes in the cities where the Chinese made up the majority. The goal of this system is not only to ensure representation of Malays in proportion to their population share but to ensure their representation is beyond their population share (Esman, 1972). While the Malays were guaranteed political supremacy by the constitution, the Chinese maintained their economic dominance. The Chinese demanded equal treatment for all citizens while the Malays wanted to keep the status quo. Ethnic tension rose and became one of the most serious problems facing the young nation. These two groups were similar in population share until Singapore was expelled, leaving Malaysia with a comfortable Malay majority (Sowell, 2004).

Malaysia's major political parties were formed along ethnic lines. The United Malay National Organization (UMNO) is the largest party followed by the Malayan Chinese Association and the Malayan Indian Congress. These three parties formed a coalition known as the Barisan Nasional seeking to appeal to all three ethnic groups. The compromise includes the continuation of preferences for ethnic Malays in the political realm. Since independence, Malaysia's prime ministers have all been ethnically Malay.

Against this backdrop, when the Chinese-dominated opposition parties⁸ made significant gains in the 1969 general elections, heightened tensions between ethnic Malays and Chinese led to racial clashes that claimed several hundred lives.⁹ In response, the government declared a state of emergency and formed a caretaker

⁷ This term can be translated literally as "son of the land" or "son of the soil" used to describe ethnic Malays in Malaysia. It includes all Malays and the indigenous people of Sabah and Sarawa.

⁸ In particular, the Democratic Action Party (DAP) and Parti Gerakan.

⁹ "Race War in Malaysia", *Time*, May 23, 1969, assessed October 30, 2016, <https://web.archive.org/web/20070518061525/http://www.time.com/time/magazine/article/0,9171,900859,00.html>.

government - the National Operations Council (NOC). In 1971, the NOC passed the New Economic Policy (NEP) which included major affirmative action policies that favored ethnic Malays at the expense of other groups.

5.4 Components and Consequences of the NEP

Launched in 1971, the NEP was intended to “eradicate poverty irrespective of race” and to “restructure society to abolish the identification of race with economic function” (Government of Malaysia, 1971). Table 5.1 provides a brief overview of the main components of the NEP in the labor market, politics and business. As shown in Table 5.1, one of the NEP’s main goals was to increase Malay representation and reduce the share of ethnic Chinese in high-level occupations. In this period, most ethnic Malays worked in traditional and small-scale agriculture while the Chinese dominated business and commerce, and the majority of Indians worked in plantations (Ong, 2012).

Taking a closer look at the NEP’s specific goal of increasing the share of Malays in high-level occupations, Table 5.2 illustrates the initial occupational distribution by ethnicity in 1970 and the NEP-targeted distribution by 1990.¹⁰ The NEP aimed to increase Malay representation (columns in blue) and reduce the share of ethnic Chinese (columns in yellow) in all non-agricultural occupations including professional, administrative, clerical, production, sales and services. In order to reach this goal, the Malaysian government employed a variety of strategies including 1) the preferential hiring and promotion of ethnic Malays in the public sector and 2) the imposition of employment quota in the private sector.

In the public sector, the government’s strategy is straightforward: they first expanded the public sector, then filled available positions, especially higher adminis-

¹⁰ This targeted employment distribution is based on the 1970 population: 52.7% Malay, 35.8% Chinese and 10.6% Indian.

Table 5.1: Overview of the New Economic Policy: Areas, Programs and Features

Area	Programs	Features
High-level occupations	<i>Bumiputera</i> representation among professionals and management	<i>Bumiputera</i> quota in the public sector
	Industrial Coordination Act (ICA) 1975	30 percent <i>bumiputera</i> quota in medium and large manufacturing firms
Wealth ownership	Foreign Investment Committee	30 percent <i>bumiputera</i> ownership of shares in listed companies
	Government investment funds	<i>Bumiputera</i> quotas
Politics	Civil service	<i>Bumiputera</i> quotas
Education	MARA junior science colleges	Exclusively <i>bumiputera</i> until 2000
	Post-secondary matriculation colleges	Exclusively <i>bumiputera</i> till 2002
	MARA University of Technology	Exclusively <i>bumiputera</i>
	Public university admissions	<i>Bumiputera</i> quota (70%)
	Government scholarships	Most were reserved for <i>bumiputera</i>

Source: Reproduced from Lee (2012)

trative and professional level positions, with ethnic Malays (Means, 1972). The rapid expansion of the public sector following the implementation of the NEP is illustrated by Table 5.3. Public expenditure budgets increased considerably from 4.6 billion Malaysian Ringgit (RM) (8.7% of GDP) in 1966-1970 to 48.9 billion RM (48.9% of GDP) in 1981-1985. During the same period, the number of public enterprises

Table 5.2: Occupational Distribution by Ethnicity
Occupation Initial Position in 1970 Target of NEP by 1990

Occupation	Initial Position in 1970			Target of NEP by 1990		
	Malay (%)	Chinese (%)	Indian (%)	Malay (%)	Chinese (%)	Indian (%)
Administrative and managerial	24.1	62.9	7.8	22.8	49.3	39.4
Agricultural	72.0	17.3	9.7	62.3	27.8	9.2
Clerical and related	35.4	45.9	17.2	47.9	38.7	12.5
Production, transport and other	34.2	55.9	9.6	52.0	38.0	9.6
Professional and technical	47.0	39.5	10.8	50.7	37.2	11.5
Sales and related	26.7	61.7	11.1	36.9	51.8	11.0
Services	44.3	39.6	14.6	52.3	35.4	11.4

Notes: Total percentage does not add up to 100% because other ethnic groups are not included. *Source:* Government of Malaysia (1976), collected by Osman and Shahiri (2017)

rose twelvefold from 54 to 656 across all sectors and industries (Rugayah, 1995). As shown in Panel C of Table 5.3, by 1983, the public sector hired almost four times more employees than it did in 1970. It is clear that the explosion in the size of the public sector was to create employment for ethnic Malays (Ong, 2012) instead of accommodating a growing population because during this period, Malaysia’s population grew at moderate and stable rates between 2.5% and 2.7%.

A majority of positions in the public sector were given to the Malays. In 1969, the Malay Civil Service (MCS) was made up of 61% Malays, 20% Chinese, and 17% Indians (Puthuchery, 1978). By 2005, the Malay proportion rose to 77% while the Chinese and Indian shares dropped to 9% and 5%, respectively (Ong, 2012). Between 1970 and 1985, 80% of the most senior government jobs were held by Malays and only 6.3% by ethnic Chinese (Ling, 1988). Although public sector wages are not as competitive as wages in the private sector, they provide greater job security and guarantee life-long pensions.

The exclusion of *non-bumiputeras* from the public sector forced many Chinese

Table 5.3: The Expansion of Malaysia's Public Sector between 1965 and 1985.

Panel A: Growth in Public Expenditure Budgets

	1966-1970	1971-1975	1976-1980	1981-1985
RM billion	4.6	10.3	31.3	48.9
As a Percent of GDP	8.7%	11.3%	15.7%	14.1%
Population Growth	2.7%	2.5%	2.5%	2.6%

Panel B: Growth in the Number of Public Enterprises

	1965	1970	1975	1980
Number of Public Enterprises	54	109	362	656

Panel C: Growth in Public Sector Employment

	1970	1983
Number of public sector employees	139,467	521,818

Sources: Government of Malaysia (1966); Government of Malaysia (1971); Government of Malaysia (1976); Government of Malaysia (1981) collected by Ong (2012); Hirschman (1980)

and other ethnic minorities to look for jobs in the private sector, however, they faced discrimination in this domain as well. In the private sector, the NEP set a quota of 30% *bumiputera* equity participation and employment in companies through the Industrial Coordination Act (1975).

This dissertation argues that the preferential hiring in the public sector and employment quota imposed in the private sector decreased demand for Chinese labor in the economy, thus, putting downward pressure on Chinese wages. As Chinese Malaysians saw their employment prospects in these sectors declining, they started to look for job opportunities abroad and it is not surprising that their top destination was Singapore (World Bank, 2011) which used to be a part of Malaysia and had a large Chinese community.

