Essays on Immigrants and their Impact on the Local Labour Market

by

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Essays on Immigrants and their Impact on the Local Labour Market

submitted by **Ronit Mukherji**

in partial fulfillment of the requirements for the degree of **Doctor of Philosophy** in **Economics**.

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Abstract

The first chapter studies how low-skilled immigrant entry can explain the falling labour unionization rate in the U.S. economy. This paper argues that the entry of immigrants has significantly altered the incentives of native-born workers to join labour unions and for firms to hire unionized workers, prompting a fall in unionization. The chapter uses spatial variation in immigrant entry to show that a higher entry of immigrants leads to a higher fall in unionization rates across regions in the U.S. It develops a search-theoretic framework to bear out the mechanism and test some over-identifying predictions. The model is further calibrated and finds that low-skilled immigrant entry can explain 48-55% of the total fall in union density.

The second chapter exploits plausibly exogenous changes in exchange rates across source countries for immigrants in Canada to evaluate how these changes impact their earnings. It presents evidence that Canadian immigrants, in response to a 10 per cent depreciation of the home currency relative to the Canadian dollar, reduce their annual earnings by 0.36 per cent, mainly by reducing hours worked. The effect is greater for recent male immigrants, who are less educated and their spouses abroad. They also tend to be from lower-income countries and located in immigrant enclaves. Crucially, remittance senders are more affected, but these exchange rate fluctuations do not affect the amount of remittance sent. Thus, suggesting that immigrants tend to be target earners and react accordingly to exchange rate fluctuations.

The third chapter examines how immigrants' labour market conditions at the point of entry affect their earnings, labour market outcomes, and reverse migration decisions both in the short and long run. Using administrative tax data, this chapter finds that it takes 12-15 years for an initial adverse effect of entering the labour market when unemployment is high to dissipate completely. It further documents the heterogeneity existing in this impact based on age, gender, marital status, country of origin, and education. The chapter provides novel insights into the outmigration behaviour of immigrants and how it depends on the initial conditions they face post-arrival.

Lay Summary

My dissertation consists of three chapters in labour economics and macroeconomics centred around understanding immigrant workers and how their entry impacts labour market institutions. The first chapter analyses how low-skilled immigrant labour entry can explain falling unionization rates in the U.S., where regions with a higher entry of low-skilled immigrants saw a larger fall in union density. It is further evaluated using a search-theoretic model, which provides useful over-identifying predictions and lends itself to quantitative evaluation through a calibration exercise. The second chapter shows that immigrants in Canada tend to be target remitters, and they often reduce their earnings when faced with a currency depreciation in their source country. The third chapter evaluates how immigrants' labour market conditions at the time and place of entry impact their earnings. I underline the heterogeneity in this impact and how it might affect the outmigration decisions of immigrant workers.

Preface

Chapters 2, 3, and 4 of the thesis are pieces of original, unpublished and independent work by the author, R. Mukherji.

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Finally, I would like to thank my parents for their unconditional love and support throughout this journey. They never stopped believing in me, and this thesis would not be possible without them. I also want to dedicate my thesis to the memory of my maternal grandfather.

Chapter 1

Introduction

This thesis comprises three chapters looking into immigrant behaviour, earnings and how their entry affects the local labour market. The thesis uses micro data-based empirical investigation to make causal statements on immigrant entry affecting the local economy and how macroeconomics conditions in the source and foreign economy affect their earnings in the short and long run. It then combines it with macroeconomic models and calibration tools to better understand these changes occurring in the local economy. In particular, the first chapter studies how the entry of low skilled immigrants can explain the drastic and consistent fall in the unionization rate in the U.S. starting in the late 1960s. The second chapter looks at how exchange rate fluctuations between foreign and the source economy can affect the earnings of immigrant workers by changing the real income of these workers. Finally, the third chapter analyses how macroeconomic conditions at the point of entry can affect the earnings of immigrant workers in the long-run and documents the substantial heterogeneity in this impact.

Can the entry of low skilled immigrants explain falling unionization rates as seen in the U.S.? The first chapter of this thesis directly answers this question. The chapter argues that the entry of immigrants into the U.S. economy has significantly altered the incentives of native-born workers to join labour unions and firms to hire unionized workers, prompting a fall in unionization. High-skilled workers find their efforts better rewarded in the non-union sector once immigrants enter the workforce, thus, leaving the union. On the other hand, low-skilled native workers who face competition from immigrant workers are now less valued by firms if unionized and cannot demand a union wage. Thus, high skilled native-born workers leave the union for better pay, and low skilled native-born workers leave as firms do not as highly value them in the face of competition from similarly skilled immigrants. Thus, we find unionization falling around the two ends of the skill distribution and concentrating towards the middle. I present evidence that the entry of low skilled immigrants drives down union rates across geographical regions using an instrumental variable approach. The relationship is robust in controlling for other potential causes proposed to explain a decline in union density. I also show how this fall in unionization is not driven by immigrants joining the workforce who, on average, are less likely to be unionized. The chapter then develops a search-theoretic framework to bear out the mechanism and empirically test predictions derived from the model. Besides being novel in their own right, the over-identifying predictions from the model also lend confidence to the forthcoming calibration exercise. The model is further calibrated to fit the data in 1980 and used to predict union density in 2000. This exercise finds that low skilled

immigrant entry can explain 48-55% of the total fall in union density.

The chapter contributes to three strands of the literature in labour economics and macroeconomics. Firstly, it contributes to the literature trying to determine the cause behind falling union rates in the U.S. Acemoglu et al. (2001) considers skill-biased technical change (SBTC) to be the leading cause and argues that with SBTC, highly skilled workers prefer leaving the union. The model presented in this paper can generate similar findings but is different in two crucial aspects. Firstly, this analysis predicts that high- and low-skilled workers leave the union, supported by my empirical results. Secondly, this chapter differs by highlighting the contributions of both native-born workers and firms in reducing union rates. MacDonald and Robinson (1992) analyze unionization using the firm's cost function in a partial equilibrium setting. However, their analysis omits the strategic interaction between workers and firms in reducing union rates. Dinlersoz and Greenwood (2016) again argue for SBTC as the driving force behind falling union rates in a theoretical setting. However, they do not provide empirical evidence to back their causal story. Finally, this study is closest to the approach of Açıkgöz and Kaymak (2014) from a theoretical standpoint. They assume an exogenous increase in productivity prompts deunionization when unions follow an egalitarian approach, as shown by Freeman and Medoff (1984) and Card (1996). This work goes beyond their contribution in two primary ways: Firstly, it highlights in the model the critical determinant- low-skilled immigrant entry and how that affects productivities and incentives to unionize and backs it up with calibrating the identifying changes. Secondly, I deploy a rigorous empirical investigation into how immigrant entry leads to a fall in union rates, thus making a causal claim.

This second strand of literature this work contributes to studies of the impact of immigrant entry into the labour market on native earnings and other outcomes. There are two approaches used in this literature. The first method explored in Card (2001b), Altonji and Card (2007) and Card (2009) looks to compare labour market outcomes or changes in labour market outcomes in response to local immigrant inflows across locations. To account for the endogenous sorting of migrants, they use what is known as the ethnic enclave instrument. In the same vein, Card (1990) reports that the large inflow of Cubans to Miami in 1980 (during the Mariel Boatlift) had a minimal effect on the Miami labour market. Some other papers that make use of natural experiments to analyze the effect of immigrant entry are Friedberg (2001), Glitz (2012), and Angrist and Kugler (2003). On the other hand, Borjas (2003) argues for comparing labour market outcomes across education and experience groups at the national level. However, the identification strategy in Borjas (2003) relies on the exogeneity of immigrant flows into skill-experience cells.[1] This chapter takes the first approach and evaluates the impact of immigrant entry on unionization rates across geographical regions but looks closely at low skilled immigrants and how they affect unionization rates of differently skilled natives.

[1]Ottaviano and Peri (2012) and Monras (2020) for a more careful evaluation of the issues surrounding the Borjas (2003) method.

From a more modelling standpoint, papers have tried to analyze the effect of immigrants on the local labour market. Ottaviano and Peri (2012) in a structural production function approach, introduce substitutability between natives and immigrants of similar education and experience levels and take that to data to find immigrant entry has a more severe impact in terms of wage reduction on previous immigrants than low-skilled natives. Chassamboulli and Palivos (2014) use a search and matching framework to analyze immigrant entry on native-born wages and find it to be substantial after a calibration exercise. Amior and Manning (2020) looks at the wage effects of immigration in the presence of a monopsonistic labour market. Albert (2021) find undocumented immigrants have a high job creation effect on natives and thus increase their employment and wages. In this work, I also employ a search and matching framework but look at how the impact of immigrant entry in general equilibrium distorts the incentives of native workers to join the union and for firms to hire unionized workers.[2] This chapter thus captures the dual-sided incentives of workers and firms alike through a change in wage, leading to a decline in union densities.

Finally, there are concerns about growing income inequality in the U.S. a fall in the union rate has also been proposed to have caused an increase in wage inequality, Card (1996), DiNardo et al. (1996), Fortin and Lemieux (1997). Card (2001a) finds 15-20% of the rise in male wage inequality in the U.S. between 1973-1993 can be accounted for by falling union rates. A recent paper by Farber et al. (2021) using new survey data before 1973 points to how U.S. income inequality has varied inversely with union density over the past 100 years. Lemieux (1998) argues that this is because unions compress the returns to a time-invariant unobservable measure of skill. At the same time, studies like Card (2009) have linked an increase in wage inequality to higher low skilled immigrant entry. By analyzing how the entry of low skilled immigrants leads to the fall in union rates, this analysis contributes by tying the two important strands of the literature on income inequality together and, in my knowledge, is the first to do so. Besides inequality, the decline in unions is a major factor behind job polarization, Tüzemen and Willis (2013), Föll and Hartmann (2019) and jobless recoveries, Berger et al. (2012), and the vanishing procyclicality of productivity in the U.S., Mitra (2021). Given how many countries, especially in Europe, continue to have higher union density and have recently established more welcoming immigration policies, it is crucial to understand how the entry of immigrants can affect union density and, in turn, other macroeconomic areas of concern.[3]

In the second and third chapters, instead of looking at how immigrant entry affects the local labour economy, it focuses on how macroeconomics conditions both at home and in the foreign economy affect the earnings of immigrants in both the short and long run. In particular, the second chapter explores how exchange rate fluctuations between source and foreign economies can impact immigrant workers' earnings and labour supply. Immigrants often divide their income in the

[2]This paper, therefore, in a similar contribution to the likes of Lewis (2011) in looking at how immigrant entry can incentivize firms and impact their hiring process.

[3]For job polarization and union presence in Europe, Goos et al. (2009).

foreign economy between consumption in the foreign economy and income sent back to the source country, often remittances. Therefore, any source country's currency devaluation would mean an increase in the immigrant workers' real income, given that a portion of the income is sent to the source economy. This unanticipated wage shock, leading to a rise in real income, can either lead to an increase in earnings by supplying more labour or can also lead to a fall in earnings by reducing the labour supply. The first hypothesis drawn argues for the upward-sloping supply curve for labour. The second hypothesis is the backward bending supply curve or behaviour consistent with target earnings. I find in this chapter that a source country's currency depreciation leads to a fall in earnings, thus backing either the backward bending supply curve or the remittance targetting behaviour. This chapter further finds that this currency depreciation episode affects remittance payers more than others but not the remittance amount paid in the foreign denomination. This concludes that immigrants tend to be remittance targeters and hence cut back on their earnings when faced with a source country currency depreciation. The fall in earnings can be primarily explained by a fall in labour supply.

This chapter seeks to contribute to two strands of the literature. The first strand of literature this paper contributes to is the study of how macroeconomic conditions in the home country affect immigrant behaviour and earnings outcome and the well-being of immigrant labour in general, perhaps first popularized by Borjas (1985). Nekoei (2013) studies the impact of exchange rate volatility on immigrants' labour supply decisions in the U.S. The paper shows that a Dollar appreciation decreases an immigrant's earnings mainly by reducing their hours worked. A 10% dollar appreciation leads to a 0.85% fall in earnings and a 0.55% fall in hours worked in a year. However, the study uses the cross-sectional Current Population Survey (CPS) data and cannot study the long-term implications of exchange rate shocks. He cannot use individual-fixed effects in his regression specification and cannot control outmigration and mobility. More importantly, the study is for the U.S., where about 52% of all immigrants are Mexicans. Hence, he cannot look at the heterogeneity in the response of different immigrant groups, and focusing on a single immigrant group can lead to substantial measurement errors. Finally, the paper cannot quantify the mechanism which leads to these effects.

Besides extending Nekoei (2013), this work also offers a potential improvement over it for the following reasons. Firstly, this study looks at Canada, a country with a more diverse immigrant group than the U.S., with a much higher population classified as first and second-generation immigrants. It is, therefore, necessary to study whether the previous U.S. findings of the labour market impact of exchange rate fluctuations hold for Canada. Secondly, this study better documents and controls for observed and unobserved individual heterogeneity when analyzing exchange rate effects using a rich dataset over a long-time horizon. Previous studies have demonstrated the importance of controlling for unobserved individual heterogeneity in modelling labour market outcomes of immigrants in Canada (Hum and Simpson (2004b)), Germany (Fertig and Schurer (2007)) and the

U.S. (Borjas (1985); Duleep and Dowhan (2002); Lubotsky (2007); Abramitzky et al. (2014)). Thirdly, this chapter documents the facts using both survey and administrative datasets, with the former more prone to issues of measurement errors. I use the administrative dataset to examine heterogeneity within immigrant groups regarding nationality, years since immigration and location choice, which has been relatively unexplored. Finally, this study documents and quantifies the importance of the remittance channel as a mechanism for the behaviour of immigrants, which is absent from previous studies due to the lack of information on remittances sent. This work can thus put the remittance channel at the forefront in explaining the labour supply or earnings change to a change in the real exchange rate.

A paper by Nguyen and Duncan (2017) tries to answer a similar question for Australia but focuses on the time post the East Asian Crisis and finds that a significant devaluation incident in the home country does not significantly change the affected immigrant groups' earnings or labour supply. Specifically, concerning exchange rate shocks, Yang (2006) finds that the East Asian crisis significantly reduced the reverse migration probability of immigrants from the Philippines. Lastly, a paper by Albert and Monras (2017) looks at how the location choices of Mexican immigrants differ depending on the real exchange rate between the U.S. and Mexico. A relatively weaker Mexican Peso leads to immigrants settling in more expensive cities. These cities also have a higher native and immigrant wage gap. Thus, this chapter looks at the direct impact of these purchasing power changes commensurate with exchange rate fluctuations on labour market outcomes. Further, it would be essential to look at heterogeneity between different immigrant countries and groups.

This work also adds to the literature on inter-temporal labour supply decisions. Following an unanticipated wage increase, standard labour theory would predict that this should increase labour supply owing to a substitution effect, as agents substitute away from leisure or home production. Over time if the growth persists, the theory also predicts the emergence of an income effect leading to a backward bending labour supply curve. Papers in this literature that measure labour supply elasticities to wage changes find an insignificant or negative value. Blundell and MaCurdy (1999) argues that individuals are not free to set their labour supply hours. In contrast, Camerer et al. (1997) argues that nonstandard, reference-dependent preferences that exhibit loss aversion around a target income level can explain the insignificance in labour supply choices.[4] On the other hand, a field experiment study by Fehr and Goette (2007) finds a sizeable, positive and significant labour supply elasticity.[5] A recent paper by Thakral and Tô (2021) finds that cab drivers in New York adjust their reference points depending on what time of the day it is and accordingly work less differentially over the day as a response to higher cab fares. Therefore, the jury is still out on whether wage elasticities tend to be negative, as pointed out by the theory on target earnings, or

[4]They analyze the hours worked for New York City cab drivers following an increase in cab fares.

[5]This experiment increases the commission rates of bike messengers in Zurich and tries to find labour supply effects.

positive, as pointed out in the neo-classical theory of the labour market.[6]

The final chapter of the thesis looks at macroeconomic conditions (unemployment rate) at the point of entry of immigrants into the foreign economy and how that affects their earnings in the short and long run. Specifically, this chapter would like to answer the following questions. What are the implications to earnings and assimilation into the economy for the immigrant worker when they enter the market in an economic downturn? How does it affect their outmigration decisions? Finally, does long-term success differ between people who arrive simultaneously but are different in aspects of skills, education, nationality, and gender?

The literature on the consequences of entering the labour market in an economic downturn has concentrated on college graduates. Increasing evidence suggests that temporary exposure to increased unemployment rates can lead to long-term earnings reductions. Using data from the National Longitudinal Study of Youth (NLSY), Kahn (2010) shows that college graduates entering the labour market during the deep recession in the early 1980s experienced reductions in earnings lasting up to 15 years. Oyer (2006), Oyer (2008) presents evidence of the persistent effect on career choice for MBAs and PhD economists. Oreopoulos et al. (2012) show that college graduates in Canada suffer persistent earnings losses. These losses are substantially more significant for those graduates predicted to have low earnings at the start of their careers. Altonji et al. (2016) find heterogeneity in the differential effects of graduating in a recession by college majors. In one of the earliest papers in this literature, Baker et al. (1994) finds strong cohort wage effects in the U.S., and Beaudry and DiNardo (1991) shows that conditions at the time of entry can have a long-term impact on future earnings if job mobility is restricted among workers. Schwandt and Von Wachter (2019), using the cross-sectional Current Population Survey (CPS) data, find persistent earnings and wage reductions of entering a recession, especially for less advantaged entrants, that increases in government support only partly offset. The study was the first to document that reliance on benefits like unemployment insurance and Supplemental Nutrition Assistance Program (SNAP) benefits is higher for individuals entering the labour market in a recession. Outcomes other than earnings also appear to respond to initial labour market entry. Sullivan and Von Wachter (2009) show that entering the job market in a downturn has long-term implications on mortality rates.

The above papers have provided empirical evidence that is highly compelling in establishing the significance of persistent effects of early labour market conditions by focusing on college graduates. However, it is well known that less advantaged groups in the labour market, such as low-educated workers or minorities, experience much more significant increases in unemployment during a recession (Hoynes et al. (2012). Specifically, papers have thus far been unable to identify the impact of entering the labour market in a downturn for immigrants. Most datasets on immigrants are cross-

[6]Some other papers which find a negative wage elasticity include Crawford and Meng (2011); Chang and Gross, 2011 etc. Oettinger (1999) is another paper that supports the theory of positive wage elasticities.

sectional, with little to no information on which sub-regions they first land in or month or year. As they lack a longitudinal aspect, it is impossible to credibly estimate any long-term implication on immigrant earnings and assimilation behaviour and account for individual-level observables at the entry point. Also, these datasets survey different immigrants who are continuously staying in the country and, therefore, cannot control these immigrants' outmigration and inter-provincial migration decisions. Lastly, it is essential to understand how immigrants of different skill groups react to initial labour conditions and if education has any role in the magnitude of the effect. The dataset I use matches immigrant tax returns to their initial conditions at entry, which helps me overcome some of the earlier challenges.

Concerning the question in hand, Åslund and Rooth (2007) investigate the long-term effects on immigrant earnings and employment of labour market conditions encountered upon arrival, specifically for refugees in Sweden. They focus on the 1990 recession, study the cohort of refugees who entered Sweden that year, and find that early earnings assimilation depends on the national labour market. However, leading to small-sample issues, they cannot carefully analyze the heterogeneity in effect, nor can they analyze outmigration decisions as they look at refugees, not immigrants. However, they consider inter-provincial migration and find that as an important mechanism behind refugees improving their prospects in the country. Chiswick and Miller (2002) use the 1990 Census of Population for the U.S. and find the stage of the business cycle at entry into the U.S. labour market affects immigrant earnings for a short duration and even for those fluent in English. However, their results may be biased due to their focus on a single cohort of entrants. They also cannot document or control outmigration and inter-provincial migration. MacDonald and Robinson (1992) look at immigrants in Canada and study cohort effects to explain immigrant and native wage differentials but not look at entry-level conditions. Fernández and Ortega (2008) find that compared to natives, immigrants face higher participation and unemployment rates initially and a higher incidence of overeducation and temporary contracts. However, five years after arrival, immigrants' participation rates start to converge to natives' rates, unemployment rates decrease to levels even lower than natives', and the incidence of overeducation and temporary contracts remains roughly constant.

Chapter 2

Deunionization and Immigrant Entry

2.1 Introduction

The U.S. economy witnessed a significant and steady decline in union membership starting from the late 1960s. From 40% at its peak in the 1950s, union density reached 9% by the end of the century (Figure 2.1). This fact coincided with an epochal wave of low skilled immigrants entering the U.S. The share of total immigrants as a part of the U.S. population increased from 3% in the 1960s to around 12% in the last decade (Figure 2.1).[7] These immigrants, especially those entering between the 1970s and 2000s, were low skilled, with the majority without a high school degree, Hanson et al. (2017).

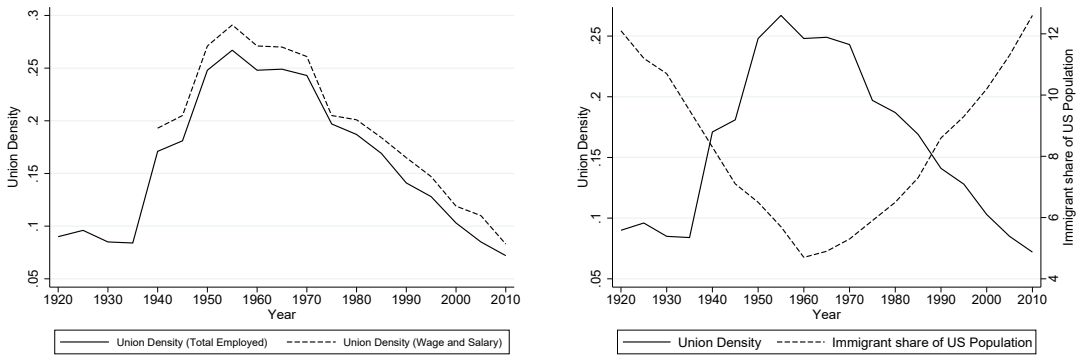


Figure 2.1: Left panel: Private Sector Union Rate in the US. Right panel: Immigrant share in the total U.S. population and private sector union rates.

The strong coincidence in the two trends in fig. 2.1 raises the intriguing possibility that the decline in unionization was at least partly driven by the increase in unskilled immigration. Given how immigrant entry affects wages and competition in the market, a natural question arising from observing these trends is whether they translate to a more granular level. Therefore, to further evaluate these seemingly related phenomena and allay scepticism naturally occurring from observing time trends, I look at cross-sectional variation across U.S. states.[8] I look at heat maps of U.S.

[7] Using historical data from the U.S. Census, it is also valid that immigrant entry has followed broadly 'U-shaped' trend with immigrants as a percentage of the U.S. population decreasing from 14.8% in the early 1900s and declining steadily during and after the World Wars and reaching the lowest at 4.7% in the 1960s. This share has then increased steadily and is at 13.7% in recent years.

[8] The scepticism from observing these trends would be because other contemporaneous changes might be driving

States, and in the top panel of figure 2.2 plot the fall in union rates between 1980 and 1990, and the bottom panel shows the immigrant entry in different U.S. states at the same time. The strong negative correlation of -0.45, as seen in Figure 2.2 immediately raises the possibility of a causal link with immigration being a factor that drove down unionization. My goal in this paper is to investigate that possibility.

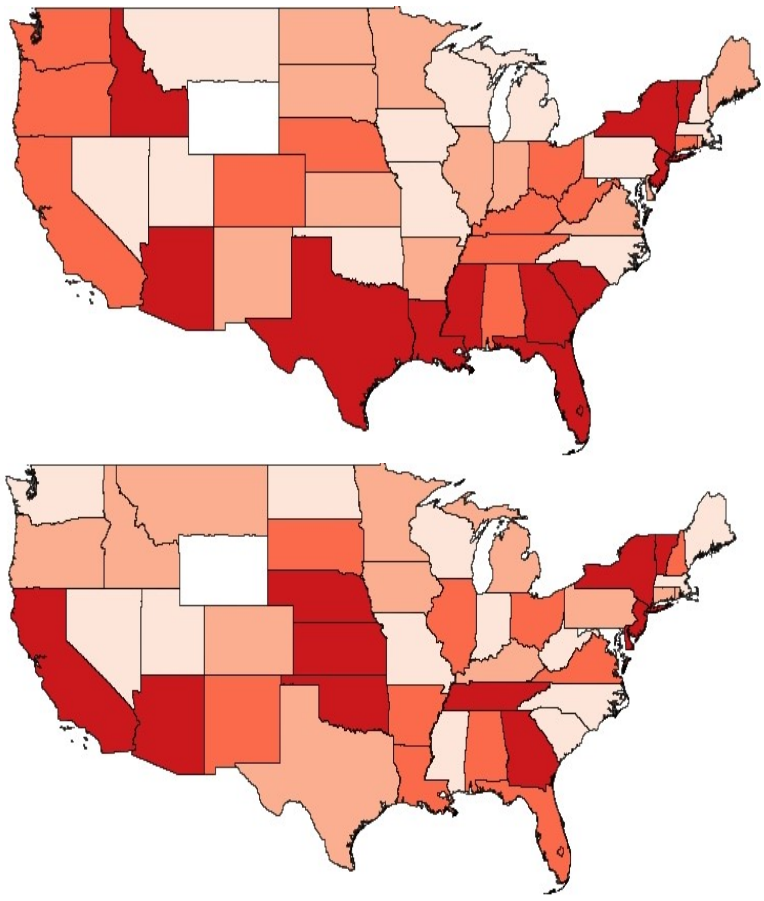


Figure 2.2: Top panel: Union Rate changes in the U.S. states, 1980-1990. Bottom panel: Immigrant population change in U.S. states, 1980-1990. Darker red colours show larger fall in union rates in top panel and higher entry of low skilled immigrants in the bottom panel.

To understand if there is a causal link between increased immigration and the unionization rate, it is essential to think of how immigrant entry affects the local labour market and, at the same time, understand the implications brought in by market structures like unions. Immigrant workers entering a region potentially affect the region in two crucial ways. Firstly, they change the skill mix of the region as they are mainly low skilled; this is especially, so the case for the U.S. between 1970-2000, Butcher and Card (1991). Secondly, they may seek lower wages than similarly

both trends.

skilled native-born workers because of their lower outside options. They have lower outside options as they often lack access to unemployment benefits and do not value leisure in a foreign setting as much as natives, thus, improving the outside option for firms, Albert (2021), and Amior and Manning (2020). These two effects of immigrant entry can lead to a fall in union rates because of how unions are set up. Unions value an egalitarian approach and flatten skill differentials, with a strong tendency to pay similar wages to all their members. In this equilibrium with a certain amount of union membership, a sizeable entry of low-skilled immigrants into the U.S. affects the incentives of native-born workers to join the union and firms to hire unionized workers. High skilled workers get better pay in the non-union sector and prefer not to join the union. Given that firms now have a better outside option in terms of lower wage seeking immigrants; because of that, they resist unionization more actively. Hence, it would be less likely that low skilled workers are now not hired at union wage and would be better off by taking a non-union job.

I aim to evaluate this causal mechanism in the data, and for that, I use the following empirical strategy. I start by examining correlations and find a significant negative correlation between immigrant entry and union membership across U.S. MSAs, industries, and occupations, showing the correlation seen in figure 2.2 is also present in other cross-sectional variations. I also find the correlation holding in a broader context at the international level, suggesting that this causal mechanism can be generalized to more diverse settings. I show why this phenomenon is not the result of a mechanical shift because one might expect immigrants to be less unionized. Thus, as immigrants become a larger workforce share, we might expect lower unionization rates. I see that unionization rates among native-born workers have decreased.

To make a causal statement- immigrant entry leading to a fall in union rates, I need to be mindful of two potential issues to the identification strategy. Firstly, there are endogeneity issues as omitted variables may be driving both immigrant entry and union rate decline. Secondly, spillover effects caused by the migration of native-born workers and firms across regions violate the closed geographical region assumption, potentially biasing my estimates from the correlation analyses. I follow the literature using the famous 'ethnic enclaves' instrumental variable (IV) approach to tackle the endogeneity issue. This IV approach uses past immigrant stocks to predict future immigrant shocks in a region. The crucial assumption is that past immigrant stocks are not correlated with changes in current economic conditions. However, despite dealing with the endogeneity issue, the IV often fails to account for spillover effects of migration, especially over longer time horizons. As pointed out by Jaeger et al. (2018), the ethnic enclaves IV conflates the short and long-run impact of immigrant entry in a region when immigrant inflows and stocks become serially correlated.[9] Since most of the analysis is at the long-run level; I use the IV approach suggested by Jaeger et al. (2018) that accounts for this adjustment by using an even further lagged instrument.

[9] A good summary of this IV and debate surrounding it can be found in the likes of but not confined to Borjas (1995b) and Card and Peri (2016)

Using both methods, I find that low-skilled immigrant entry can explain 48% of the total union fall between 1980 and 2000.[10]

My IV estimates point to a substantial fall in union rates caused by the low skilled immigrant entry. To check for robustness, and specifically, if I am picking up effects from alternate forces, I look at other possible reasons for a fall in union rates. Specifically, I evaluate the introduction of the right to work, the growing importance of the service sector and skill-biased technical change, behind the fall in unionization rates in the U.S. I find a measure for each of these reasons and see that they alone cannot explain the entirety of the fall in unionization. When used as additional checks in my preferred specification, these channels do not undermine the significant importance of the immigrant channel in explaining the fall in union density. These measures can explain some of the fall in unionization but even controlling for these alternative explanations, increased low-skilled immigration still accounts for half of the total decline in unionization.

Next, I develop a model to capture the causal mechanism I discussed earlier formally. The model uses a standard search-theoretic setting to formalize the arguments put forth and shows the mechanism qualitatively and intuitively and, in turn, is useful for two main reasons. Firstly, it provides me with over-identifying predictions that I can take to the data, which serve to be both novel and prove model validity. Secondly, it allows me to calibrate the environment to explain how much of the fall in union rate can be explained by the channel. I do this by allowing workers to differ in their observable skills as either high or low, and an unobservable efficiency parameter that directly affects their productivity when matched to a firm. Unions take the non-union wages as given and set a uniform wage for all the members to maximize total union membership. The value functions of the workers and firms decide the efficiency levels at which a worker chooses to join the union and the firms hire a unionized worker. The general equilibrium framework finds that when low-skilled immigrants enter the labour market, unionization tends to shrink from the two ends of the skill distribution and gets more concentrated towards the middle. High-skilled native-born are better off not joining the union as they become more productive due to the complementarity of skills in the production function. More firms are now ready to hire these high-skilled workers given their better productivity, further pushing up their non-union wages. On the other hand, low-skilled native-born workers at union wage are now less desirable by firms for two reasons. The first is due to diminishing returns in the production function as more low-skilled workers are in the market. Second is a better outside option for firms in terms of low-wage seeking immigrants due to their lower outside options. Firms would prefer to hire immigrant workers, thus reducing their probability of hiring a unionized low skilled native-born worker. These workers, therefore, leave the union and are better off taking a non-union wage.

[10] In the main text, I discuss why my ethnic enclaves and Jaeger et al. (2018) IV approaches provide similar results. In short, it is because serial correlations between immigrant entry become a concern only after 1980, and my IV uses the 1970 stock of immigrants in the U.S.

My model has three main over-identifying predictions in the data: Firstly, I find an inverted 'U' shape relationship when plotting the unionization rate across skill deciles. Secondly, low-skilled immigrant entry into a region increases the wage gap between high and low skilled non-union native-born workers. Finally, I find that immigrant entry into a region reduces the mean union wage. I calibrate the model to the U.S. setting between 1980-and 2000 to see the impact immigrants have had on the wages of native-born workers of different skills and how that translates into a fall in union density. Using estimates both established in the literature and targeting moments based on union rates in 1980, I find that the model can predict about 48-55% of the total fall in union rates. The model does better in predicting union rate changes towards the two ends of the skill distribution than in the middle. I re-do this calibration exercise but now for the period between 2000 and 2017, a period characterized by high skilled immigrant entry and find that the model does similarly well in predicting the changes in these decades.

The rest of the paper proceeds as follows: Section 2 describes the data and motivating trends. Section 3 describes the specifications, identification and estimation strategies used in the main empirical results. Section 4 tries to hold other possible reasons for falling union rates in the U.S. to closer scrutiny and conducts robustness checks. Section 5 examines a search and matching model to analyze the general equilibrium effects of immigrant entry on unionization rates. Section 6 looks at specific model predictions and evaluates them in the data. Section 7 provides model calibrations and evaluates how well the model can capture the change in union density in the U.S. Finally, section 8 concludes and offers potential avenues for further research.