5.5 Wage Difference between Malaysia and Singapore

Drawing from the formal model presented in Chapter 3, I expect potential migrants among Chinese Malaysians to be attracted to occupations which had the largest wage spread between Singapore and Malaysia. In order to examine the wage differential between two countries across multiple occupations, I obtained raw data from the International Labor Organization's (ILO) annual October Inquiry, which conducted large scaled surveys of wages in 159 occupations. The data were then calibrated for cross-country consistency by Freeman and Oostendorp (2005) and made publicly available in the Occupational Wages Around the World (OWW) database.¹¹ There are two features of the OWW which make this dataset particularly useful for comparing wages between Singapore and Malaysia over time. First, the OWW contains a comprehensive list of occupations. The number of occupations covered in this dataset increased from 48 (for the time period between 1953 and 1982) to 161 (1983 onwards). In addition, the ILO's International Standard Classification of Occupations clearly defines each occupation by a set of tasks involved (International Labour Office, 2012), providing a useful guideline for country statistical agencies to report wages for identical work. Thus, I expect consistency in the reporting of wage returns across countries.

Figure 5.2 is the graphic summary of the wage difference (in USD) of hourly wages earned in Malaysia versus in Singapore by occupation from 1965 to 1985. The black dotted line marks the onset of the NEP in 1971. The Singapore-Malaysia wage gap in the professional job category experienced a sharp increase in the early 1970s and continued an upward trend for the next two decades. Meanwhile, the wage difference across other job categories between the two countries initially hovered around their pre-NEP levels and started to rise up in the late 1970s but to a smaller extent than

¹¹ The occupational wage data from 1983 to 2008 are available at <http://www.nber.org/oww/>. The extended version of the OWW for 1968-1998 was generously provided by Dr. Remco Oostendorp.

the increase in the wage spread in the professional category. One shortcoming of this dataset is that there are missing data on wages across all professions in Malaysia and Singapore for a short time period between 1977 to 1984, however, this figure clearly indicates that professional occupations experienced the biggest wage gap between Malaysia and Singapore following the introduction of the NEP.

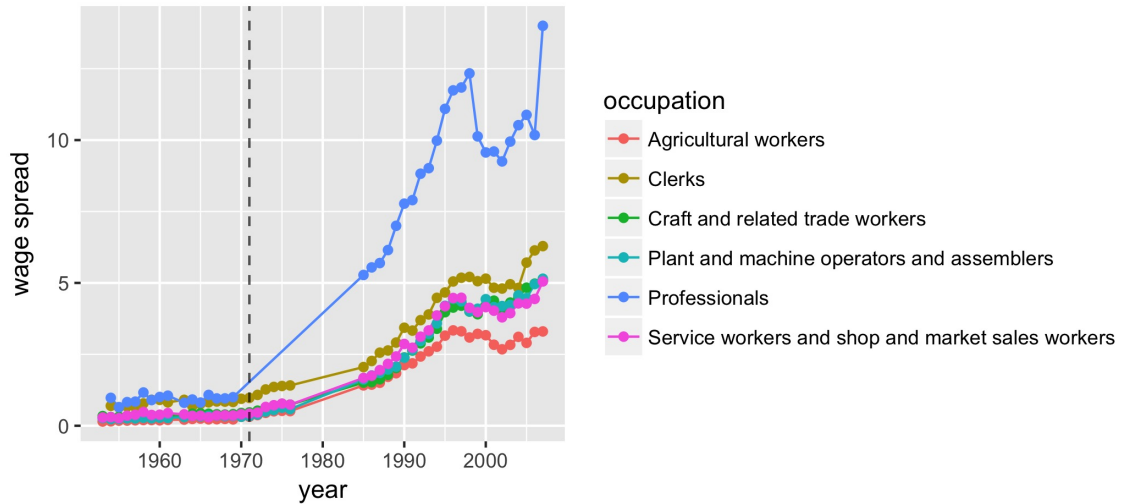


FIGURE 5.2: Wage Spread between Malaysia and Singapore by Occupation.
Notes: Wages were computed using exchange rate information and country-specific calibration with lexicographic imputation (Freeman and Oostendorp, 2005).
Source: Occupational Wages around the World (OWW) database.

The significant wage gap for professional occupations between Singapore and Malaysia made this job category most appealing to ethnic Chinese who wished to migrate to Singapore for better employment prospects.

5.6 Skill Selection in Singapore

As illustrated in Figure 5.3, from 1970 to 2000, Singapore is by far the top destination for Malaysian emigrants followed by the United Kingdom, Australia, Brunei and the United States. A vast majority of the Malaysians abroad are ethnic Chinese. For example, Figure 5.4 shows that ethnic Chinese have consistently made up the

majority (59% - 88%) of the Malaysian community in Singapore throughout the last several decades. This section will now briefly discuss the immigration system of Singapore.

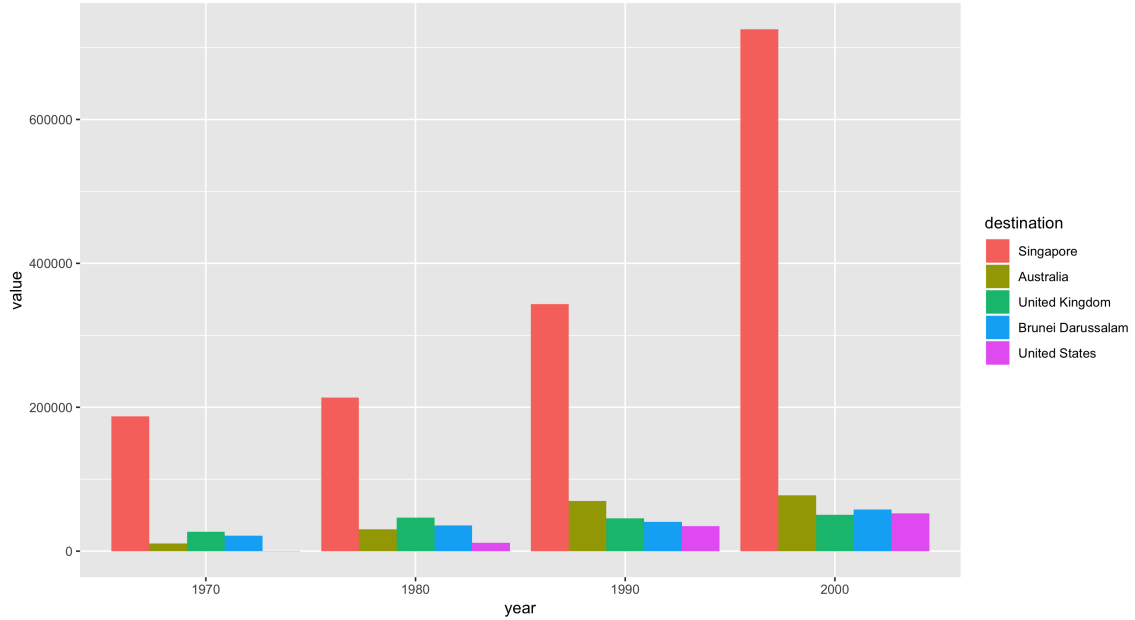


FIGURE 5.3: Top Destinations for Malaysian Emigrants
Source: Global Bilateral Migration Database, World Bank

Singapore has a long history of migration with Southeast Asian countries, particularly Malaysia. After breaking off from Malaysia in 1965, Singapore experienced two major challenges: low fertility rates and shortages of labor due to robust economic growth. In order to mitigate the effects of low fertility rates and provide sufficient manpower to the economy, the Singapore government pursued an open door approach to immigration. Singapore encouraged the hiring of low-skilled foreign workers on a temporary basis and attracted high-skilled foreign labor and top foreign students with potential for naturalization (Chew and Chew, 1995).

Although there have been policy changes over time, Singapore’s immigration system has consistently given strong preference to foreign workers with tertiary ed-

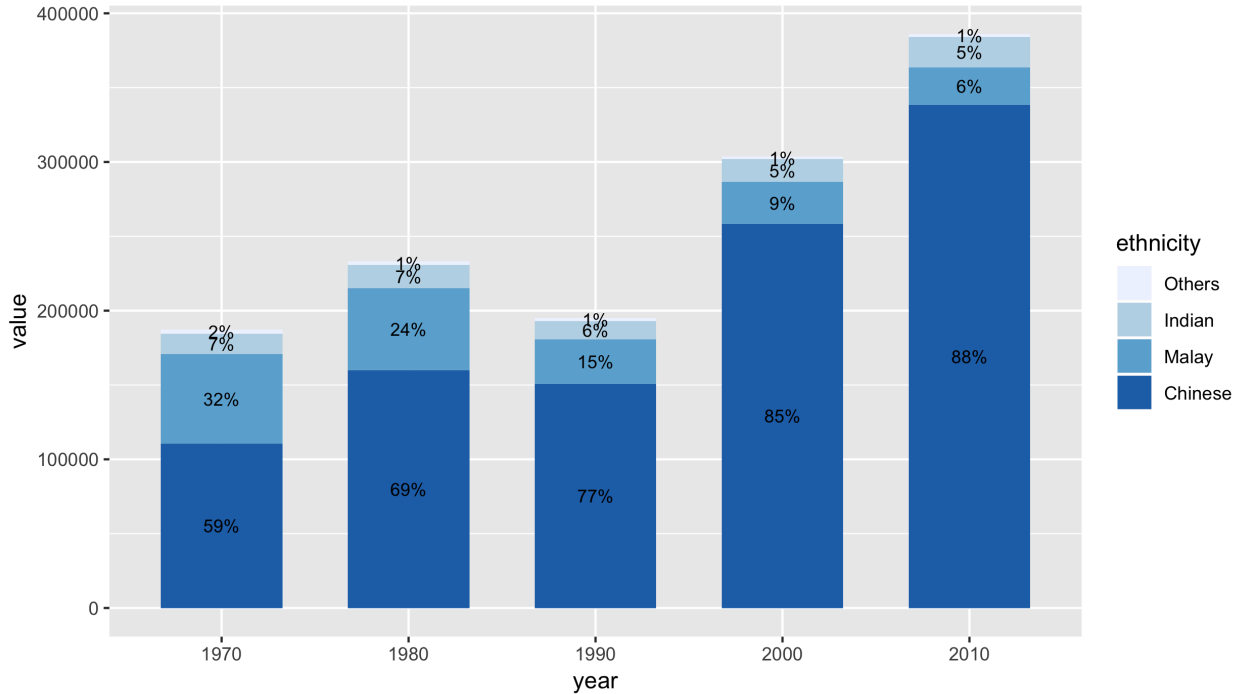


FIGURE 5.4: The Share of Ethnic Chinese among Malaysian Diaspora in Singapore. *Source:* Singapore Census of Population 1970, 1980, 1990, 2000, 2010. Collected by Koh (2015)

ucation. In 1973, the government created the work permit for low-skilled workers and the employment pass for high-skilled foreign labor. There was a limit on the number of work permit holders (low-skilled) each company could have but no such limit for (high-skilled) workers holding employment passes (Ho and Tyson, 2011). As a result, there was a decrease in Malaysian low-skilled labor in Singapore in the 1970s and 1980s.¹²

Meanwhile, the Singapore government actively recruited high-skilled talent from neighboring countries and encouraged them to consider permanent settlement in Singapore. For example, the ASEAN¹³ scholarship first established by the Ministry

¹² There were 100,000 low-skilled Malaysian workers in Singapore in 1978. This number dropped to 55,000 in 1985 and 30,000 in 1989. (Ho and Tyson, 2011).

¹³ The Association of Southeast Asian Nations is a regional intergovernmental organization comprising ten Southeast Asian countries including Indonesia, Thailand, Vietnam, Malaysia, Singapore, Philippines, Myanmar, Cambodia, Laos and Brunei.

of Education in 1969 was granted to students from other ASEAN countries (which includes Malaysia) to study in Singapore at the pre-university level. The establishment of the ASEAN scholarship happened to coincide with the commencement of the NEP which imposed ethnic quotas on public universities, resulting in a lack of opportunities for *non-bumiputeras* to pursue higher education in their home country (Selvaratnam, 1988). In 1984, Singapore’s secretary of the Ministry of Trade and Industry, Mr Ngiam Tong Dow announced that high-skilled foreign workers “whose culture, traditions and customs are compatible” would be given permanent residence 6 months after they found a job and citizenship after 5 years while it previously took 10 years (Ho and Tyson, 2011, 136). Given the similarity in culture and ethnic composition between the two countries, it is not surprising that Malaysian nationals were welcomed in Singapore, evidenced by a government program which provided subsidized rental of Housing Development Board apartments to Malaysians¹⁴ and the willingness of the Singapore Public Service Commission to offer top Malaysian students full scholarships to Singapore universities in the 1980s (Ho and Tyson, 2011).

Both due to the widening wage gap between Malaysia and Singapore, especially in the professional occupations as well as Singapore’s welcoming immigration policy toward Malaysians, educated Chinese from Malaysia have been overrepresented in the migrant population in Singapore.

5.7 Data and Model Specifications

I use pooled cross-sectional survey data from the Population and Housing Census conducted in 1970, 1980, 1991 and 2000 by the Department of Statistics of Malaysia.¹⁵ The census conducted in 1970 serves as the baseline pre-treatment data before the

¹⁴ This program was discontinued by the 1990s.

¹⁵ Census data samples were obtained from the Integrated Public Use Microdata Series (IPUMS) International online repository (Minnesota Population Center, 2018)

NEP commenced in 1971. The 2% sample data from these censuses offer information collected from 947,910 randomly selected persons in total. I will focus on individuals aged between 22 and 55 in each dataset because they would have likely completed their schooling and were still in the labor force.¹⁶

The main dependent variable is a dichotomous variable measuring whether an individual has obtained a college degree. At first glance, limited dependent variable models such as logit or probit seem appropriate. However, the linear probability model (LPM) is a better fit for several reasons. First, the interaction effect in non-linear models cannot be interpreted by simply looking at the sign, magnitude and statistical significance of the coefficient on the interaction term (Ai and Norton, 2003). In addition, the risk of omitted variables bias is lower in the LPM model compared to in logistic regression (Mood, 2010) and the coefficients of the LPM model are relatively easy to interpret in terms of probabilities (Angrist and Pischke, 2010). Moreover, a linear probability model does not require assumptions about how errors are distributed while estimates from a probit or logit model will only be correct if the assumptions on the distribution of errors are correct.

One concern is that ordinary least squares estimation imposes heteroscedasticity in the case of a binary response variable. To address the second concern, I use heteroscedasticity-consistent robust standard error estimates. In addition, standard errors are clustered at the state level to account for potential differences in educational attainment among states. Table 5.4 presents a balance table between the treatment and the control group, measured in 1970, prior to the start of the NEP. One significant demographic difference between the two ethnic groups is that in 1970, a larger share of ethnic Malays aged between 22 and 55 were married compared to their Chinese peers. However, this should not affect the main regression results.

¹⁶ The retirement age for civil servants in Malaysia was 55 years old in 2000 (Ong, 2012).

Table 5.4: Balance between Treatment and Control Groups based on 1970, Pretreatment Data

Variables	Means (N= 1878)		Difference in Means (N= 1878)	
	Malay	Chinese	T-Statistics	P-Value
Age	32.43	32.60	0.44	0.65
Female	0.52	0.51	-1.12	0.26
Married	0.76	0.61	-6.8	1.38e-11

5.8 Empirical Results

As illustrated by Figure 5.5, before the NEP was implemented, the tertiary attainment rates of ethnic Chinese and Malays were at around the same level. Following the implementation of the NEP, the Malays' tertiary attainment rate outpaced the Chinese. This could be attributed to the NEP's ethnicity-based quota in tertiary education. 55% of university places were reserved for ethnic Malays from the late 1970s into the early 2000s (Aihara, 2009). In addition, most government scholarships (in Malaysia and overseas) were reserved for *bumiputeras*. A survey of 1982/1983 graduates of five universities in Malaysia reveals that 80% of local public university scholarships were awarded to Malay students, 14% to the Chinese, 4% to the Indians and 3% to indigenous peoples (Mehmet and Hoong, 1986). Furthermore, 96% of government-sponsored study abroad scholarships from 1980 to 1984 were given to the *bumitepuras* and only 4% to *nonbumiputeras* (Ling, 1988).

Given that higher education is the key to upward mobility, this heavy bias against *nonbumiputeras* students was of great concern to many Chinese parents in Malaysia. Many middle-class Chinese families sent their children to universities overseas¹⁷ and lower-income Chinese families had to save more or borrowed money to finance their children's education at private and foreign universities (Koon, 1997). The increasing

¹⁷ Mostly to the United States, Britain, Canada, Australia and New Zealand.