2.2 Empirical Evidence

2.2.1 Data

I base the empirical analysis on two primary data sources. Firstly, I use the U.S. Census data for the years 1960, 1970, 1980, 1990, and 2000, combined with pooled observations from the American Community Survey (ACS) for 2009-2011 and 2016-2018. The Census provides details of immigrant entry in the U.S. across states and MSAs, besides providing much-needed information on worker characteristics like industry and occupation, which is crucial for the analysis I undertake. However, the Census does not provide information on union status. I use the Current Population Survey (CPS) for all union and union-related information. I use data from the May supplements from the NBER website to get union information in the 1970s and monthly files in the later years after

1983.[11,12] To achieve time consistency on union rates across states, I follow Hirsch et al. (2001).[13] For other non-union information from the CPS, I use the March files, which contain more detailed information on location, country of birth, union status and other variables that I need; I use it to construct yearly data. This data on immigrants in the CPS is available only from 1994, and thus, I use the CPS from 1994-to 2017, where I need information on the union status of immigrants. All data are from the Integrated Public Use Microdata Series.[14] The main sample consistent across the CPS and Census includes workers aged 18 to 64 who are not self-employed and work for wages and salaries, not enrolled in school, and report positive hours of work and earnings. I drop immigrants with no information on their country of birth or year of arrival in the United States.

2.2.2 Long Run Trends

I start the analysis by evaluating long-run trends in unionization rates and immigration inflows in the U.S. Particularly of fundamental interest are to assess the general timing of these changes and see if they point to certain conjectures. As shown in the left panel in figure 2.3, the fall in unionization rate was contained to about three per cent in the 60s, seven per cent in the 1970s but showed a significant decline later, starting in the 1980s. To illustrate the immigration channel in falling union rates, I look at how the entry of immigrants into the U.S. has changed over the years. The rise in the immigrant population especially starting in the 1960s, suggests that an increase in immigrants and a decline in union rates occurred in a very similar time frame. Further, between the 1920s and 1960s, immigrants as a percentage of the U.S. population declined steadily while union rates increased.[15] The implementation of the Immigration and Nationality Act of 1965 lead to a substantial increase in the number of immigrants in the U.S. and altered the immigration demographics in the U.S. As seen in figure 2.3 union rates started falling steadily since the late 1960s. An emerging trend in the U.S., especially in the late 1980s and 1990s, was the increase in the size of undocumented immigrants, Monras (2020). Neither the CPS nor the Census allows for the direct identification of undocumented immigrants. However, the surveys conducted by the U.S. Census Bureau for the Census and CPS are address-based and designed to be representative of the whole population; they also include undocumented respondents. The Department of Homeland Security (DHS) uses the CPS and ACS surveys as the primary source to estimate the size of the

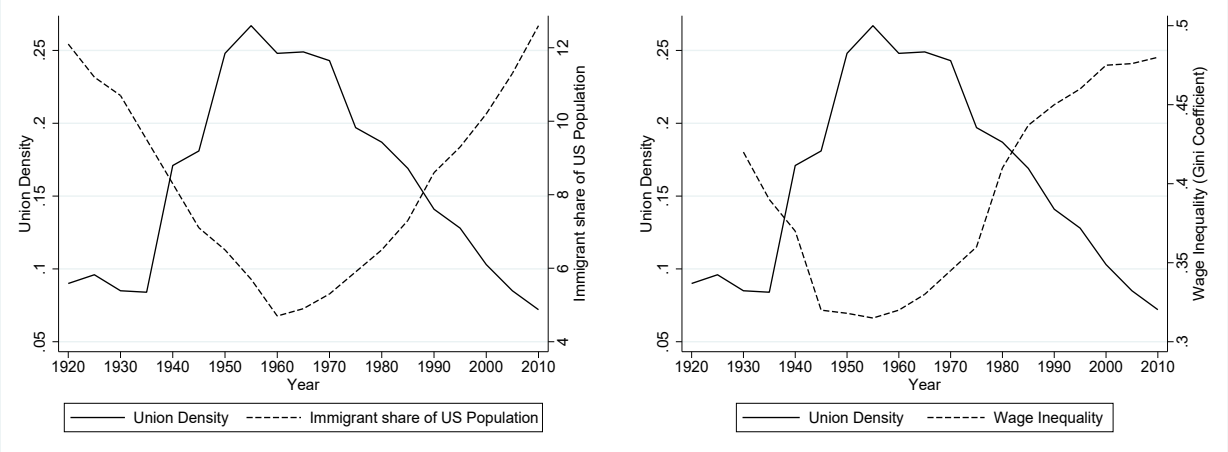
[11] Papers which use the same are Hirsch and Macpherson (1993) and Mayer (2004)

[12] The estimates of union membership and the total number of persons employed for 1994-2003 were calculated from the monthly Current Population Survey (CPS). Estimates of union membership for 1973-1993 are from Barry T. Hirsch and David A. Macpherson, Union Membership and Earnings Data Book: Compilations from the Current Population Survey, Washington, Bureau of National Affairs, 2003, p. 11. Union membership data for 1930-1972 are from: U.S. Department of Labor, Bureau of Labor Statistics, Handbook of Labor Statistics, Bulletin 1865, U.S. Govt. Print. Off., 1975, p. 389.

[13] The paper Hirsch et al. (2001) corrects for the measurement errors introduced in the CPS when measuring union rates due to a change in the questions asked concerning union status. It is crucial to make this assessment to correctly quantify the drop-in union rates, which started in the late 1960s.

[14] (IPUMS-USA, Ruggles, Flood, Goeken, Grover, Meyer, Pacas and Sobek, 2018)

[15] The Nationals Origins Formula was a basis of the U.S. Immigration policy between 1921 and 1965, which strategically discriminated against the entry of Southern and Eastern Europeans, South Americans, Asians, as well as other non-Northwestern European ethnic groups from the American Immigration policy



Note: Left panel: Unionization is measured as fraction of all employed workers and Immigrant population change in the US. Right panel: Wage inequality is measured by Gini Coefficient. Sources: Kopczuk et al. (2010).

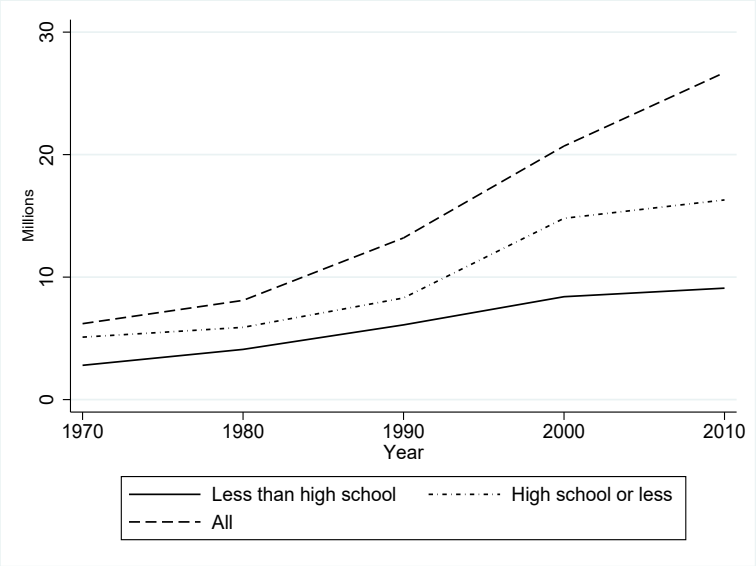
Figure 2.3: Deunionization, wage inequality and immigrant entry in the US

undocumented immigrant population, Albert (2021).

Therefore, I acknowledge the presence of undocumented immigrants in my sample, but I do not make distinctions between them and documented ones as that is not crucial to the analysis. As will be later established in the empirical discussions, the critical area of focus would be the 1980s to the 2000s, when unionization rates fell by about 9%. I use the period between 1980-and 2000 for evaluating the impact of immigrant entry on the union rate for two primary reasons. Firstly, the period between the 1980s to 2000s saw a significant fall in the union rate. After the 2000s, the union rates were already at historically low levels of under 10% and primarily confined to the public sector, so to expect them to fall further would be a stretch.[16] Also, starting my analysis allows me to use the 1970s and 1960s Census data later for IV estimation and will enable me to use the 2017 years for the calibration and model predictions. The right-hand panel of Figure 2.3 plots the change in union membership rates and wage inequality in the United States.[17]

[16]This is also consistent with the literature, Açıkgöz and Kaymak (2014).

[17]Here, I evaluate inequality using the Gini coefficient; other alternate methods have found similar changes. Yun (2006) evaluates this using a variety of techniques.



Note: Data based on the US Census 1970,80,90,2000 and ACS (2009-11). Additional source: Hanson et al. (2017)

Figure 2.4: Education Level of Immigrant Population in the US

In figure 2.4, I graph the education level of the immigrants entering the U.S. starting in the 1970s based on the Census. As the graph suggests, a substantial portion of the immigrant population entering the U.S. was either high school educated or less, indicating a lower skill level. The percentage of high skilled immigrants started to increase from the late 1990s, as is also suggested by Peri et al. (2015).[18] Starting in the 1990s, as identified by the Pew Research Center, undocumented immigrants who are essentially less educated and without high school diplomas increased steadily and decreased only after 2007, Passel and Cohn (2016). The characteristics of incoming immigrant cohorts are provided in Table 2.1. As less-educated, foreign-born labour supplies increased sharply after 1970, their predominant national origins shifted from Europe to Latin America. Cohorts' sizes increased steadily over the time considered, with the 1960s cohort comprising around 1200 thousand individuals, the 1980s cohort 4.2 million individuals and the 2000s cohort 5.5 million individuals. This substantial increase in the size of the immigrant inflows was accompanied by an essential shift in their ethnic and educational composition. In the 1960s, most immigrants originated from Western source countries and relatively few from Mexico and Asia. Over the following decades, this pattern reversed, with the share of migrants from Western countries decreasing and the percentage from Mexico and Asia increasing. The level of formal education of the new cohorts of immigrants improved since the late 1980s, with the share of high school dropouts decreasing from 51.1 per cent in the 1960s to 33.6 per cent in the 2000s. The percentage of college-educated immigrants increased from 21.6 per cent in the 1960s to 31.3 per cent in the 2000s. However, age and average wage profiles have remained similar.[19]

[18]This is especially so after Since the Great Recession, after which the U.S. border became a less active place when it comes to net inflows of low-skilled labour from abroad, Hanson et al. (2017).

[19]Data source from the Census, using appropriate individual weights obtained from IPUMS and Albert et al. (2020)

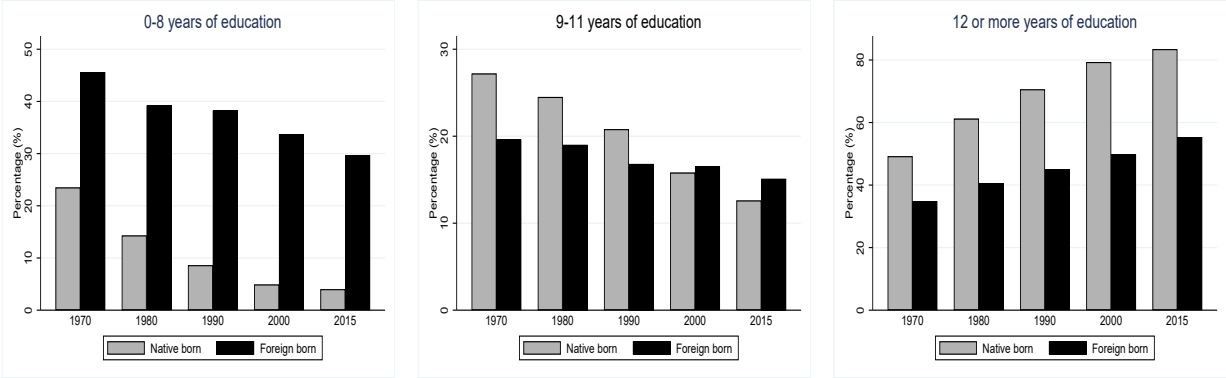
In figure 2.5, I compare the education levels of native and foreign-born in the U.S. over the last 50 years. As seen in the left panel of the figure, consistently amongst all foreign-born working workers in the U.S., a very high portion have only 0-8 years of education. 9-11 years of schooling are more similar among the two groups, but again, the percentage of native-born with 12 or more years of schooling far outnumbers the foreign-born. This figure decreases over the decades but consistently remains significantly higher than natives'.[20] This evidence again underlines that immigrants, especially in the 70s, 80s and 90s, were predominantly low skilled when referenced to natives.

Table 2.1: Descriptive Statistics of Immigrant Cohorts

	Entry Decade:			
	1960-69	1970-79	1980-89	1990-99
Share of population (%)	1.2	2.9	4.2	5.5
Cohort Size (millions)	0.9	1.6	2.7	3.8
Age	35.3	33.6	33.2	33.1
Hourly Wage ($ adjusted)	18.6	17.8	15.7	17.1
HS dropouts (%)	51.1	46.1	36.1	33.6
HS graduates (%)	18.1	18.2	22.6	26.8
Some College (%)	9.1	10.1	15.8	9.5
College graduates (%)	21.6	23.5	25.6	31.3
Mexico (%)	9.6	23.5	21.5	29.5
Other Latin America (%)	27.8	19.4	25.2	20.5
Europe(%)	37.8	17.8	11.1	9.8
Asia (%)	14.9	31.4	33.9	27.6
Other (%)	9.9	7.9	8.2	12.6

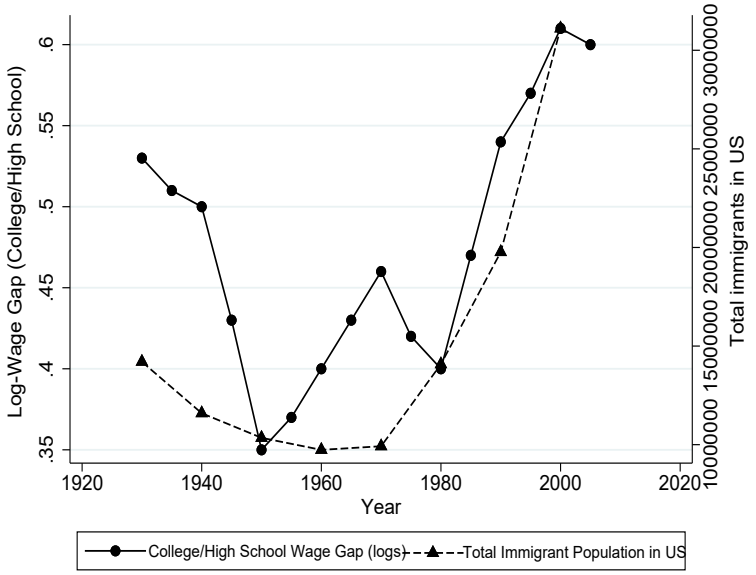
Note: The statistics are based on the sample of male immigrants aged 18-64 reporting positive income, that entered the United States during the respective time intervals,measured in the first Census year following the arrival. Observations are weighted by the personal weights obtained from IPUMS, rescaled by annual hours worked.

[20] Also essential to remember here is that the education received by most foreign-born is in their home country, and as the literature suggests, foreign education is less valued and often even discriminated against. Oreopoulos (2011) besides pointing to the vast literature on this issue, looks at discrimination among highly skilled workers in the Canadian context.



Note: Left panel shows percentage of foreign and native born with 0-8 years of education. Middle panel shows percentage of foreign and native born with 8-11 years of education. Right panel shows percentage of foreign and native born with 12 or more years of education. Data sourced from the Census, Hanson et al. (2017).