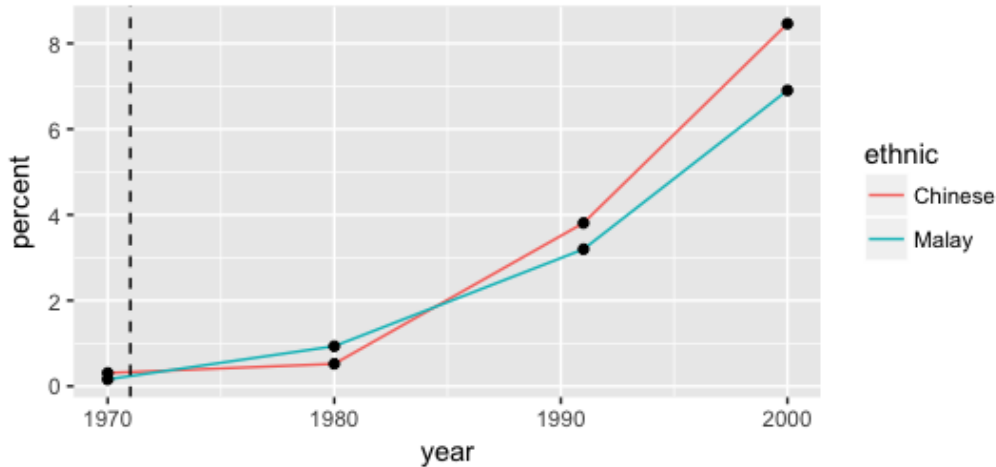


FIGURE 5.5: Tertiary Attainment Ratios by Ethnicity
 Source: Malaysia Population and Housing Census, 1970, 1980, 1991, 2000

demand for tertiary education from *non-bumiputeras* led to an expansion of private universities in Malaysia in the 1980s (Lee, 2012). The proportion of private higher education institutions in Malaysia increased from 8.9% in 1985 to 34.7% in 1995 (Wan, 2007). The establishment of new domestic private institutions and accessibility to universities abroad compensated for the insufficient supply of opportunities to be placed at public universities for *non-bumiputeras* in Malaysia. This explains how the Chinese tertiary attainment rate could catch up with and surpass the Malays' in the mid-1980s (Figure 5.5). The inter-ethnic gap in higher education achievement continued to widen in the following decade.

5.8.1 Difference-in-Difference Analysis

To examine the effect of the NEP on the educational outcomes of ethnic Chinese, I limit my analysis to individuals in the professional job category because as explained earlier, the effect of NEP would be most pronounced in this group. I then compare the change in the probability of acquiring tertiary education of ethnic Chinese and ethnic Malays using the following specification:

$$Pr(Y_{it} = 1) = \alpha + T_t\beta + D_{it}\gamma + T_tD_{it}\theta + X_{it}\delta + \epsilon_{it} \quad (5.1)$$

where:

Y_{it} = a binary variable indicating whether or not individual i has acquired a college degree at time t .

T_t = a dummy time variable which equals 0 for 1970 and 1 otherwise.

D_{it} = the treatment variable that equals 1 for ethnic Chinese and 0 for ethnic Malays.

θ = interaction between T_t and D_{it} , which is the average treatment effect (ATE) of the intervention.

X_{it} = a vector of control variables.

Summary statistics of all variables included in the model are shown in Table 5.5.

Table 5.5: Summary Statistics

Statistic	N	Mean	St. Dev.	Min	Max
Age	342,441	34.2	9.0	22	55
Female	342,441	0.5	0.5	0	1
College	335,337	0.1	0.3	0	1
Married	342,441	0.7	0.4	0	1
Chinese	342,441	0.3	0.5	0	1
Indian	342,441	0.1	0.3	0	1
Malay	342,441	0.6	0.5	0	1
Employed	342,441	0.7	0.5	0	1

Table 5.6 represents the results of the main regression. The row (Chinese*Time) highlights the average treatment effect for the analysis, which is positive and statistically significant at the 95% level across all specifications. The pre-policy likelihood of acquiring tertiary education for the Chinese was 3.2 to 3.8 percentage points lower than the Malays. This might be attributed to the limited state funding given to Chinese public schools which suffered from shortages of teachers, textbooks and facilities.

The poor quality of these schools would have likely negatively impacted Chinese students' learning and their chance of getting into college. However, the probability of ethnic Chinese obtaining a college degree post-policy was 4.8 percentage points greater than their Malay peers. Column 2 shows the results of the same regression when including individual controls as well as state and year fixed effects. Here the estimate of the average treatment effect is still positive and statistically significant.

As discussed in the previous section, after the NEP was introduced, many Chinese Malaysian families sent their children to private and foreign universities which likely cost more than public universities. This shows that after the NEP, Chinese Malaysian families were willing to bear greater costs for the education of their children, which further supports the main findings of this chapter.

Table 5.6: Difference-in-Difference Estimation, 1970-2000

<i>Dependent variable:</i>		
Probability of Acquiring Tertiary Education		
	(1)	(2)
Chinese*Time	0.048*** (0.012)	0.046*** (0.011)
Chinese	-0.038*** (0.009)	-0.032*** (0.009)
Time	0.116*** (0.006)	0.142*** (0.007)
Female		0.044*** (0.005)
Married		0.010* (0.006)
Age		-0.006*** (0.0004)
Constant	0.311*** (0.005)	0.390*** (0.013)
State FE	No	Yes
Year FE	No	Yes
Observations	36,481	36,481
R ²	0.017	0.044
Adjusted R ²	0.016	0.043

Notes: Regressions employ OLS with standard errors clustered at the state level ($p < 0.1$; ** $p < 0.05$; *** $p < 0.01$). Data are from the decennial Malaysia Population and Housing Census from 1970 to 2000. The 1970 census serves as the pretreatment data for the analysis. This estimation sample includes only individuals in professional occupations.*

5.9 Robustness Tests

5.9.1 *Parallel Path Assumption*

The main assumption under Equation 5.1 is the parallel trends assumption which states that absent the treatment, the outcomes of the treatment and control groups would have followed parallel paths. Ideally, this assumption could be tested by running difference-in-difference regressions using data from the 1960 and 1970 censuses because these two censuses were conducted before 1971. However, data from the Population and Housing Census 1960 are not publicly available.

Another way to test this assumption is to look at the effect of the NEP in other occupational groups. If my central claim is correct that the NEP widened the Malaysia-Singapore wage gap for professional occupations, encouraging ethnic Chinese to acquire more education in order to migrate to Singapore, we should not see any effect of the NEP on the educational attainment of individuals holding non-professional jobs. The results are reported in Table 5.7, which shows that the estimated coefficients for other occupational groups including 1) elementary occupations 2) crafts and related trades workers 3) plant and machine operators and assemblers and 4) service and sales workers,¹⁸ are not statistically significant. This means that this dissertation finds no statistically significant effect of the NEP on the educational outcomes of those in non-professional occupations.

5.9.2 *Difference-in-Difference-in-Difference Analysis*

In order to determine the differences in educational achievement between the Chinese and the Malays both across occupations and time, I use a difference-in-difference-in-differences analysis. The triple difference measure captures whether the time was

¹⁸ The Malaysia Population and Housing Census from 1970 to 2000 adopt the International Standard Classification of Occupations (ISCO) which is a tool for organizing jobs into a clearly defined set of groups according to the tasks and duties undertaken in the job. See Appendix C for a list of professions included in each major occupational group.

Table 5.7: Difference-in-Difference Estimation by Occupation

	<i>Dependent variable:</i>	
	Probability of Acquiring Tertiary Education	
	(1)	(2)
Chinese*Time:		
Elementary occupations	0.001 (0.004)	0.001 (0.004)
Crafts and related trades workers	-0.006 (0.004)	-0.004 (0.004)
Plant and machine operators and assemblers	-0.001 (0.004)	0.001 (0.004)
Service and sales workers	0.007 (0.006)	0.005 (0.006)
State FE	No	Yes
Year FE	No	Yes

Notes: Regressions employ OLS with standard errors clustered at the state level ($p < 0.1$; ** $p < 0.05$; *** $p < 0.01$). Data are from the decennial Malaysia Population and Housing Census from 1970 to 2000. The 1970 census serves as the pretreatment data for the analysis.*

before or after the introduction of the NEP, whether individual i was ethnic Chinese or ethnic Malay and whether they held a professional job. This regression seeks to eliminate potentially confounding trends in the probability of obtaining a college degree of ethnic Chinese across occupations that are not related to the NEP. It also controls for changes in the likelihood of acquiring tertiary education for both ethnic Malay and Chinese in professional occupations which might have happened due to other factors. Individual demographic variables were added to control for confounding factors. The linear probability model I am estimating is as follows:

$$Pr(Y_{it} = 1) = \alpha + \beta_1 T_t D_{it} P_{it} + \beta_2 T_t D_{it} + \beta_3 D_{it} P_{it} + \beta_4 T_t P_{it} + \beta_5 T_t + \beta_6 D_{it} + \beta_7 P_{it} + \delta X_{it} + \epsilon_{it}$$

where:

Y_{it} = a binary variable indicating whether or not individual i has acquired a college degree at time t .