Figure 2.5: Native born versus Foreign born Education over the years



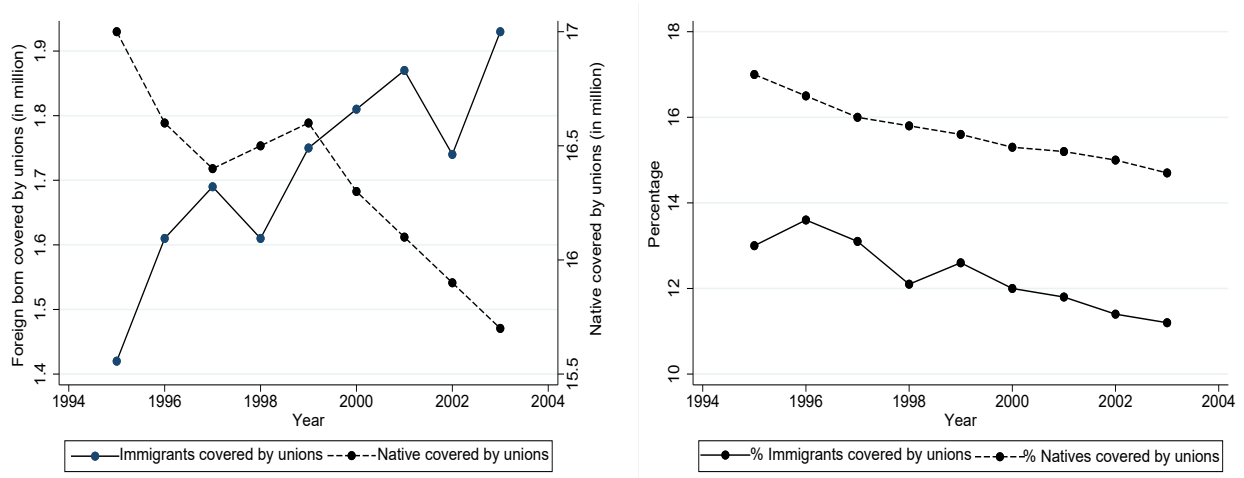
Note: College wage premium in US sourced from Goldin and Katz (2008) and immigrant % sources from 2010-19 American Community Surveys (ACS), and 1970, 1990, and 2000 decennial census. All other data are from Gibson and Lennon (1999).

Figure 2.6: College Wage premium and immigrant entry in the US.

Finally, figure 2.6 plots the logs of the wage gap between college and high school graduates in the U.S. along with the total immigrants entering the U.S. Consistent with previous long-run trends, the slight growth in the immigrant population in the 1960s followed by a more substantial increase in the 80s and 90s, closely followed by a similar rise in the wage gap amongst college and high school graduates in the U.S.

With the significant rise of the immigrant workforce as a part of the total workforce of the

U.S., especially post-1965, a reasonable doubt might be that the fall in union rates can be simply a compositional shift as immigrants are significantly less likely to unionized. Using the CPS data, I find that this is not true.[21] Even though the total number of immigrants joining the unions, as documented in the left panel of figure 2.7 is increasing, this does not keep up with the existing increase in the share of immigrants leading to an overall fall in the total percentage of immigrants being unionized in the U.S. as shown in the right panel of figure 2.7. Starting from around 13% in 1994, it had gone below 10% in 2003. On the other hand, native-born decreased their union participation in absolute numbers and as a percentage of the workforce. The unionization for native-born came down from around 16% covered in 1994 to 13% in 2003 among all 16-65 aged, wage and salaried workers.



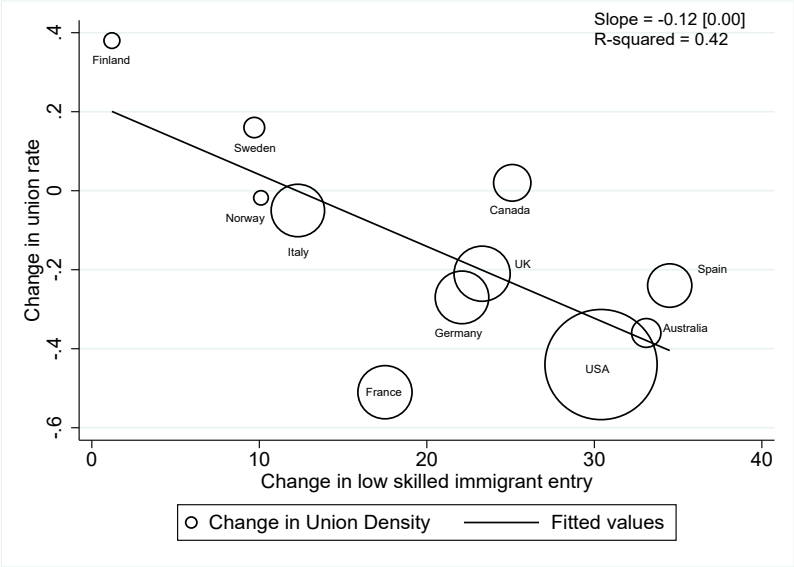
Note: In figure on the left: Union Affiliation of Employed Foreign-Born Wage and Salary Workers and Native Wage and Salary Workers, Age 16 Years and Over, 1996 to 2003. In the figure on the right: Percentage of total wage and salaried immigrant and native workers as part of unions, 1996 to 2003. Data Source: Current Population Survey, 1995 to 2003 (annual averages)

Figure 2.7: Immigrant and Native Union Rates in the US

Besides concentrating on the U.S. and evaluating how union rates have changed with immigrant entry, I also study the correlations between the two in an international context. I do this to understand how union rates and immigrant entries have evolved worldwide and check if my findings for the U.S. can be corroborated in other settings. The countries considered are developed economies with well-defined labour markets but differ regarding immigrant penetration of the labour market, political institutions, and skill composition. Figure 2.8 shows these correlations and finds a significant positive relationship between a change in low skilled immigrant entry and a change in union density. Most countries that have increased the low skilled immigrant entry have also seen a fall in union density, including Australia, Spain, the UK, France, and Germany, with Canada's notable

[21] Ideally, the task would be to see these rates and numbers are changing from the start of the 1980s, but unfortunately, data about immigrants as part of unions starts from 1994.

exception. The figure shows that most Nordic countries have very low immigrant entry and high union rates.



Note: Union density data for all countries are sourced from OECD Annual Trade Union Density Dataset. Estimates on immigrant entry derived from various sources including StatsCan, Census, Migration Policy institute document, country specific press release and World Bank.

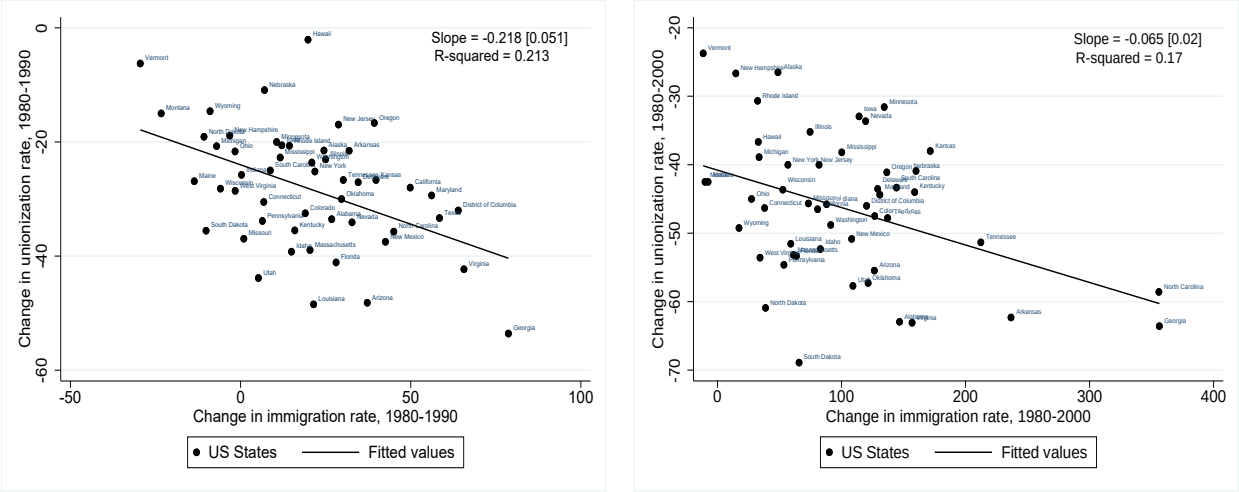
Figure 2.8: International Evidence for De-unionization and Immigrant Entry

2.3 Specification and Results

2.3.1 Correlation Analysis

In the previous section, we observe the long-run patterns in the data and consistencies in the timing of the two events, namely, a decline in unions and an increase in the low-skilled immigrant entry. However, given the bi-causal nature of the relationship concerned, it is essential to consider this relationship in far greater depth. Therefore, this section presents a framework to study the relationship between the concerned variables using both correlations across sectors and an instrumental variable approach. I first undertake the analysis in a difference-in-difference approach, where I analyze how immigrant entry and union decline has changed across states, industries, and occupations. This multi-dimensional approach is vital to avoid any possibilities of spurious correlations that might be possible in a single sector. I use the following specification:

$$\Delta\, Union_c = \alpha + \beta\, \Delta\, (\frac{I}{N})_c + \gamma\, X_{c,1980} + \epsilon_c \tag{2.1}$$



Note: In the left panel: Change in union rates and immigrant population shares across states between 1980 and 1990. In the right panel: Change in union rates and immigrant population shares across states between 1980 and 2000. Data on state level unionization rates comes from CPS and Hirsch and Macpherson (1993). The p-value of the slope coefficient using robust standard errors in reported in parentheses.

Figure 2.9: Cross-State Evidence on De-unionization and Immigrant entry

Here, ΔU_c is the change in the union rates in the concerned time horizon. c indexes the concerned area of investigation, state or MSA. Therefore, here differencing means I am controlling for c specific effects, and I in turn implement it separately by decade, thereby allowing general time effects. $\Delta(\frac{I}{N})_c$ is the change in immigrant to the native-born population between the years in labour marker of interest. γ controls state-level variables like log population, region dummy, average income, and population share in different industries.[22] I have used both union membership and the percentage of workers covered under the collective bargaining agreement, which show similar results. I start my analysis first with some basic correlation analysis across states between 1980-1990 (left panel) and 1980-2000 (right panel) in figure 2.9.[23] Both figures highlight the significant negative correlation between the degree of unionization and the magnitude of the increase in immigration across U.S. states. The results with weighted observations where weights are the average employment levels in each state bear similar patterns.[24,25]

A concern with the regression would be that the fall in unionization rates and the rise in the immigrant population might be compositional. The fall might be driven by employment shifts towards less unionized states rather than changes within each region. This would be undesirable to

[22] I use 19 broad industry classifications. Results are similar with narrower (14) or broader (31) classifications.

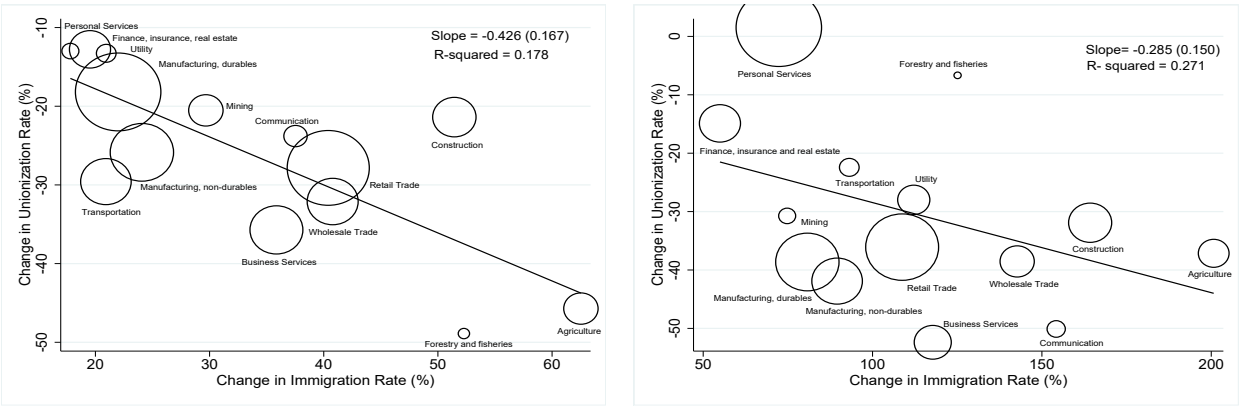
[23] On careful evaluation, it is plausible that places that undergo higher growth can attract both immigrants and make it easier for unions to start. This leads to a positive relationship between the two variables. However, as we see in the results, this is not the case.

[24] I run the same correlation graphs with state weights, and the results are not different. I try different weights, but the most logical seems to be employment share. These graphs are a part of the Appendix, figure A.1

[25] I also run correlations between 1990-2000, the results are still significant, although the coefficients are slightly smaller. Results in Appendix, figure A.2.

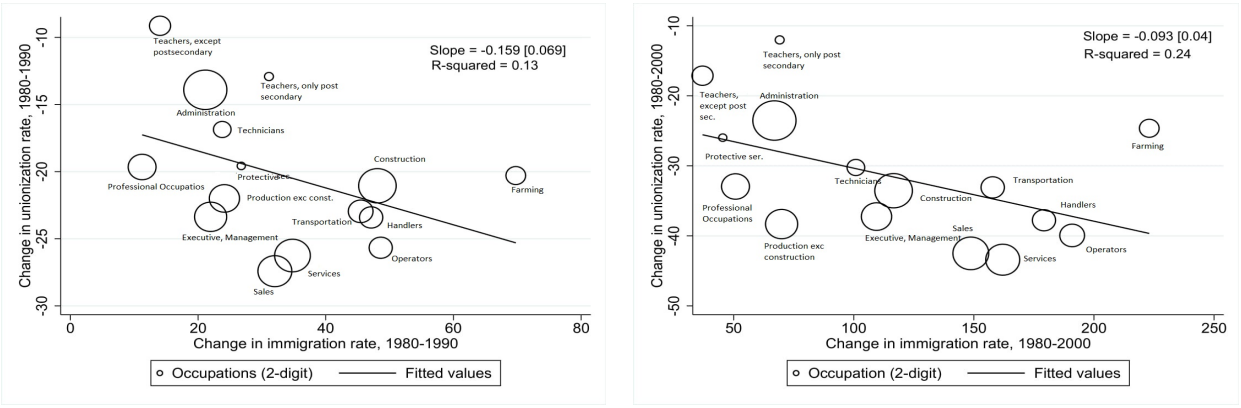
give any causal interpretations to the coefficient. However, a simple decomposition exercise helps us find that about 89% of the fall in union rates within 1981-1990 took place within states and not through employment shifts to less unionized states.[26]

Next, I look at similar correlations but across industries in figure 2.10.[27] The figure shows a significant negative correlation between the degree of unionization and immigrant entry into industries. Thus, the relationship holds not only across states but also across industries.



Note: In the left panel: Change in union rates and immigrant population shares across industries between 1980 and 1990. In the right panel: Change in union rates and immigrant population shares industries states between 1980 and 1998. Data on industry level unionization rates comes from CPS. Size of the bubbles represent rolling average industry employment level. Slope coefficient and robust standard errors are reported in parentheses.

Figure 2.10: Cross-Industry Evidence on De-unionization and Immigrant entry



Note: In the left panel: Change in union rates and immigrant population shares across occupations between 1980 and 1990. In the right panel: Change in union rates and immigrant population shares across occupations between 1980 and 2000. Data on occupation level unionization rates comes from CPS. Size of the bubbles represent rolling average occupation employment level. Slope coefficient and robust standard errors are reported in parentheses.

Figure 2.11: Cross-Occupation Evidence on De-unionization and Immigrant entry

[26] change in union density across states can be decomposed as = Within$-s$ changes, $\sum_{i=1}^{S} e_s \delta u_s$ + Between$-s$ change, $\sum_{i=1}^{S} e_s \delta u_s$, where e_s is the average employment share and u_s is the average union density in-state s.

[27] Unweighted correlation graphs are shown in Appendix as figure A.3.

Finally, in Figure 2.11, I look at unionization rates across occupations and immigrant entry in these specific occupations. I again see a significant negative relation between union rates and immigrant entry. The relationship is stronger for the 1980-1990 decade and even after accounting for employment under each occupation as weights.[28] In the following sections, I carefully lay out the identification strategy and analyze in detail the instrument variable technique undertaken to investigate these robust correlations further.

2.3.2 Instrument Variable

A potential channel of endogeneity that might threaten the causal interpretation of the OLS estimates is reverse causality. An argument can be made that the fall in unionization in certain specific areas prompted the entry of immigrants. This is so that they could take advantage of the fewer restrictions afforded to firms in their hiring practices in areas with fewer unions, which would mean less competition for immigrant workers from natives. In other words, immigrants were strategically located in areas with a higher level of de-unionization. I use an instrumental variable technique familiar in the literature to overcome this issue. My study here, like others in past (Altonji and Card (2007), Card (2001a), Bartel (1989)) will rely on spatial variation in immigrant inflows for identification. To address the endogeneity of the location choices of new immigrants, inflows at an aggregate level will be combined with the lagged geographic distribution of immigrants to create an instrument. The argument for this type of instrument's validity is that the persistence of regional immigration patterns derives from new immigrants' preference to resettle with family—and much of U.S. immigration is "family-based" or to be in a culturally familiar environment.[29] Often referred to as a 'shift share' instrument; I instrument for immigrant entry in different U.S. states by their share in 1970.

Since the regressions are at the geographic level, I can predict the regional flows of immigrants to this region using the initial geographic distribution in the base year. National inflow of immigrants $I_{c,e,t}$ are defined as the difference in the number of immigrants from origin country c with education e between time period t and $t-1$. Let $\pi_{c,e,r,t}$ denote share of immigrants from country c with education e who live in region r at time t. The inflows used to compute the instruments are given by the sum of these immigrant inflows to a specific region:

$$I^z_{e,r,t} = \sum_c I^z_{c,e,r,t} = \sum_c \pi_{c,e,r,t-1} I_{c,e,t} \tag{2.2}$$

[28] Current Population Survey (CPS) Outgoing Rotation Group (ORG) Earnings Files are used from 1983. The sample includes employed wage and salary workers ages 16 and over. For the pre-1983 figure, monthly files of the CPS are used. Source: Hirsch and Macpherson (1993)

[29] Shown in many papers but not restricted to the likes of Munshi (2003), Bertrand et al. (2000).

The predicted population levels of immigrants at time t are then:

$$P^Z_{e,r,t} = P_{e,r,t-1} + I^Z_{e,r,t} \tag{2.3}$$

And predicted population shares are

$$N^Z_{e,r,t} = P^Z_{e,r,t}/(P^Z_{E,r,t} + \sum_e P^Z_{e,r,t}) \tag{2.4}$$

where $(P^Z_{E,r,t} + \sum_e P^Z_{e,r,t})$ is the total imputed population (natives and predicted number of immigrants) in a time-region cell. The final instrument are the changes in the above shares between two consecutive periods of consideration given as $N^Z_{e,r,t} - N^Z_{e,r,t-1} = \Delta N^Z_{e,r,t}$, which is used to predict the variation in the true change, $\Delta N_{e,r,t}$ that is exogenous to the current labour market conditions.

Finally, it is essential to consider the region or geographic level at which the analysis runs. By choosing MSA, city or state, the assumption is that these regions are closed economies, and there are no spillover effects through internal migration of workers or firm relocation. However, U.S. workers are knowns to be geographically mobile, and an immigrant shock might be dampened over the long run by these migrations. This is especially true because I look at changes in unionization rates over the long run. There are two approaches; firstly, by using a broader geographic region of consideration to evaluate these changes, I do so by considering my analysis at the state level in addition to the MSA analysis. Most U.S. migration are within states, especially in earlier decades when migrations were less frequent. Therefore, this can partly address the issue at hand.

Secondly, I substantiate my result with another IV technique as suggested by Jaeger et al. (2018). Consider if immigrants join the pool of the unemployed upon arrival, their initial impact on vacancy creation will be much more significant than their long-run impact as the probability of matching with a cheaper worker will be very high in the beginning and subsequently decrease to its new steady-state level as the initially unemployed immigrants are compared to firms. Suppose there are long-lasting adjustment or transition processes, and the original composition and immigrant settlement patterns are correlated over time. In that case, the coefficients of the above-outlined IV estimation are biased. This is because the short- and long-run responses to local immigration shocks would be conflated. Therefore, I use the approach laid out in their paper to account for the long-run adjustment process by also including the first leg of the immigrant shares in the model. The results from Jaeger et al. (2018) suggest that periods with substantial changes in the country of origin composition may provide variation that can be exploited with a variant of the shift-share strategy. By instrumenting both current and past immigrant inflows with versions of the past settlement instrument that vary only in their national components, it is possible to isolate the variation in inflows that are uncorrelated with current local demand shocks and the adjustment process to past supply shocks. Their results also suggest that the 1970s are the best time to con-

sider the use of this procedure.[30] Therefore, for evaluation, I consider the following OLS model first:

$$\Delta log\, U_{r,t} = \alpha + \beta \Delta log\, N_{r,t} + \gamma X_{r,t} + \epsilon_{r,t} \tag{2.5}$$

where $log\, U_{r,t}$ is the union rate in region (MSA, state) r at time t. $N_{r,t}$ is the immigrant share and X are region level controls. The first stage regression for the standard IV approach would then be given as:

$$\Delta\, N_{r,t} = \delta_{10} + \delta_{11} \Delta\, N^{Z}_{r,t} + \epsilon_{r,t} \tag{2.6}$$

Next using Jaeger et al. (2018), from now referred to as JRS-IV, the first stage additionally includes the first lag of the immigrant shares in the model. Thus, the first stage would be written as:

$$\begin{aligned} \Delta\, N_{r,t} &= \delta_{10} + \delta_{11} \Delta\, N^{Z}_{r,t} + \delta_{12} \Delta\, N^{Z}_{r,t-1} + \epsilon_{r,t} \\ \Delta\, N_{r,t-1} &= \delta_{20} + \delta_{21} \Delta\, N^{Z}_{r,t} + \delta_{22} \Delta\, N^{Z}_{r,t-1} + \epsilon_{r,t} \end{aligned} \tag{2.7}$$

In the table below, I present, the first stage results for both the standard IV model and JRS-IV.[31] This allows me to write the second state estimation equation as follows.

$$\Delta log\, U_{r,t} = \alpha + \hat{\beta}_1 \Delta log\, \hat{N}_{r,t} + \hat{\beta}_2 \Delta log\, \hat{N}_{r,t-1} + \gamma X_{r,t} + \epsilon_{r,t} \tag{2.8}$$

In both the models, the instruments have positive and significant effects on the shares they predict, as shown in Table 2.2.

[30] In their paper Jaeger et al. (2018) show that a high degree of correlations in immigrant entry post-1980 lead to serial correlations issues, thus making the "ethnic-enclaves" instrument biased. Using their methodology, they find their instrument leads to a more negative impact of immigrant entry on native wages.

[31] Albert (2021) finds similar results.

Table 2.2: First Stage Results

State	IV	JRS-IV	
	$Imm.Share$	$Imm.Share$	$(Imm.Share)_{t-1}$
$(Imm.Share)^Z$	0.698	0.578	0.535
	(0.072)	(0.093)	(0.098)
$(Imm.Share)^Z_{t-1}$		0.073	0.518
		(0.061)	(0.048)
R^2	0.715	0.756	0.801
MSA	$Imm.Share$	$Imm.Share$	$(Imm.Share)_{t-1}$
$(Imm.Share)^Z$	0.613	0.498	0.411
	(0.101)	(0.115)	(0.131)
$(Imm.Share)^Z_{t-1}$		0.061	0.498
		(0.049)	(0.015)
R^2	0.657	0.677	0.689

Note: Population data are from the US Census 1960-2000. The sample consists of 51 states and MSAs, for which data are available. Standard errors are clustered at the Stae/MSA level. The observations are weighted by State/MSA population.

As reported in table 2.3, the results for the OLS and second stage results for the IV and JRS-IV technique are presented with different specifications for state and Table 2.4 provides the same for MSAs. The table below shows the first regressions between immigrant population growth and unionization rates across states between 1980 and 1990. Column (1) highlights the correlation results and an additional check by including log population. Column (2) controls for the region, and columns (3) and (4) control for other different state-level variables of interest: average income and education. In column (5), I show IV results where I instrument immigrant population shares in 1980 with the stock of immigrants in 1970 and finally, in column (6), I look at results from the JRS-IV technique.

Table 2.3: Estimates of the impact of low-skilled immigrant entry on union rates, 1980-90, (States)

			Full Sample		IV-1970	JRS-IV
	(1)	(2)	(3)	(4)	(5)	(6)
(Immigrant/Native) Ratio	-0.358***	-0.271**	-0.315**	-0.329***	-0.452***	-0.477***
	(0.095)	(0.131)	(0.150)	(0.151)	(0.106)	(0.151)
Log Population	x	x	x	x	x	x
Region Dummy	-	x	x	x	x	x
Average Income	-	-	x	x	x	x
Average Education	-	-	-	x	x	x
R^2	0.21	0.59	0.594	0.597		
N	51	51	51	51	51	51

Note: The results are obtained from the decennial Census, 1970, 1980 and 1990. Robust standard errors are in parentheses, adjusted for clustering at state level. $^{*}p < 0.10$; $^{**}p < 0.05$; $^{***}p < 0.01$.

Both the state and MSA level regressions indicate a significant negative relationship between immigrant entry and unionization. Controls for the region, population, average income, and education do not change the relationship.[32] For both States and MSAs, the effect is less when all controls are introduced in column (4) as compared to estimates in column (1). Finally, the IV results in column (5) and JRS-IV results in (6) point to causality such that entry of low skilled immigrants leads to a fall in union rates across states and MSAs. Given the log-log specification of the regression equations, the coefficients under consideration have an easy translatable form.

[32]Albert and Monras (2018), and Monras (2020) have shown immigrant locations prefer settling in areas with higher wages and more population. Therefore, it is essential to control for these variables when looking at immigrant entry impact on unions

Table 2.4: Estimates of the impact of low-skilled immigrant entry on union rates, 1980-90, (MSAs)

			Full Sample		IV-1970	JRS-IV
	(1)	(2)	(3)	(4)	(5)	(6)
(Immigrant/Native) Ratio	-0.328***	-0.241**	-0.245**	-0.290***	-0.422***	-0.434***
	(0.101)	(0.119)	(0.12)	(0.141)	(0.116)	(0.171)
Log Population	x	x	x	x	x	x
Region Dummy	-	x	x	x	x	x
Average Income	-	-	x	x	x	x
Average Education	-	-	-	x	x	x
R^2	0.18	0.47	0.48	0.49		
N	183	183	183	183	183	183

Note: The results are obtained from the decennial Census, 1970, 1980 and 1990. Robust standard errors are in parentheses, adjusted for clustering at MSA level. $^{*}p < 0.10$; $^{**}p < 0.05$; $^{***}p < 0.01$.

In Table 2.3, the central coefficient of interest in column (5) shows that a 1% increase in immigrant to native population ratio leads to a 0.45% fall in union rates. The standard IV approach has a higher estimate than the OLS result. The JRS-IV result in (6) shows a similar effect of a 1% increase in immigrant to native population leading to a 0.47% fall in union density. Between 1980 and 1990, a low-skilled immigrants to native population rose by about 28%, indicating a 13% fall in union density by using the empirical estimates obtained. Union coverage and membership actually decreased by about 27% between 1980-1990. Therefore, the results suggest that low skilled immigrant entry can account for about 47% of the total fall in union density. The reasonably high values of R^2 in the OLS specifications show that the regressions are well explained.[33] The coefficients of interest for both OLS and IV for state-level specification in Table (2.5) between 1980-2000 and MSAs in Table (A.1) in Appendix are also significant but smaller, but this is because there is a higher immigrant entry between these years due to a longer time horizon. As was the case with the specification between 1980-and 1990, the results for the IV specification have a higher magnitude than for OLS. Similar controls for state/MSA characteristics and other factors that have had a negative impact on union rates have also been controlled for as previously. In Table (2.5), a 1% increase in low skilled immigrants to the native-born ratio in a state leads to a 0.24% fall in union density. Union density fell by about 42% between 1980 and 2000, while the low skilled immigrant to population ratio increased by 85%. Therefore, the results indicate that a rise in immigrant entry predicts a 20.4% fall in union rates. Thus, it predicts about 48.5% of the total fall in union density.

[33]Results are similar for union membership versus people covered under union bargaining agreement. The coefficients are higher for the latter.

Table 2.5: Estimates of the impact of low-skilled immigrant entry on union rates, 1980-2000, (States)

			Full Sample		IV-1970	JRS-IV
	(1)	(2)	(3)	(4)	(5)	(6)
(Immigrant/Native) Ratio	-0.228***	-0.195**	-0.201**	-0.219***	-0.242***	-0.247***
	(0.066)	(0.092)	(0.095)	(0.071)	(0.102)	(0.101)
Log Population	x	x	x	x	x	x
Region Dummy	-	x	x	x	x	x
Average Income	-	-	x	x	x	x
Average Education	-	-	-	x	x	x
R^2	0.21	0.59	0.594	0.597		
N	51	51	51	51	51	51

Note: The results are obtained from the decennial Census, 1970, 1980 and 1990. Robust standard errors are in parentheses, adjusted for clustering at state level. $^{*}p < 0.10$; $^{**}p < 0.05$; $^{***}p < 0.01$.

2.4 Other Plausible Reasons

This paper projects the entry of low skilled immigrants as one of the primary proponents for the fall in union rates across the U.S. It puts forward a coherent empirical analysis to back the claim. The literature has argued for other plausible reasons. In this section, I will try to analyze different conceivable channels explored in the literature as potential explanations for the falling union rates and hold these to closer empirical scrutiny.

2.4.1 Political Reasons- Right-to-Work Law and Anti-Union Politics

"Right-to-work" laws generally refer to laws initiated in the different U.S. States that prohibit union security agreements between employers and labour unions. This law acts as a government ban on contractual agreements between employers and union employees, requiring workers to pay for the costs of union representation, Baird (1998). It has been passed in 27 U.S. states thus far and has led to earnings inequality across states, Nieswiadomy et al. (1991). A recent study by Kogan (2017) and backed by similar findings from Feigenbaum et al. (2018) points to how right-to-work laws lead to greater economic inequality by indirectly reducing the power of labour unions. A concern with the analysis so far can be that immigrants chose to locate in states where "Right-to-Work" was in place, thus, contributing to the reduction in union rates. I have two plausible reasons that

go against this theory. First, right-to-work laws were adopted in different states at very different times. A lot of the states adopted them in the late 40s and early 50s, and some others like Michigan (2012), Missouri (2017), Kentucky(2017), Wisconsin(2015) and Indiana (2012) have adopted it much more recently. As shown in the long-run trends, union rates did not decline during the 1940s ad 1950s and, in fact, increased in many states during the period. Also, these periods do not line up with immigrant entry, i.e., immigrants started entering the U.S. in the mid to late 1960s after the Immigration and Nativity Act. I present a timeline of U.S. states and when they adopted right-to-work laws in table A.2 in the Appendix. I re-run the correlation graphs from figure 2.9 but now separately for right-to-work states and states without right-to-work regulations.[34] The coefficients are significant for both; it is more significant for the states with the 'right to work' legislation. Appendix, figure A.4 and A.5 presents the graphs. The result shows that despite controlling for 'right-to-work' regulations, immigrant entry can still explain falling union density, but political institutions surely aid the decline. .

Next, I perform a simple regression analysis to see if immigrants have settled more in states with right-to-work laws. I run the following specification:

$$\Delta(\frac{Imm}{Pop})_{Z,t} = \beta \Delta State_Z + \alpha X_{Z,t} + \epsilon_{Z,t} \tag{2.9}$$

The variable $\Delta(\frac{Imm}{Pop})_{Z,t}$ is the period change in immigrant population shares. The analysis spans from 1970-to 2000, and I choose to partition these into three time periods, 70-the 80s, 80-90s and 90-2000s. The main coefficient of interest is β which evaluates the significance and magnitude of the dummy if the state has right-to-work laws. $X_{Z,t}$ controls for state characteristics in state Z in decade t. Results are provided in table 2.6. Right-to-work adoption has not differentially affected immigrant entry.

[34] A method also employed in Mitra (2021).