T_t = a dummy time variable which equals 0 for 1970 and 1 otherwise.

D_{it} = the treatment variable that equals 1 for ethnic Chinese and 0 for ethnic Malays.

P_{it} = a dummy variable indicating whether or not individual i holds a professional degree at time t .

X_{it} = a vector of control variables.

These results can be observed in Table 5.8. The coefficient on the triple interaction which is the effect of the NEP on Chinese professionals is approximately 3 percentage points and is significant at the 95% confidence level. However, the interaction term (Time*Chinese) which represents the treatment effect of the NEP on all ethnic Chinese in Malaysia is not statistically significant. This result confirms my claim that although the NEP was disadvantageous to all ethnic Chinese, its effect on Chinese professionals were considerably more pronounced because these occupations had the greatest wage gap between Malaysia and Singapore, which motivated ethnic Chinese to acquire higher education in order to migrate.

5.10 Chapter Summary

The main argument of this chapter is that decreasing domestic wages in migrant-sending countries raise the wage difference between the home and foreign countries, thus, motivating potential migrants to acquire more education in order to get higher paying jobs in migrant-receiving countries. By utilizing Malaysia's New Economic Policy - an exogenous shock that caused a decrease in wages in all occupations for ethnic Chinese - this chapter found that decreasing domestic wages in Malaysia had a positive impact on the educational outcomes of Chinese Malaysians. This is a relevant

Table 5.8: Difference-in-Difference-in-Difference Estimation, 1970-2000

	<i>Dependent variable:</i>	
	Probability of Acquiring Tertiary Education	
	(1)	(2)
Chinese*Time*Professional	0.031*** (0.009)	0.030*** (0.009)
Time	0.009*** (0.001)	0.001 (0.001)
Chinese	0.003*** (0.001)	0.0002 (0.001)
Professional	0.068*** (0.003)	0.063*** (0.003)
Female		-0.008*** (0.001)
Married		-0.012*** (0.001)
Age		-0.0003*** (0.00005)
Time*Chinese	-0.002 (0.002)	-0.002 (0.002)
Time*Professional	0.078*** (0.005)	0.080*** (0.005)
Chinese*Professional	0.058*** (0.005)	0.059*** (0.005)
Constant	0.004*** (0.001)	0.026*** (0.002)
State fixed effects	No	Yes
Year fixed effects	No	Yes
Observations	342,441	342,441
R ²	0.059	0.068
Adjusted R ²	0.059	0.068

Notes: Regressions employ OLS with standard errors clustered at the state level ($p < 0.1$; ** $p < 0.05$; *** $p < 0.01$). Data are from the decennial Malaysia Population and Housing Census from 1970 to 2000.*

topic for countries which are currently implementing some form of affirmative action and those considering imposing affirmative action policies in the future. The findings of this chapter demonstrate that a potential unintended consequence of this kind of policy is that it can incentivize the excluded group to invest more in education in order to leave the country, which inadvertently helps improve the educational outcome of the non-preferred group.

There are several potential limitations to this research project. First, it is possible that Malaysia is different from other migrant-sending countries, and consequently that the main findings of this chapter cannot be generalized to other countries. However, evidence suggests that the Malaysia experience is not that unusual. For example, Fiji, a country that modeled its preferential policy after the NEP also witnessed a large improvement in the educational outcomes of Indian Fijians - the excluded group - who then left the country in massive numbers for higher paying jobs in the developed world (Chand and Clemens, 2008).

The biggest threat to internal validity is that the treatment group may differ from the control group in ways that affect their educational outcomes. Ethnic Chinese may be more willing and able to invest in the education of their children by sending them to private schools or universities abroad than their Malay peers *regardless of the NEP*. A lack of pretreatment data on the percentage of enrollment into public vs. private, and domestic vs. foreign schools for both ethnic groups make it difficult to assess this alternative explanation for the difference in the educational outcome between the Malays and Chinese.

Limitations aside, this chapter broadens our understanding of the effect of decreasing domestic wages on the educational attainment of potential migrants and the human capital stock of migrant-sending countries.

6

Conclusion

The acceleration of high-skilled migration has generated an considerable amount of research. Much research has been done to examine the consequences of this phenomenon for migrant-sending countries but the findings are far from conclusive. This dissertation augments the discussion and makes several important theoretical and empirical contributions. Theoretically, it challenges a critical but outdated assumption which most extant brain gain models are based on, that is, migrant-receiving countries cannot differentiate high-skilled workers from low-skilled workers when deciding whether to grant them entry. This dissertation draws upon an alternative theoretical framework - the tournament model - to shed light on how skilled migration affects the level of human capital in migrant-sending countries. By adapting a two-period tournament model to the context of international migration, this research project demonstrates that two key factors determining the income gap between migrant-sending and migrant-receiving countries are 1) the intensity of screening by migrant-receiving countries and 2) the wage level in migrant-sending countries.

In order to examine the effect of the first factor, this dissertation employs an increase in screening by the United States following the 9/11 terrorist attacks and finds

that the intensity of screening in migrant-receiving countries fosters human capital formation in migrant-sending countries. This dissertation makes several important policy recommendations. First, it recommends that when facing strict visa restrictions imposed by migrant-receiving countries, migrant-sending countries should invest more in their own higher education institutions, collaborate with reputable universities abroad and welcome international branch campuses. In addition, this dissertation cautions migrant-receiving countries against increasing visa restrictions because they may consequently lose foreign talent and hinder economic growth.

With regard to the second determining factor of the foreign-home wage differential, utilizing a quasi-natural experiment in Malaysia, this research project finds that a decrease in the wage level in migrant-sending countries has a positive impact on the educational outcomes of potential migrants. The empirical findings provide insight into the effect of one of the world's most comprehensive affirmative action programs (Ong, 2012) on the educational attainment of the non-preferred group. This dissertation concludes that counter-intuitively, such preferential policies can benefit the excluded group more than the protected group by creating an incentive for the former to invest more in education than they would otherwise in order to migrate to different countries.

Overall, this dissertation advances our understanding of the effect of high-skilled migration on human capital accumulation in migrant-sending countries.

Appendix A

Appendix to Chapter 3

A.1 The Nash Equilibrium in an Even Tournament

Each worker's expected utility function is:

$$\begin{aligned} U(w_k, e_k) &= P \cdot [w_H(s) - c(e_k)] + (1 - P) \cdot [w_L - c(e_k)], \quad k = i, j \\ &= P \cdot w_H(s) + (1 - P) \cdot w_L - c(e_k) \end{aligned}$$

The probability that i wins is:

$$\begin{aligned} P(y_i > y_j) &= P(e_i + \epsilon_i > e_j + \epsilon_j) \\ &= P(e_i - e_j > \epsilon_j - \epsilon_i) \\ &= P(e_i - e_j > \gamma) \\ &= G(e_i - e_j) \end{aligned} \tag{A.0}$$

where $\gamma \equiv \epsilon_i - \epsilon_j$, $\gamma \sim g(\gamma)$, $G(\cdot)$ is the cdf of γ and $E(\gamma) = 0$ because ϵ_i and ϵ_j are independent and identically distributed.