Table 2.6: Estimates of 'Right-to-Work' Legislation on Immigrant Entry

	Dependant Variable: Change in Immigrant to total Population		
	(1) 1970-80	(2) 1980-90	(3) 1990-2000
Dummy for Right-to-work State	-2.75	1.56	3.45
	(7.48)	(6.60)	(22.55)
Average Income	x	x	x
Average Education	x	x	x
Average Age	x	x	x

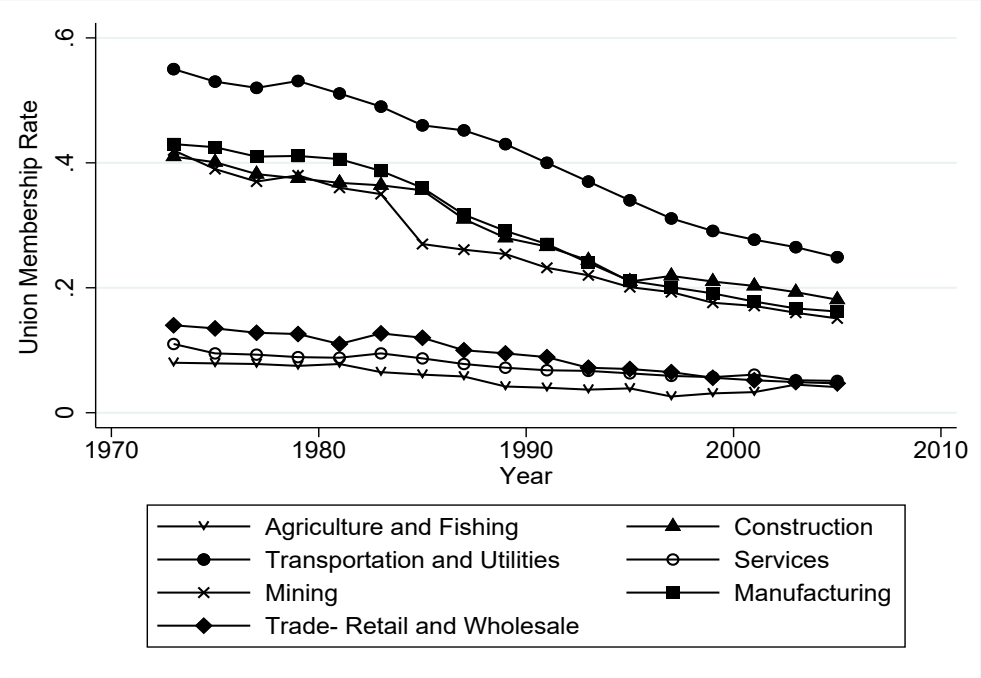
Note: The results are obtained from the (Census, 1970-2000). Average income is the mean of all income earned in the state. Average education is the percentage of people in the state who have more than a high school diploma. Average age of the state is the mean of the age of the working population of the state. Robust $P > |t|$ values are in parentheses.

The other argument put forward is the anti-union efforts of the Reagan administration in the U.S. and the Thatcher government in the UK, Howard (1995). Although these policies effectively put pressure on the reduction of union activities, the timing of the deunionization events suggests that forces that started to push unionization down were already in play before these Reagan's presidency. Farber and Western (2001) points to how the number of union elections began to decline in the early 70s and was much ahead of the Reagan Labor Board in 1983. Unionization declined in the U.S. from the late 1960s, in the 70s and up until the 2000s. They also claim that union membership and other activities started to fall from 1974, before which public and private union rates were similar, but private union rates fell drastically post that year.

2.4.2 Composition of Industries

It might be that the decline in union rates is not a result of the entry of low skilled immigrants entering the workforce but of a change in the relative employment of the different industries. Industries like services are a lot less unionized than manufacturing, and thus, as more people work in these non-unionized sectors, the overall percentage of unionized workers has decreased. This argument lends credibility because, in the U.S., employment share has shifted away from sectors where unions have been traditionally strong, like manufacturing and construction, to services. Although the output share of the services sector has increased from about 74% in 1965 to about 80% in 2005 and the share in total hours worked has increased by about 20 percentage points, the fall in union

rates has occurred in this sector. [35] In figure 2.12, I graph the unionization rates across major industries between 1973 to 2005. Union rates across all sectors have declined, and this substantial decline within each industry points to deunionization in the U.S. is solely not due to a compositional shift. Further, following Farber (1990) and Farber and Krueger (1992), I estimate the union membership rate changes within and between industries. I estimate the industry composition effect at the two-digit industry level, keeping constant the employment share at the 1978 levels and updating only the industry-wise union coverage rates.[36] This is done between 1978 and 1999, and I find that a 13.6% decline in union rates is within industries, and about 3.2% is between industries. In a similar vein, Baldwin (2003) argues that trade and the possibility of out-sourcing by specific industries have led to a fall in union rates. However, the decline in the unionization rate was not confined to the tradable goods sector and has been almost uniform across industries. Furthermore, as seen in the data and from union elections, the union wage premium has been stable for 40 years. Thus, any theory based on the depletion of economic rents available to unions must adhere to a union strategy that trades size for more significant wage premiums.



Note: Union Membership and Coverage by Industry in the US (1973-2007) – Percent of workers. The sample consists of male, private wage, and salary workers over the age of 16 from in the CPS May supplements (1973-1981) and the monthly ORG files (1983-2007).

Figure 2.12: Industry wise Union Membership Rate

[35] Data on service sector output and total hours share taken from KLEMS annual dataset.

[36] I map the 3-digit census coding to the 2-digit classification, as defined by the NBER. Due to the change in the census industrial classification system in 2000, I confine the compositional analysis to 1978-1999. As the rate of unionization declined by 4% after 1999, this would not alter the composition analysis much by including the period after 1999

Next, I try to see if falling union rates across industries correlate with an immigrant entry into those industries. To check for this, I look at 19 broad industry classifications and regress the difference in union rates across sectors on the difference in the immigrant share of the labour share in those industries over time by using the specification as follows:

$$\Delta \ln Union_i = \alpha + \beta \ln \Delta(\frac{Immigrant}{Native})_i + \gamma X_{i,1980} + \epsilon_i \tag{2.10}$$

I present the results for 1980-1990 in Table 2.7 and the results for 1980-2000 are in the Appendix as Table A.3. As the results show and further encourage the correlation graphs earlier, industries saw higher growth in the immigrant population and a higher fall in union rates. Although the IV argument for the state or region level exercise is not as valid for industries because past immigrant inflows in a specific industry may not predict future immigrant inflows, the IV estimates also point to a similar outcome.

Table 2.7: Estimates of the impact of low-skilled entry on union/coverage rates-CPS (1980-1990), industry level

	Union Rates	Coverage Rates	IV-1970	IV-1960
	(1)	(2)	(3)	(4)
(Immigrant/Native)	-0.416***	-0.425***	-0.476***	-0.531***
	(0.152)	(0.167)	(0.142)	(0.162)
Average Income	x	x	x	x
Employment Shares	x	x	x	x
R^2	0.231	0.234		
N	16	16	16	16

Note: The results are obtained from the decennial Census, 1960, 1970, 1980, 1990 and CPS (March files). Robust standard errors are in parentheses, adjusted for clustering at state level. $^{*}p < 0.10$; $^{**}p < 0.05$; $^{***}p < 0.01$.

2.4.3 Technology Improvements- Skill Biased Technical Change (SBTC)

Most studies that have argued for skill-biased technical change to be the driver of de-unionization in the U.S. have not presented adequate empirical evidence to back their claims. Recent work by

Dinlersoz and Greenwood (2016) puts forward SBTC has the primary component behind falling union rates but mainly from a theoretical standpoint. Acemoglu et al. (2001) also provides theoretical justification behind SBTC leading to a fall in unionization. Their model predicts that skilled workers leave unions and enter the non-union sector to get a higher wage due to the introduction of skill-biased technology. I can replicate this with my model; crucially, their analysis claims that low-skilled workers do not leave the union. Their model is silent on the firm's role in deunionization. Thus, it contradicts data facts based on Farber (1983) and Açıkgöz and Kaymak (2014) who find unions concentrated towards the middle of the skill distribution. Also, Acemoglu et al. (2001) does not provide any empirical support behind SBTC leading to a fall in union rates. Finally, SBTC also cannot explain the lack of deunionization in countries with similar episodes of SBTC. Most countries, especially in Europe, have seen technology adoption in production but still maintain high union rates. The primary reason behind this could be that technological change is difficult to measure quantitatively. However, I test the hypothesis using recent automation data if an increase in automation take-up has changed unionization rates in different U.S. Metropolitan Statistical Areas (MSAs). I proxy automation technology by relying on data from Leigh and Kraft (2018) based on the location of robot integrators, a strategy used by Acemoglu and Restrepo (2020).[37] Table 2.8 offers estimates for the following model

$$\Delta Union_z = \beta\ \Delta.Integrators_z + \alpha X_{z,1990} + \epsilon_z \tag{2.11}$$

$Integrator_z$ for if an MSA has an integrator between 1990-2015. Here, z denotes an MSA with a dummy $D\Delta Union$ indicates the change in union rates between 1990 and 2015. Here robotic integrators are used only to proxy for skill-biased technical change, which is difficult to measure. Given the scope of robots and their penetration in the U.S. economy, to the extent to which it can proxy SBTC, I find no evidence pointing to a relationship between it and union rates, as is seen in Table 2.8. Papers like Krueger (1993) and Beaudry et al. (2010) have tried to reason if the introduction to computers should proxy SBTC. In contrast, recent papers like Rubinton (2020) have reasoned for a more general definition, where the investment in Information and Communication Technologies (ICT) should be considered SBTC. It is hard to argue against SBTC not impacting union rates even remotely. Still, I am not aware of any papers trying to empirically show the relationship between the two, which is beyond the scope of this paper.

[37] A map outlining the data is provided in Appendix as figure A.6

Table 2.8: Estimates of the impact of location of robot integrators in the US on unionization rates, 1990-2015

	Dependant Variable: Change in union rates		
	(1)	(2)	(3)
Dummy for Robot Integrator in MSA	2.038	1.556	1.221
	(0.765)	(0.677)	(0.419)
Average Income	x	x	x
Average Education	-	x	x
Right-to-Work	-	-	x
N	161	161	161

Note: Union and other MSA level data from Census and American Community Survey, 2015. Robotic integrator data from Leigh and Kraft (2018) and Acemoglu and Restrepo (2018). $P > |t|$ values are in parentheses and have been clustered at MSA level.

Finally, considering alternative explanations for the fall in union density in the U.S., I analyze all the options together in a specification as considered in Eq.2.6 and Eq.2.8. I bring the controls from Table2.3 and, in addition to those, look at how right-to-work, industry composition and SBTC as measured by robotic integrators compare to when evaluated against low skilled immigrant entry. In Table 2.9, column (1) is the OLS result from Table 2.3. In Column (2), I additionally control for right-to-work states and the interaction with immigrant entry, Column (3) controls for service sector population share.[38,39]. In Column (4) and Column (5), I consider the standard IV estimates and JRS-IV estimates. Finally, in Columns (6) and (7), I bring in an SBTC variable and analyze it in the IV set but between the years 1990-2015, as this is for when the SBTC data is available, as discussed in the previous section. Table 2.10 analyzes the MSA level between 1980-and 1990. Additionally, Table A.4 in the Appendix looks at the same specification across states between 1980-and 2000. The tables below show that there is still a robust negative relationship between immigrant entry and unions after controlling for the previously mentioned variables. Columns (6) and (7) have a much smaller coefficient on the immigrant to native-born ratio term because of the period considered. The rate of decline in unions decreased post-2000s because the immigrant population that came into the U.S. post-2007 was a lot more skilled.

[38]Removing the interaction term between right-to-work states and immigrant entry also does not change the significance of the results.

[39]Controlling instead for a share of the population in manufacturing has similar results. Interaction terms also do not change the results

Table 2.9: Estimates of the impact of low-skilled immigrant entry on union rates, 1980-90, (States)

		Full Sample		IV-1970	JRS-IV	IV-1970 (1990-15)	JRS-IV (1990-15)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
(Immigrant/Native) Ratio	-0.329***	-0.312***	-0.319**	-0.424***	-0.431***	-0.101*	-0.098**
	(0.151)	(0.113)	(0.158)	(0.124)	(0.131)	(0.050)	(0.048)
Right-to-Work	-	-0.024	-0.026	-0.05	-0.01	-0.04	-0.04
		(0.05)	(0.13)	(0.04)	(0.11)	(0.13)	(0.12)
Right-to-Work X (I/N) Ratio	-	-0.192	-0.20	-0.09	0.00	0.00	0.00
		(0.17)	(0.18)	(0.12)	(0.39)	(0.7)	(0.8)
% Services	-	-	-0.109	-0.05	-0.03	-0.02	-0.03
			(0.12)	(0.13)	(0.21)	(0.04)	(0.05)
SBTC	-	-	-	-	-	-0.19	-0.18
						(0.91)	(0.93)
R^2	0.597	0.61	0.65				
N	51	51	51	51	51	51	51

Note: The results are obtained from the decennial Census, 1970, 1980 and 1990 and ACS (2014-16). Robust standard errors are in parentheses, adjusted for clustering at state level. $^{*}p < 0.10$; $^{**}p < 0.05$; $^{***}p < 0.01$. Specification(6) and (7) does not have region dummy

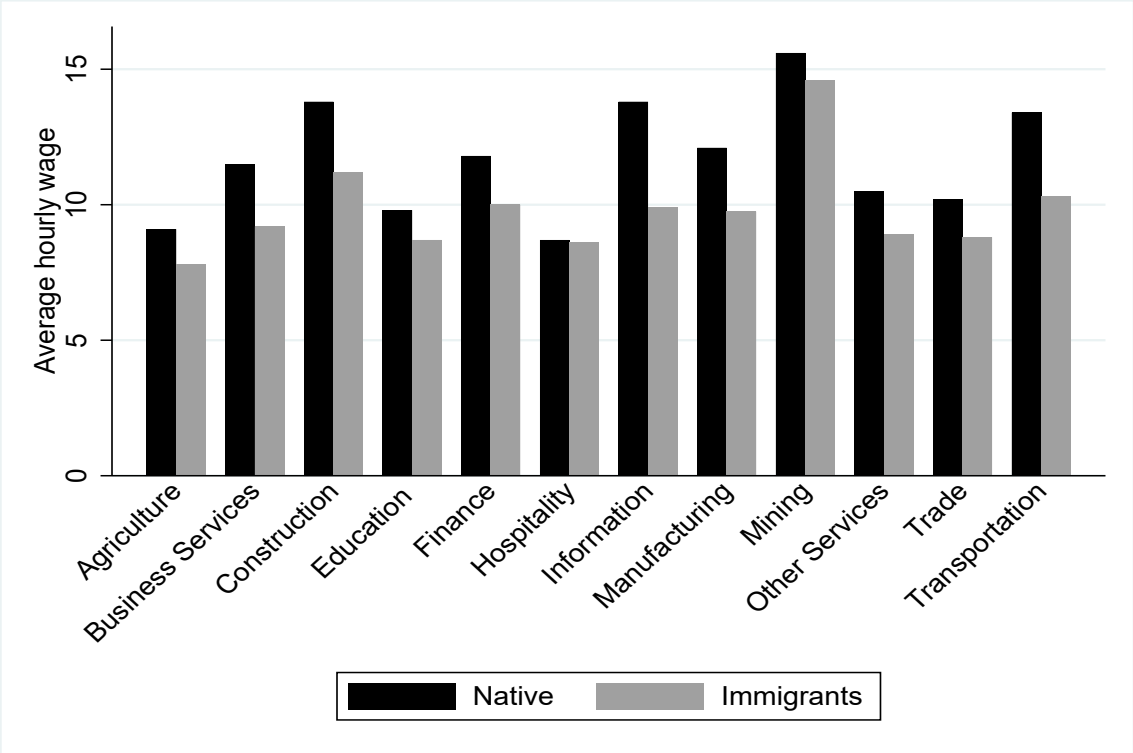
Table 2.10: Estimates of the impact of low-skilled immigrant entry on union rates, 1980-90, (MSAs)

		Full Sample		IV-1970	JRS-IV	IV-1970 (1990-15)	JRS-IV (1990-15)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
(Immigrant/Native) Ratio	-0.290***	-0.295***	-0.261**	-0.341***	-0.351***	-0.089**	-0.092*
	(0.141)	(0.076)	(0.13)	(0.128)	(0.132)	(0.04)	(0.046)
Right-to-Work	-	-0.013	-0.016	-0.03	-0.02	-0.15	-0.14
		(0.04)	(0.15)	(0.04)	(0.04)	(0.2)	(0.2)
Right-to-Work X (I/N) Ratio	-	-0.132	-0.120	-0.17	-0.14	-0.02	-0.01
		(0.19)	(0.11)	(0.17)	(0.19)	(0.7)	(0.8)
% Services	-	-	-0.109	-0.03	-0.04	-0.02	-0.03
			(0.12)	(0.13)	(0.22)	(0.04)	(0.05)
SBTC	-	-	-	-	-	-0.22	0.28
						(0.41)	(0.43)
R^2	0.49	0.52	0.65				
N	162	162	162	162	162	162	162

Note: The results are obtained from the decennial Census, 1970, 1980 and 1990 and ACS (2014-16). Robust standard errors are in parentheses, adjusted for clustering at MSA level. $^{*}p < 0.10$; $^{**}p < 0.05$; $^{***}p < 0.01$. Specification(6) and (7) does not have region dummy

2.5 Model

This section presents a model that explains the relationships between low skilled immigrant entry and deunionization. The model helps formalize the mechanism behind the data facts we see in previous sections. Also, the model is crucial to verify some of the specifications used in the empirical section and to perform calibrations to see how well the model can predict declining union rates. Before laying out the model foundations, it is essential to show two critical differences between low-skilled native-born, i.e., high school graduates or less and immigrants. Firstly, there is extensive documentation that immigrants are paid less than natives even after controlling for observables. I formalize this argument by looking at immigrants in the U.S. using the CPS data and comparing them to low-skilled native-born. [40] I analyze the differences across industries, including only individuals between the age group of 18-65 and excluding all who are self-employed, work below 35 hours per week and are working without pay. Total wage income deflated to 1999 U.S. Dollar and divided by the number of hours worked per year, after controlling for outliers, is used to generate the average hourly wage.[41] Figure 2.13 reports these figures; native-born earn more in all industries except for the hospitality sector, where the averages are very close.