Both i and j choose the level of effort that maximizes their expected utility. This means the optimal effort level occurs when the marginal benefit of effort equals its

marginal cost. Thus, each worker's effort choice must satisfy the following first-order condition:

$$[w_H(s) - w_L] \cdot \frac{\partial P}{\partial e_k} - C'(e_k) = 0, \quad k = i, j \quad (\text{A.1})$$

and the second-order condition:

$$[w_H(s) - w_L] \cdot \frac{\partial^2 P}{\partial e_k^2} - C''(e_k) < 0, \quad k = i, j \quad (\text{A.2})$$

The concavity of each worker's payoff function ensures that Equation A.2 is satisfied. Worker i takes e_j^* as a given when determining his own effort level and vice versa. From Equation (A.0), for worker i :

$$\frac{\partial P}{\partial e_i} = \frac{\partial G(e_i - e_j)}{\partial e_i} = g(e_i - e_j) \quad (\text{A.3})$$

which after substitution into (A.1) yields:

$$[w_H(s) - w_L] \cdot g(e_i - e_j) - c'(e_i) = 0 \quad (\text{A.4})$$

Worker i 's function is symmetrical to Equation (A.4). Symmetry implies that when the Nash solution exists, $e_i = e_j$ and $P = G(0) = 1/2$. Substituting $e_i = e_j$, equation (A.4) reduces to:

$$[w_H(s) - w_L] \cdot g(0) = c'(e_k) \quad (\text{A.5})$$

Given the distributional assumptions on ϵ_k , this equation can be rewritten as:

$$e_k^* = \frac{(w_H - w_L) \cdot c}{4\alpha}, \quad k = i, j \quad (\text{A.6})$$

A.2 The Nash Equilibrium in an Uneven Tournament

In a uneven tournament, each worker's expected utility is the same as in an even tournament:

$$U(w_k, e_k) = P \cdot [w_H(s) - c(e_k)] + (1 - P) \cdot [w_L - c(e_k)], \quad k = i, j$$

and the probability that worker i wins is also the same:

$$P(y_i > y_j) = P(e_i + \epsilon_i > e_j + \epsilon_j)$$

The only difference between the two versions of the game is that in a uneven tournament, one worker is “disadvantaged,” which means this individual bears more cost for the same amount of effort than the other worker. In particular, consider the case where worker j 's cost function is $m \cdot C(e_i)$ where $m > 1$ while worker i 's remains the same:

$$C_i(e) = \frac{e_i^2}{c}$$

$$C_j(e) = m \cdot \frac{e_i^2}{c}$$

In this case, worker j is disadvantaged. If an interior Nash equilibrium exists, then at the equilibrium $e_i^* = m \cdot e_j^*$ ($m > 1$). Each worker's first condition and second condition must be satisfied.

Worker i 's first condition is:

$$[w_H(s) - w_L] \cdot \frac{\partial P_i}{\partial e_i} - C'(e_i) = 0 \tag{A.7}$$

and second condition is:

$$[w_H(s) - w_L] \cdot \frac{\partial^2 P_i}{\partial e_i^2} - C''(e_i) < 0 \tag{A.8}$$

Worker j 's first condition is:

$$[w_H(s) - w_L] \cdot \frac{\partial P_j}{\partial e_j} - m \cdot C'(e_j) = 0 \quad (\text{A.9})$$

and second condition is:

$$[w_H(s) - w_L] \cdot \frac{\partial^2 P_j}{\partial e_j^2} - m \cdot C''(e_j) < 0 \quad (\text{A.10})$$

The concavity of each worker's payoff function ensures that the second conditions (Equations (A.8) and (A.10)) are satisfied.

Given the distributional assumptions on ϵ_k , it can be shown that:

$$e_j^* = \frac{c(w_H - w_L)/4m\alpha}{1 + [(1 - m)/4\alpha^2](c(w_H - w_L)/2\alpha)} \quad (\text{A.11})$$

Recall that at the equilibrium $e_i^* = m \cdot e_j^*$ ($m > 1$). This means:

$$e_i^* = m \cdot e_j^* = \frac{c(w_H - w_L)/4\alpha}{1 + [(1 - m)/4\alpha^2](c(w_H - w_L)/2\alpha)} \quad (\text{A.12})$$

A.3 Relationship between Effort and Screening in an Even Tournament

The Nash equilibrium in an even tournament is as follows:

$$e_k^* = \frac{(w_H - w_L) \cdot c}{4\alpha}, \quad k = i, j \quad (\text{A.13})$$

Substituting $w_H = ab + s$, equation (A.13) becomes:

$$e_k^* = \frac{(as + b - w_L) \cdot c}{4\alpha}, \quad k = i, j \quad (\text{A.14})$$

This equation yields:

$$\frac{\partial e_k^*}{\partial s} = \frac{ac}{4\alpha}, \quad k = i, j \quad (\text{A.15})$$

Given that $a > 0$, $c > 0$ and $\alpha > 0$:

$$\frac{\partial e_k^*}{\partial s} > 0, \quad k = i, j \quad (\text{A.16})$$

A.4 Relationship between Effort and Screening in an Uneven Tournament

A.4.1 Find $\frac{\partial e_j^*}{\partial s}$ for the disadvantaged worker j

As shown in Equation A.11, the Nash equilibrium in a uneven tournament is as follows:

$$e_j^* = \frac{c(w_H - w_L)/4m\alpha}{1 + [(1 - m)/4\alpha^2](c(w_H - w_L)/2\alpha)} \quad (\text{A.17})$$

This means:

$$\frac{\partial e_j^*}{\partial s} = \frac{c}{4m\alpha} \cdot \frac{\partial}{\partial s} \left(\frac{as + b - w_L}{1 + [(1 - m)/4\alpha^2]c(as + b - w_L)/2\alpha} \right) \quad (\text{A.18})$$

$$= \frac{c}{4m\alpha} \cdot \frac{a[1 + [(1 - m)/4\alpha^2] \cdot c(as + b - w_L)/2\alpha] - ca(1 - m)(as + b - w_L)/8\alpha^3}{[1 + [(1 - m)/4\alpha^2] \cdot c(as + b - w_L)/2\alpha]^2} \quad (\text{A.19})$$

$$= \frac{c}{4m} \cdot \frac{8^2 a \alpha^5}{[c(1 - m)(as + b - w_L) + 8\alpha^3]^2} \quad (\text{A.20})$$

$$= \frac{16ca\alpha^5}{m[c(1 - m)(as + b - w_L) + 8\alpha^3]^2} \quad (\text{A.21})$$

Given that $a > 0$, $c > 0$, $\alpha > 0$ and $m > 0$:

$$\frac{\partial e_j^*}{\partial s} > 0 \quad (\text{A.22})$$

A.4.2 Find $\frac{\partial e_i^*}{\partial s}$ for the advantaged worker i

As shown in Equation A.12, the Nash equilibrium for the advantaged worker in a uneven tournament is as follows:

$$e_i^* = me_j^* = m \cdot \frac{c(w_H - w_L)/4m\alpha}{1 + [(1 - m)/4\alpha^2](c(w_H - w_L)/2\alpha)} \quad (\text{A.23})$$

$$= \frac{c(w_H - w_L)/4\alpha}{1 + [(1 - m)/4\alpha^2](c(w_H - w_L)/2\alpha)} \quad (\text{A.24})$$

This means:

$$\frac{\partial e_i^*}{\partial s} = \frac{c}{4\alpha} \cdot \frac{\partial}{\partial s} \left(\frac{as + b - w_L}{1 + [(1 - m)/4\alpha^2]c(as + b - w_L)/2\alpha} \right) \quad (\text{A.25})$$

$$= \frac{16ca\alpha^5}{[8\alpha^3 + c(1 - m)(as + b - w_L)]^2} \quad (\text{A.26})$$

Given that $a > 0$, $c > 0$ and $\alpha > 0$:

$$\frac{\partial e_i^*}{\partial s} > 0 \quad (\text{A.27})$$

Appendix B

Appendix to Chapter 4

Table B.1: Predictors of Average SAT Score

Predictors	Definition
Gross Domestic Product (GDP)	GDP per capita, PPP (current international \$)
GDP Growth Rate	Annual percentage growth rate of GDP at market prices based on constant local currency.
Population	Population, total
Expenditure on Education	Expenditure on education as % of total government expenditure (%)
Expenditure on Primary Education	Expenditure on primary as % of total government expenditure (%)
Expenditure on Secondary Education	Expenditure on secondary as % of total government expenditure (%)
Expenditure on Post-Secondary Education	Expenditure on post-secondary, non-tertiary as % of total government expenditure (%)
Expenditure on Tertiary Education	Expenditure on tertiary as % of total government expenditure (%)
Expenditure per Primary Student	Government expenditure per primary student (constant PPP\$)
Expenditure per Secondary Student	Government expenditure per secondary student (constant PPP\$)
Expenditure per Post-Secondary Student	Government expenditure per post-secondary non-tertiary student (constant PPP\$)
Expenditure per Tertiary Student	Government expenditure per tertiary student (constant PPP\$)
Pupil-Teacher Ratio in Primary Education	Pupil-teacher ratio in primary education (headcount basis)
Pupil-Teacher Ratio in Secondary Education	Pupil-teacher ratio in secondary education (headcount basis)
Pupil-Teacher Ratio in Tertiary Education	Pupil-teacher ratio in tertiary education (headcount basis)