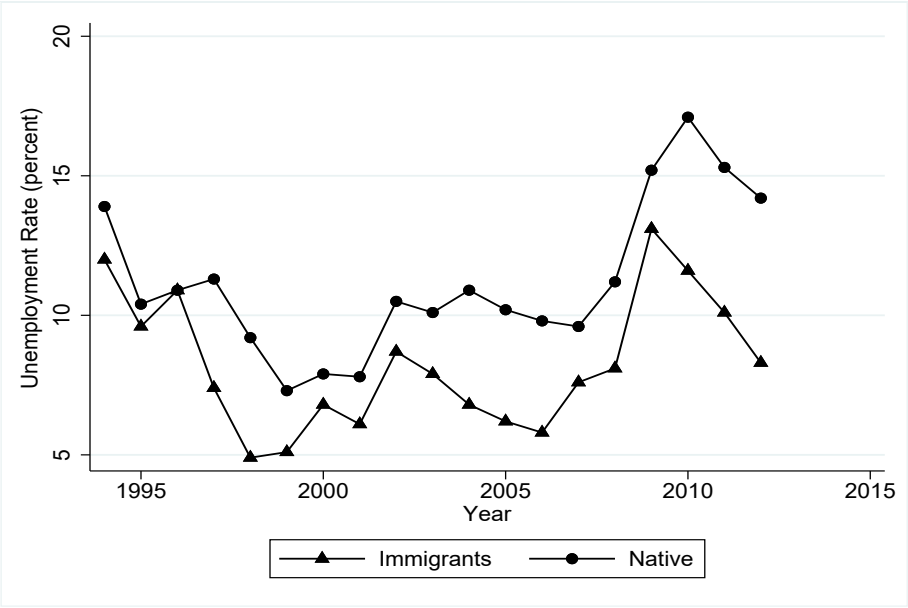


Note: Averages drawn from 1994-2007 CPS March files.

Figure 2.13: Hourly wage of low-skilled workers (1999 dollar)

[40] In my model, I will formally classify any native who does not have a high school diploma or less as being low-skilled.

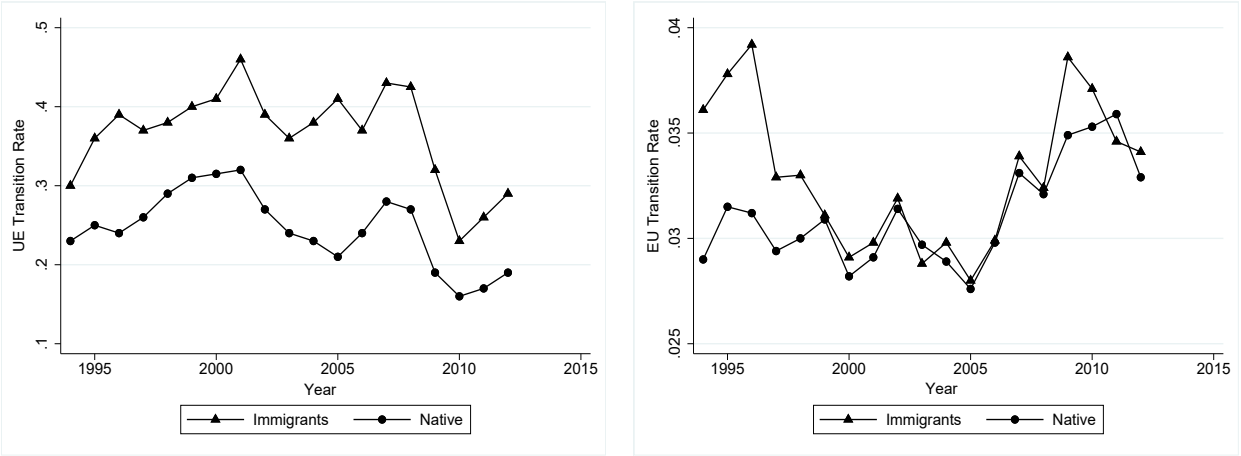
[41] drop first and 99th percentile of the distribution



Note: Constructed using CPS March data.

Figure 2.14: Unemployment Rates

Next, I look at unemployment rates and employment-unemployment transition rates across natives and immigrants who are low skilled. Again using CPS March Supplement files over time, I find that, as shown in figure 2.14, the unemployment rates of low-skilled native-born workers are higher than that of immigrant workers. The averages are closer in the 1990s but more expansive in the 2000s. As this difference in the unemployment rate could be due to higher job finding rates or lower job separation rates for immigrants, I analyze both these aspects to check to see what might explain these differential unemployment rates.



Note: Yearly averages constructed using CPS basic monthly files.

Figure 2.15: Transition Rates

Using CPS basic monthly files, I calculate unemployment to employment (U.E.) and employment to unemployment (E.U.) transition rates for all individuals who can be linked over time, closely following Shimer (2012). The left panel of Figure 2.15 documents unemployment to employment transition rates between natives and immigrants, and the right panel shows employment to unemployment transition rates. In a search and matching set-up, this is synonymous with the job-finding rate and job separation rate, respectively. In all years, the job-finding rates of immigrants are higher than natives, which can account for the lower unemployment rates in figure 2.14 as the differences in the separation rates post 2000 do not seem to be significant. These empirical findings are important as they motivate the assumptions in the model that will follow. Immigrants have lower wages and higher job finding rates but similar job separation rates than low skilled native-born.

2.5.1 Baseline Model

The model is mainly adopted from Blanchard and Diamond (1994), Chassamboulli and Palivos (2014) and Açıkgöz and Kaymak (2014). It extends the seminal search and matching literature, introduced by Mortensen and Pissarides (1994) with the existence of low skilled immigrants and a separate union player in two different skill markets.

There is a continuum of measures one of risk-neutral, infinitely lived native workers in the economy. These workers are divided into either high-skilled (H) or low-skilled (L). Besides native-born, there are also immigrants in the economy. The mass of native-born is normalized to unity and let I denote the mass of immigrants. Let λ of native-born be L type, and $1-\lambda$ be H type with I being immigrants who are all low skilled (L) type.[42] There is also a large measure ($n >> 1$) of

[42] All immigrants are expressed as low-type because, being immigrants, their education or an observable skill is not

ex-ante identical and risk-neutral firms. Time is discrete and all agents have a common subjective discount factor $r \epsilon (0,1)$. There is also a representative union that is separate from the firm. The representative union has an egalitarian approach and sets a uniform wage for all workers who join the union, irrespective of type. The union does not discriminate based on the type or nativity of the worker. All workers, native-born or immigrants, besides being of a particular type, also have an unobservable skill measure: efficiency given by ζ such that $\zeta \epsilon \mathbb{R}$ with distribution $g(.)$. This internal efficiency is known to workers, and the firms know this efficiency only after they match with the worker.[43] Given a skill type, the higher the efficiency of the worker, the more productive the worker. All workers draw their efficiency parameters from the same distribution. I assume that the efficiency parameter for the highest efficiency high (H) type is above the efficiency parameter for the highest efficiency low-type worker. However, the efficiency of the lowest efficiency high type workers could be below the highest efficiency low type worker.

The workers identify the market they must enter based on their observable type (H or L) and decide to join the union or not. After this, they enter the market and potentially match with a firm. The firm can potentially hire factors of production from three markets, the high-skilled, low skilled labour market and a capital market. However, a firm hires either an individual H type or L type, worker. It produces the respective good, which a worker of that skill can only produce, i.e. H or L. These intermediate goods and sold to the final good producer, who combines it with Capital (K) and makes the final numeraire good. The final good determines the price of the individual intermediate good. After all, vacancies have been filled; the firm produces an intermediate good using either high skilled or low skilled worker with production function $f(\zeta)$, where ζ is the worker's efficiency. The function $f : \mathbb{R} \to \mathbb{R}_{++}$ is continuously differentiable, measurable with respect to μ such that, $f^{'}(\zeta) > 0$, $lim_{\zeta \to -\infty} f(\zeta) = 0$ and $lim_{\zeta \to \infty} f(\zeta) = \infty$. This implies that higher efficiency workers would produce higher output. irrespective of type I also assume, $\int_{-\infty}^{\bar{T_L}} f(\zeta) = L$ for all L types and $\int_{\bar{T_H}}^{\infty} f(\zeta) = H$ for all H types. That is, low type workers have efficiency between $-\infty$ to $\bar{T_L}$ and high type workers have efficiency between $\bar{T_H}$ and ∞, where $\bar{T_L}$ could be greater than or equal to $\bar{T_H}$. A final output Y is produced using two intermediate inputs, H and L. The final good is numeraire, and its production function is given by:

$$Y = AK^{\alpha}[\gamma H^{\sigma} + (1-\gamma)L^{\sigma}]^{\frac{1-\alpha}{\sigma}}, \quad 0 < \alpha, \ \frac{1}{2} < \gamma < 1, \ \sigma \leq 1 \tag{2.12}$$

where A and K represents efficiency parameter of the worker employed and capital stock, α and γ are parameters that govern the income shares. $\frac{1}{1-\sigma}$ is the elasticity of substitution between skilled input and unskilled input respectively. All three goods are sold in a competitive market. The

as valued as that of natives. However, even immigrants have an efficiency parameter drawn from the same distribution as natives.

[43] The difference between skill type denoted as either being H or L and efficiency given by (ζ) is that skill type is an observable and verifiable measure, such as educational attainment, which workers, firms and unions can see. In comparison, efficiency is observed post-match like cognitive ability, punctuality or logical ability.

prices of the two intermediate goods say p_H and p_L will equal the marginal product of the inputs, $\frac{\partial Y}{\partial i}$, $i = H, L$. There also exists a competitive capital market for firms where they can buy and sell capital. The marginal product of capital is equal to rental price $p_k = \delta + r$, which is the interest rate plus depreciation rate.

It is to be recognized here that in the model, workers first decide on union status and then potentially match with a firm and get hired if the firm chooses such. In reality, in the US, union decisions are often made post the hiring process. This brings in potentially interesting dynamics of firm exit and entry and can potentially change the firm hiring process as explained in, Taschereau-Dumouchel (2020). However, this model examines what happens to the unionization rate post-immigrant entry and can also allow this more realistic hiring process as the firm can always exercise the option of not hiring if a worker is unionized and not profitable for the firm. In the more realistic setting, this happens if the worker chooses to unionize after getting hired, they can do so only if the firm is profitable. This may seem unusual, but given how the model will be solved, the firm never exercises this option at the equilibrium since only workers who know who will be hired at union wage choose to unionize. Therefore, at the steady-state equilibrium, a worker optimally looks for a union job or a non-union job. Hence, both hiring methods would only allow a firm to hire a unionized worker if they are profitable for the firm at union wage, thus giving equivalent results.

2.5.2 Matching

The High skilled (H) and Low skilled (L) markets are simultaneously open, and workers in both markets are matched with vacant positions available in every period. Firms post vacancies in either high skilled or low skilled workers market, which can be applied for and matched by only that type of worker. Each firm posts one vacancy, and firm entry in each market is determined endogenously. Firms in the high skilled market randomly match with high type native workers. However, firms can post nativity specific vacancies in the low skilled market and perform a kind of directed search. Therefore, firms that desire to hire low-skilled workers can do so from either the immigrant or native markets.

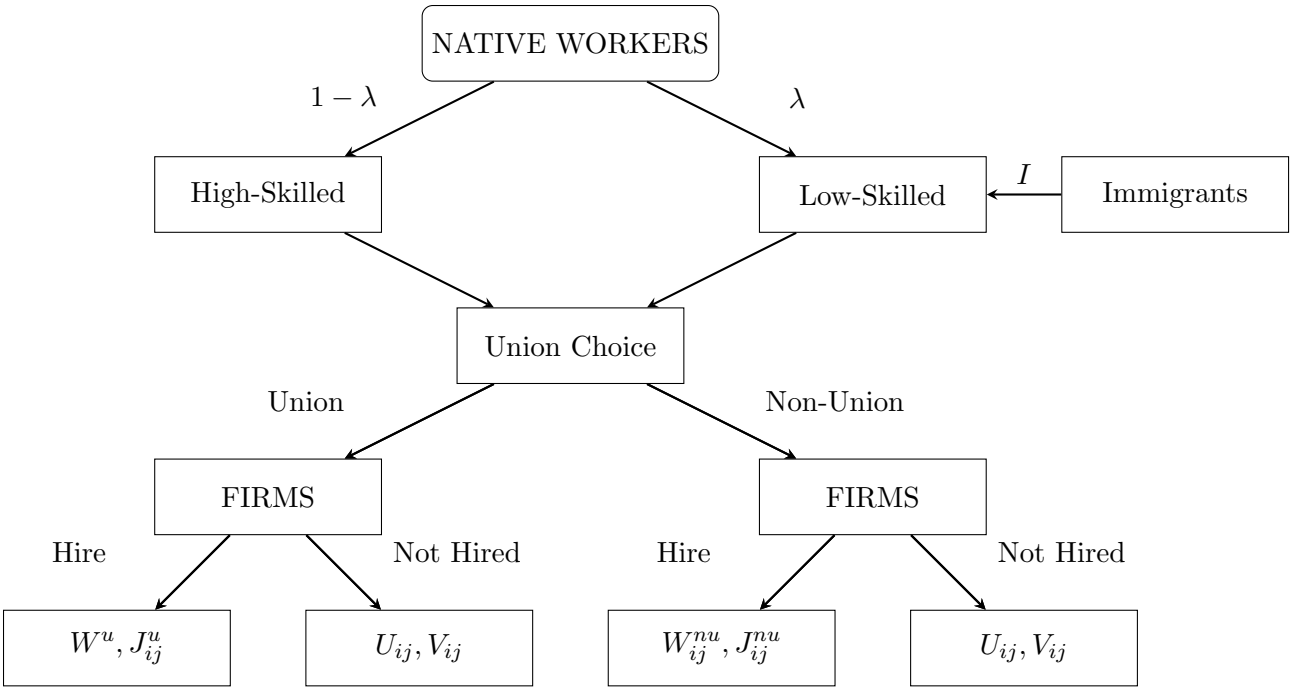
The matching function in each market is defined by $M(U_{ij}, V_{ij}) = MU_{ij}^{\epsilon} V_{ij}^{1-\epsilon}$, where M is an efficiency parameter and U_{ij} and V_{ij} denote unemployed workers and vacancies of the particular skill type i and nativity j. The flow rates of a match for a worker and for vacancy are $M(U_{ij}, V_{ij})/U_{ij} = M\theta_{ij}^{1-\epsilon} = m(\theta_{ij})$ and $M(U_{ij}, V_{ij})/V_{ij} = M\theta_{ij}^{-\epsilon} = q(\theta_{ij})$, respectively. $\theta_{ij} = \frac{V_{ij}}{U_{ij}}$ is an indicator of the tightness in labour market i and j. Finally, a vacant firm has to incur a recruitment cost, c_i, $i = H, L$. The assumption that firms can post nativity specific post can be rationalised from the empirical finding as discussed in figure 2.14 and 2.15 as discussed earlier in this section. This assumption allows us to rationalize the data fact that immigrants and natives who are both low skilled to have different unemployment and job finding rates.