Table B.2: List of Countries in the Control Group

Model 1: Developing Countries	Model 2: Only Latin America
Bahamas, The	Bahamas, The
Bangladesh	Colombia
Bermuda	Dominican Republic
Bulgaria	Ecuador
China	Guatemala
Colombia	Haiti
Dominican Republic	Honduras
Ecuador	Jamaica
Ethiopia	Panama
Ghana	Peru
Guatemala	Trinidad and Tobago
Haiti	
Honduras	
India	
Indonesia	
Jamaica	
Jordan	
Kenya	
Kuwait	
Malaysia	
Nepal	
Nigeria	
Pakistan	
Panama	
Peru	
Philippines	
Romania	
Sri Lanka	
Thailand	
Trinidad and Tobago	
Turkey	
Uganda	
Vietnam	
Zimbabwe	

Appendix C

Appendix to Chapter 5

The International Standard Classification of Occupations (ISCO) divides jobs into major occupational groups. For more information on the definitions of each group, see International Labour Office (2012).

Craft and Related Trades Workers

1. Building and Related Trades Workers (excluding Electricians)
2. Metal, Machinery and Related Trades Workers
3. Handicraft and Printing Workers
4. Electrical and Electronic Trades Workers
5. Food Processing, Woodworking, Garment and Other Craft and Related Trades Workers

Elementary Occupations

1. Cleaners and Helpers
2. Agricultural, Forestry and Fishery Laborers
3. Laborers in Mining, Construction, Manufacturing, and Transport
4. Food Preparation Assistants

5. Street and Related Sales and Services Workers
6. Refuse Workers and Other Elementary Workers

Plant and Machine Operators and Assemblers

1. Stationary Plant and Machine Operators
2. Assemblers
3. Drivers and Mobile Plant Operators

Professionals

1. Science and Engineering Professionals
2. Health Professionals
3. Teaching Professionals
4. Business and Administration Professionals
5. Information and Communications Technology Professionals
6. Legal, Social and Cultural Professionals

Services and Sales Workers

1. Personal Services Workers
2. Sales Workers
3. Personal Care Workers
4. Protective Services Workers

Technicians and Associate Professionals

1. Science and Engineering Associate Professionals
2. Health Associate Professionals
3. Business and Administration Associate Professionals
4. Legal, Social and Cultural Associate Professionals
5. Information and Communications Technicians

Bibliography

- Abadie, A. and Gardeazabal, J. (2003), “The economic costs of conflict: A case study of the Basque Country,” *American economic review*, 93, 113–132.
- Abadie, A., Diamond, A., and Hainmueller, J. (2010), “Synthetic control methods for comparative case studies: Estimating the effect of California’s tobacco control program,” *Journal of the American statistical Association*, 105, 493–505.
- Ai, C. and Norton, E. C. (2003), “Interaction terms in logit and probit models,” *Economics letters*, 80, 123–129.
- Aihara, A. (2009), “Paradoxes of Higher Education Reforms: Implications on the Malaysian Middle Class,” *International Journal of Asia-Pacific Studies*, 5.
- Angrist, J. D. and Pischke, J.-S. (2010), “The credibility revolution in empirical economics: How better research design is taking the con out of econometrics,” *Journal of economic perspectives*, 24, 3–30.
- Arcidiacono, P. and Lovenheim, M. (2016), “Affirmative action and the quality-fit trade-off,” *Journal of Economic Literature*, 54, 3–51.
- Batista, C., Lacuesta, A., and Vicente, P. C. (2012), “Testing the ‘brain gain’ hypothesis: Micro evidence from Cape Verde,” *Journal of Development Economics*, 97, 32–45.
- Beine, M., Docquier, F., and Rapoport, H. (2001), “Brain drain and economic growth: theory and evidence,” *Journal of development economics*, 64, 275–289.
- Beine, M., Docquier, F., and Rapoport, H. (2008), “Brain drain and human capital formation in developing countries: winners and losers,” *The Economic Journal*, 118, 631–652.
- Beine, M. A., Docquier, F., and Rapoport, H. (2003), “Brain drain and LDCs’ growth: winners and losers,” *IZA Discussion Paper*.
- Berry, R. A. and Soligo, R. (1969), “Some welfare aspects of international migration,” *Journal of political economy*, 77, 778–794.

- Bhagwati, J. and Hamada, K. (1974), "The brain drain, international integration of markets for professionals and unemployment: a theoretical analysis," *Journal of Development Economics*, 1, 19–42.
- Bhagwati, J. and Rao, M. (1999), "Foreign students in science and engineering Ph. D. programs: An alien invasion or brain gain," *Foreign temporary workers in America: Policies that benefit the US economy*, pp. 238–258.
- Bhagwati, J. N. and Partington, M. (1976), *Taxing the Brain Drain: Theory and empirical analysis*, vol. 2, North-Holland.
- Bloom, D. E., Altbach, P., and Rosovsky, H. (2016), "Looking Back on the Lessons of Higher Education and Developing Countries: Peril and Promise: Perspectives on China and India," *IZA Discussion Paper*.
- Borjas, G. J. (2002), "An evaluation of the foreign student program," *KSG Working Paper No. RWP02-026*.
- Borjas, G. J. (2005), "The labor market impact of high-skill immigration," Tech. rep., National Bureau of Economic Research.
- Cervantes, M. and Guellec, D. (2002), "The brain drain: old myths, new realities.(Brain drain)," *OECD Observer*, pp. 40–43.
- Chand, S. and Clemens, M. A. (2008), "Skilled emigration and skill creation: a quasi-experiment," *Available at SSRN 1299135*.
- Chew, S.-B. and Chew, R. (1995), "Immigration and foreign labour in Singapore," *ASEAN Economic Bulletin*, pp. 191–200.
- Commander, S., Kangasniemi, M., and Winters, L. A. (2004), "The brain drain: curse or boon? A survey of the literature," in *Challenges to globalization: Analyzing the economics*, pp. 235–278, University of Chicago Press.
- Desai, M. A., Kapur, D., McHale, J., and Rogers, K. (2009), "The fiscal impact of high-skilled emigration: Flows of Indians to the US," *Journal of Development Economics*, 88, 32–44.
- Docquier, F. and Marfouk, A. (2006), "International migration by education attainment 1990–2000," *International migration, remittances, and the brain drain*, pp. 151–99.
- Docquier, F. and Rapoport, H. (2004), *Skilled migration: the perspective of developing countries*, World Bank, Washington, DC.
- Docquier, F. and Rapoport, H. (2012), "Globalization, Brain drain, and Development," *Journal of Economic Literature*, 50, 681–730.

- Dwivedi, D. (2005), *Macroeconomics: theory and policy*, Tata McGraw-Hill Education.
- Easterly, W. and Nyarko, Y. (2008), "Is the brain drain good for Africa?" *Brookings Global Economy and Development Working Paper*.
- Esman, M. J. (1972), *Administration and development in Malaysia: Institution building and reform in a plural society*, Ithaca: Cornell University Press.
- Freeman, R. B. and Oostendorp, R. H. (2005), "Occupational Wages around the World (OWW) Database," .
- Goodrich, J. G. (2007), "Help Wanted: Looking for a Visa System That Promotes the US Economy and National Security," *University of Richmond Law Review*, 42, 975.
- Government of Malaysia (1966), *First Malaysia Plan, 1966-1970*, Government Press.
- Government of Malaysia (1971), *Second Malaysia Plan, 1971-1975*, Government Press.
- Government of Malaysia (1976), *Third Malaysia Plan, 1976-1980*, Government Press.
- Government of Malaysia (1981), *Third Malaysia Plan, 1981-1985*, Government Press.
- Grubel, H. B. and Scott, A. D. (1966), "The international flow of human capital," *The American Economic Review*, 56, 268–274.
- Hamada, K. and Bhagwati, J. (1975), "Domestic distortions, imperfect information and the brain drain," *Journal of Development Economics*, 2, 265–279.
- Hirschman, C. (1980), "Demographic trends in Peninsular Malaysia 1947-75," *Population and Development Review*, 6, 103–125.
- Ho, Y.-J. and Tyson, A. D. (2011), "Malaysian migration to Singapore: Pathways, mechanisms and status," *Malaysian Journal of Economic Studies*, 48, 131–145.
- Holzer, H. and Neumark, D. (2000), "Assessing affirmative action," *Journal of Economic Literature*, 38, 483–568.
- Honaker, J., King, G., Blackwell, M., et al. (2011), "Amelia II: A program for missing data," *Journal of statistical software*, 45, 1–47.
- Hou, A. Y.-C., Hill, C., Chen, K. H. J., and Tsai, S. (2018), "A comparative study of international branch campuses in Malaysia, Singapore, China, and South Korea: regulation, governance, and quality assurance," *Asia Pacific Education Review*, 19, 543–555.

- International Labour Office (2012), *International Standard Classification of Occupations 2008 (ISCO-08): Structure, group definitions and correspondence tables*, International Labour Office.
- Johnson, H. G. (1967), "Some economic aspects of brain drain," *The Pakistan Development Review*, 7, 379–411.
- Joshi, B. R. (1982), "Whose Law, Whose Order:" Untouchables," Social Violence, and the State in India," *Asian Survey*, 22, 676–687.
- Kato, T. and Sparber, C. (2013), "Quotas and quality: The effect of H-1B visa restrictions on the pool of prospective undergraduate students from abroad," *Review of Economics and Statistics*, 95, 109–126.
- Kim, E. H. and Zhu, M. (2010), "Universities as firms: The case of US overseas programs," in *American universities in a global market*, pp. 163–201, University of Chicago Press.
- Koh, S. Y. (2015), "How and why race matters: Malaysian-Chinese transnational migrants interpreting and practising Bumiputera-differentiated citizenship," *Journal of Ethnic and Migration Studies*, 41, 531–550.
- Kondapi, C. (1951), *Indians overseas, 1838-1949*, Indian Council of World Affairs.
- Koon, H. (1997), "The new economic policy and the Chinese community in Peninsular Malaysia," *The Developing Economies*, 35, 262–292.
- Lazear, E. P. and Rosen, S. (1979), "Rank-order tournaments as optimum labor contracts," .
- Lee, H.-A. (2012), "Affirmative action in Malaysia: Education and employment outcomes since the 1990s," *Journal of Contemporary Asia*, 42, 230–254.
- Limlingan, V. S. (1986), "The Overseas Chinese in ASEAN: Business Strategies and Management Practices," Ph.D. thesis, Harvard University.
- Ling, L. S. (1988), *The Future of Malaysian Chinese*, Malaysian Chinese Association.
- Maio, G. R. and Esses, V. M. (1998), "The social consequences of affirmative action: Deleterious effects on perceptions of groups," *Personality and Social Psychology Bulletin*, 24, 65–74.
- McKenzie, D. J. and Rapoport, H. (2006), "Can migration reduce educational attainment? Evidence from Mexico," *Evidence from Mexico (June 1, 2006)*. *World Bank Policy Research Working Paper*.
- Means, G. P. (1972), "Special Rights' as a Strategy for Development: The Case of Malaysia," *Comparative Politics*, 5, 29–61.

- Mehmet, O. and Hoong, Y. Y. (1986), "Human capital formation in Malaysian universities," *A Socio-Economic Profile of the 1983 Graduates, Institut Pengajian Tinggi Universiti Mayala*, p. 79.
- Minnesota Population Center (2018), "Integrated Public Use Microdata Series (IPUMS) International," <https://doi.org/10.18128/D020.V7.1>.
- Mishra, P. (2007), "Emigration and wages in source countries: Evidence from Mexico," *Journal of Development Economics*, 82, 180–199.
- Mood, C. (2010), "Logistic regression: Why we cannot do what we think we can do, and what we can do about it," *European sociological review*, 26, 67–82.
- Mountford, A. (1997), "Can a brain drain be good for growth in the source economy?" *Journal of development economics*, 53, 287–303.
- Oldman, O. and Pomp, R. (1975), "The brain drain: A tax analysis of the Bhagwati proposal," *World Development*, 3, 751–763.
- Ong, E. (2012), "Education and Labor Market Outcomes of Malaysia's Affirmative Action Policies," .
- Osman, Z. and Shahiri, H. (2017), "Ethnic and gender inequality in employment during the new economic policy," *Institutions and Economies*, pp. 57–72.
- Pepinsky, T. B. and Wihardja, M. M. (2011), "Decentralization and economic performance in Indonesia," *Journal of East Asian Studies*, 11, 337–371.
- Powers, D. E. (1988), "Preparing for the SAT: A survey of programs and resources," *ETS Research Report Series*.
- Powers, D. E. and Rock, D. A. (1998), "Effects of Coaching on SAT: Reasoning Scores," *ETS Research Report Series*.
- Puthucheary, M. (1978), *The politics of administration: The Malaysian experience*, Oxford University Press.
- Rosenzweig, M. R., Irwin, D. A., and Williamson, J. G. (2006), "Global Wage Differences and International Student Flows [with Comments and Discussion]," in *Brookings trade forum*, pp. 57–96, JSTOR.
- Rugayah, M. (1995), "Public enterprises," *Privatising Malaysia Westview Press: Boulder Colorado*.
- Samarasinghe, S. (1984), "Ethnic Representation in Central Government Employment and Sinhala-Tamil Relations in Sri Lanka: 1948-1981," *From Independence to Statehood: Managing Ethnic Conflict in Five African and Asian States*, pp. 173–184.

- Selvaratnam, V. (1988), "Ethnicity, inequality, and higher education in Malaysia," *Comparative Education Review*, 32, 173–196.
- Shachar, A. (2006), "The Race for Talent: Highly-Skilled Migrants and Competitive Immigration Regimes"[2006]," *New York University Law Review*, 81, 148.
- Snodgrass, D. R. (1980), *Inequality and economic development in Malaysia*, Oxford (UK) Oxford Univ. Press.
- Sowell, T. (2004), *Affirmative action around the world: An empirical study*, Yale University Press.
- Stark, O., Helmenstein, C., and Prskawetz, A. (1997), "A brain gain with a brain drain," *Economics letters*, 55, 227–234.
- Stark, O., Helmenstein, C., and Prskawetz, A. (1998), "Human capital depletion, human capital formation, and migration: a blessing or a "curse"?" *Economics Letters*, 60, 363–367.
- The World Bank (2018), "World Development Indicators," <http://data.worldbank.org/data-catalog/world-development-indicators>.
- UNCTAD (1975), "The Reverse Transfer of Technology: Its Dimensions, Economic Effects and Policy Implications," in *United Nations Conference on Trade and Development*.
- United Nations (2013), "World Migration in Figures," Tech. rep.
- Vidal, J.-P. (1998), "The effect of emigration on human capital formation," *Journal of Population Economics*, 11, 589–600.
- Vigdor, J. L. and Clotfelter, C. T. (2003), "Retaking the SAT," *Journal of Human Resources*, 38, 1–33.
- Wan, C. D. (2007), "Public and private higher education institutions in Malaysia: Competing, complementary or crossbreed as education providers," *Kajian Malaysia*, 25, 1–14.
- World Bank (2004), "Affirmative Action in Public Services: Comparative Administrative Practice," Tech. rep., <http://www.gsdrc.org/document-library/implementing-affirmative-action-in-public-services-comparative-administrative-practice/>.
- World Bank (2011), "Malaysia Economic Monitor: Brain Drain," Tech. rep., <http://documents.worldbank.org/curated/en/282391468050059744/Malaysia-economic-monitor-brain-drain>.

World Bank (2016), “Migration and Development: A Role for the World Bank Group,” Tech. rep., <http://documents.worldbank.org/curated/en/690381472677671445/Migration-and-development-a-role-for-the-World-Bank-Group>.

World Bank (2018), “Moving for Prosperity: Global Migration and Labor Markets,” Tech. rep., <http://www.worldbank.org/en/research/publication/moving-for-prosperity>.

Biography

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