On the worker's side, if workers are unemployed, they receive a net flow of income given by b_{ij}, which is a combination of unemployment benefits, cost of search and value of leisure. Here, I make an important reasonable assumption that $b_{iN} > b_{iI}$, since most immigrants, especially undocumented ones, have higher search costs, do not qualify for unemployment or regular benefits and do not value leisure as highly in a foreign country.[44] This is backed by the empirical finding in figure 2.13 where I find native-born workers earn more than foreign-born workers with similar skills across industries. Once a worker matches with a firm, they bargain over surplus from a match. The skill type of the worker and output that will result from the match are known to the firm and worker. Following the literature, I assume that wages are determined via Nash bargaining, where the relative allocation of power towards a worker is given by β. If a worker joins a union, the union sets a uniform wage for all the workers irrespective of skill type, nativity and efficiency. Once workers have decided on their union participation, they enter the market specific to their skill and nativity. Here, firms potentially match with workers and decide whether to hire the worker or keep the vacancy unfilled. When hiring a worker, firms know their skill, efficiency, and union status. If the worker is unionized, the firms know that they are to pay them the union set wage; otherwise, if they are not unionized, they are paid the non-union wage, which depends on the worker's characteristics. Production begins once a match takes place between worker and firm. Matches between firm and worker can also break exogenously at rate (s_i), following which they return to the market to search for work if they are a worker or create a vacancy if they are a firm.[45] The following flow chart can help formalize the structure of the model environment.[46]

[44] Drawing from empirical evidence from both survey data and Census information, paper-like Monras et al. (2018) and Albert (2021) have shown how immigrants, especially undocumented ones, are reluctant to apply for unemployment benefits. Munshi (2003) shows how immigrants, especially newly arrived ones, do not value leisure as much in a foreign country using survey data from the New Immigrant Survey

[45] Note here that a match break-up is dependent only on skill type and not nativity as referenced to from the data finding in figure2.15.

[46] Here, I assume that individual bargaining weights are independent of the nativity. In other words, immigrants and natives, when bargaining individually, have similar bargaining weights. This assumption does not distort the model results as it is natural to assume that immigrants may have lower bargaining weights than natives, and that will only reduce their equilibrium weights further.



2.5.3 Value functions

Having defined the model environment and layout, it is now crucial to understand the flow values of all parties involved in the market. Let W_{ij} represent the value function of an employed worker where $i = H, L$ denotes the skill-type of the worker and $j = N, L$ denotes the nativity of the worker. For unemployed workers, let the flow value function from being unemployed be given as rU_{ij}. Similarly, J_{ij} denotes the value functions of the firm who have matched to a worker, as their flow value depends not only on the skill type (i) of the worker they match with but also on nativity (j) of the worker. For still vacant firms, let the value function be denoted by V_{ij}. A superscript (u) denotes if it is a union match and (nu) denotes a non-union match.

Workers' value functions

Now, workers can either join the union or not, depending on which the value functions change, presented below. The value function for a worker who has not joined a union is

$$\begin{aligned} rW^{nu}_{ij}(\zeta) &= w_{ij}(\zeta) + s_i[U_{ij}(\zeta) - W^{nu}_{ij}(\zeta)] \\ rU_{ij}(\zeta) &= b_{ij} + m(\theta_{ij})[M^{w}_{ij}(\zeta) - U_{ij}(\zeta)] \end{aligned} \tag{2.13}$$

where again $i = H, L$ and $j = N, I$. The value function of the employed worker denotes that if the worker gets employed they received wage $w_{ij}(\zeta)$ and in the next period with some probability they break away from the firm and receive unemployed flow value or otherwise they remain employed. An unemployed worker in the next period can possibly join the union, therefore their flow value in

the next period is given by $M_{ij}^{w}(\zeta)$, where:

$$M_{ij}^{w}(\zeta) = \begin{cases} W_{ij}^{u}(\zeta) & \text{if } \textit{worker joins union} \\ W_{ij}^{nu}(\zeta) & \text{if } \textit{worker does not join union} \end{cases}$$

If workers decide to join union:

$$rW_{ij}^{u}(\zeta) = w^{u} + s_i[U_{ij}(\zeta) - W_{ij}^{u}(\zeta)] \tag{2.14}$$

Firms' value functions

Value functions for a firm is given as follows. Firstly, for firms who match with workers not part of the union.

$$\begin{aligned} rJ_{ij}^{nu}(\zeta) &= p_i f_i(\zeta) - w_{ij}(\zeta) + s_i[V_{ij} - J_{ij}^{nu}(\zeta)] \\ rV_{ij} &= -c_i + q(\theta_{ij})[\int M_{ij}^{f}(\zeta)d\mu - V_{ij}] \end{aligned} \tag{2.15}$$

where $i = H, L$ and $j = N, I$. As before in the case of the workers, continuation value depends on if the firm matched with a unionised worker. Therefore,

$$M_{ij}^{f}(\zeta) = \begin{cases} J_{ij}^{u}(\zeta) & \text{if } \textit{meet unionized worker} \\ J_{ij}^{nu}(\zeta) & \text{if } \textit{meet non} - \textit{unionized worker} \end{cases}$$

If they meet unionized workers, the flow value would be as follows:

$$rJ_{ij}^{u}(\zeta) = p_i f_i(\zeta) - w^{u} + s_i[V_{ij}(\zeta) - J_{ij}^{u}(\zeta)] \tag{2.16}$$

Free entry conditions and unemployment

Free entry and exit of a firm in each market where they hire L type and H type workers implies that in equilibrium, an additional vacancy has an expected net profit equal to zero,

$$V_{ij} = 0 \tag{2.17}$$

Now, I first analyze the non-union case. The total surplus from a match is given as

$$S_{ij}(\zeta) = J_{ij}^{nu}(\zeta) + W_{ij}^{nu}(\zeta) - U_{ij}(\zeta) - V_{ij} \tag{2.18}$$

On the other hand how, total surplus is divided between workers and firm with bargaining weights β and $1-\beta$ respectively. Thus, we get

$$\begin{aligned} W_{ij}^{nu}(\zeta) - U_{ij}(\zeta) &= \beta S_{ij}(\zeta) \\ J_{ij}^{nu}(\zeta) - V_{ij} &= (1-\beta) S_{ij}(\zeta) \end{aligned} \tag{2.19}$$

Given the total mass of highly skilled and low-skilled workers $1-\lambda$ and $\lambda + I$ respectively, we can get the steady-state employment levels of each type of worker as follow:

$$H = \frac{m(\theta_H)(1-\lambda)}{s_H + m(\theta_H)} \tag{2.20}$$

$$L = \frac{m(\theta_{LN})(\lambda)}{s_L + m(\theta_{LN})} + \frac{m(\theta_{LI})(I)}{s_L + m(\theta_{LI})} \tag{2.21}$$

After calculating the steady-state level of employment, it is also possible to find out steady-state unemployment levels for each skill and nativity type.

$$U_H = \frac{s_H}{s_H + m(\theta_H)} \tag{2.22}$$

$$U_{LN} = \frac{s_L}{s_L + m(\theta_{LN})} \ \ , U_{LI} = \frac{s_L}{s_L + m(\theta_{LI})} \tag{2.23}$$

2.5.4 Equilibrium

The equilibrium in the economy would be defined as follows:

A *steady-state equilibrium* with unions and immigrant workers consists of non-union wages $w_{ij}^{nu} \epsilon \mathbb{R}_+$, union wages $w^u \epsilon \mathbb{R}_+$ and net income when unemployed $b_{ij} \epsilon \mathbb{R}_+$ and set of values $\{M_{ij}^w, M_{ij}^f,\ p_i^*,\ p_k^*, H^*, L^*, K^*, u_{ij}^*, \theta_{ij}^*\}$ where $i = H, L$, $j = N, I$, so that given w_{ij}^{nu}, w^u and b_{ij}, the following conditions are met:

- $M_{ij}^w(\zeta)$ and $M_{ij}^f(\zeta)$ constitute equilibrium payoffs for each $\zeta \epsilon \mathbb{R}$.
- The goods market for both final and intermediate goods gets cleared.
- The free entry conditions and optimal vacancy posting condition are met.
- The Nash bargaining optimality condition is met for all firms and workers of all nativity and skill-type.
- Number of employed and unemployed workers of each skill and nativity remain constant.
- Non-union wages are determined by individual bargaining for each $\zeta \epsilon \mathbb{R}$ and union wage w^u is determined by solving the union maximizing total membership given non-union wage.

2.5.5 Analysis of the baseline model- Non-union sector

The first step of the analysis would be to find the surplus values and the wages offered by the firms to the workers in the non-union sector. Using Eq. 2.14, 2.15 and 2.17, we get:

$$S_{ij}(\zeta) = \frac{1}{1-\beta}\frac{p_i f_i(\zeta) - w_{ij}(\zeta)}{r+s_i} \tag{2.24}$$

Now, substituting the above equation into the flow value for the workers and using the split of surplus-value result, we get

$$w_{ij}(\zeta) = \beta p_i f_i(\zeta) + (1-\beta) r U_{ij}(\zeta) \tag{2.25}$$

This is an intuitive result showing that the wage rate should be a convex combination of the value of production $p_i f_i(\zeta)$ and worker's reservation wage rate, $rU_{ij}(\zeta)$. Now substituting out U_{ij} from the system in 2.25, using 2.13, we get

$$w_{ij}(\zeta) = b_{ij} + (p_i f_i(\zeta) - b_{ij})\frac{\beta(r+s_i+m(\theta_{ij}))}{r+s_i+\beta m(\theta_{ij})} \tag{2.26}$$

As the equation shows, a worker's wage would depend positively on the unemployment benefits they get (part of b_{ij}), productivity term captured by $(p_i f_i(\zeta))$ and market tightness, θ_{ij}. This makes intuitive sense because the more productive the worker, the higher their return from working. An increase in the opportunity cost of working increases their reservation wage and hence negotiated wage. Finally, as we call $\theta_i = \frac{V_i}{U_i}$ so an increase in θ_i would imply an increase in the probability of getting a job, which again increases negotiated wage. Also, the higher the surplus the worker negotiates for β, the higher their wage. Now to get equilibrium values, we use the above equation and match it to the value of p_i we get from the production function. So, differentiating 2.12, we express the prices of the intermediate goods as:

$$p_H = (1-\alpha)\gamma A^{\frac{1}{1-\alpha}}\left(\frac{\alpha}{r+\delta}\right)^{\frac{\alpha}{1-\alpha}}\left[\gamma + (1-\gamma)\left(\frac{L^*}{H^*}\right)^{\sigma}\right]^{\frac{1-\sigma}{\sigma}} \tag{2.27}$$

Similarly,

$$p_L = (1-\alpha)(1-\gamma)A^{\frac{1}{1-\alpha}}\left(\frac{\alpha}{r+\delta}\right)^{\frac{\alpha}{1-\alpha}}\left[\gamma\left(\frac{L^*}{H^*}\right)^{-\sigma} + (1-\gamma)\right]^{\frac{1-\sigma}{\sigma}} \tag{2.28}$$

The two equations imply diminishing marginal products and complementarity between two different inputs. This is because, $\frac{\delta p_i}{\delta i} < 0$ and $\frac{\delta p_i}{\delta j} > 0$. Finally from equation 2.20 and 2.21 we can see that $\frac{\delta_i}{\delta \theta_i} > 0$.

2.5.6 Option to hire

Crucially, since immigrants are low skilled workers, they always have lower reservation wages than low-skilled native-born, which would mean that their wages would also be lower. Thus, it can mean that all firms can extract a higher surplus after matching with immigrants and, therefore, post

vacancies only in the immigrant market when hiring a low-skilled worker. However, this would not be true as the firms may choose to post only immigrant specific vacancies, but then they would not always be able to match with them as the tightness increases, and it becomes less likely for each firm to match as v increases, so they still have an incentive to post vacancies in the low skilled native-born market as well.

Next, to formalize, I consider from 2.15, $J_{ij}^{nu} > V_{ij} = 0$ since firms in a non-union match retain a positive share of the total surplus. At equilibrium, a filled non-union position is strictly preferred to keep a vacancy for another period. Therefore, a non-union match would always result in hiring for a firm. Therefore, they would 'not hire' a non-unionized worker. Next, considering workers, from 2.13, we know $W_{ij}^{nu} > U_{ij}$ as wages in the non-union sector as given by 2.26 shows that $w_{ij}^{nu}(\zeta) > b_{ij}$ which would be true for all ζ. Therefore, all non-union workers would prefer to be employed than not. Therefore, all non-union matches in either marker irrespective of skill and nativity would result in a match.

2.5.7 Union Membership and Wage Determination

To solve the entirety of the model, I first determine how to calculate union membership and union wage. The model is solved by backward induction, such that unions take the market (non-union) wage as given and then decide on union wage to maximize union membership. Having determined the equilibrium conditions in the non-union sector, I now try and determine the union wage rate and compare it to the non-union sector. I first calculate union membership based on the non-union market wage. I use the following result:

Result 1: Given a union wage $w^u > 0$, there exists, $\overline{\zeta}$ such that a high type worker would only be a union member if $\zeta_H < \overline{\zeta}$ and there also exists, $\underline{\zeta}$ such that a low skill type would only be a union member if $\zeta_L > \underline{\zeta}$.

Assumption: The assumption here is that the lowest efficiency threshold for the high skilled workers to join the union is below the highest efficiency threshold for the low-skilled worker to join the union. These two thresholds are below the highest efficiency of high-skilled workers joining the union and above the lowest efficiency of low-skilled workers joining the union. Therefore, these are not binding. Hence, we need to concentrate only on the highest efficiency high-skilled workers joining the union and the lowest efficiency low-skilled workers joining the union. Below I prove Result 1:

- From the non-union sector we know that $J_{ij}^{nu}(\zeta) > V$ and $W_{ij}^{nu}(\zeta) > U(\zeta)$ as established in 2.5.6. Given these two conditions it is possible to figure out the payoff functions for the workers who are contemplating joining the union.

- For workers irrespective of type and nativity, $M^w(\zeta)$ will be equal to $W^{nu}(\zeta)$ and similarly for firms, $M^f(\zeta)$ will be equal to $J^{nu}(\zeta)$ if $W^{nu}(\zeta) > W^u(\zeta)$ or if $J^u(\zeta) < V = 0$. That is if the firm gets negative return from a worker of efficiency ζ, who is unionized, they would never hire them, which sets the binding constraint.

- Similarly, irrespective of type and nativity, $M^w(\zeta)$ will be equal to $W^u(\zeta)$ and $M^f(\zeta)$ will be equal to $J^u(\zeta)$ if and only if $W^u(\zeta) > W^{nu}(\zeta)$ and $J^u(\zeta) \geq V = 0$. Workers must decide to join the union given their efficiency, and the firm should be earning non-negative profits once they hire them.

- Therefore, we get two equilibrium values of efficiency to get our threshold cutoffs to determine union participation. The two conditions are: $J^u_{ij}(\underline{\zeta}) = V = 0$ and $W^u_{ij}(\overline{\zeta}) = W^n_{ij}(\overline{\zeta})$.

- Now, given that $w^u > 0$ and $f_i'(\zeta) > 0$ and $lim_{\zeta \to -\infty} f_i(\zeta) = 0$ and $lim_{\zeta \to \infty} f_i(\zeta) = \infty$. Equation 2.16 would imply that, $J^{nu}_{ij}(\underline{\zeta}) = 0$ if and only if $w^{nu}_{ij}(\underline{\zeta_L}) = w^u$, which gives us the lower cutoff threshold, $\underline{\zeta}$.

- Similarly, from Eq. 2.13, 2.15 and 2.26, we have $W^u_{ij}(\overline{\zeta}) = W^{nu}_{ij}(\overline{\zeta})$ if and only if $w^u_{ij} = w^{nu}_{ij}(\overline{\zeta})$. This is because from Eq.2.26, 2.27 and 2.28 again, $w^{nu}_{ij}(\zeta)' > 0$ and $lim_{\zeta \to -\infty} w^{nu}_{ij}(\zeta) = 0$ and $lim_{\zeta \to \infty} w^{nu}_{ij}(\zeta) = \infty$. This could gives us the higher cutoff threshold, $\overline{\zeta}$.

- Therefore, we get two unique thresholds of efficiency at which a worker decides to join the union, and the firm decides to hire a union worker. The worker decides the upper efficiency $\overline{\zeta}$, and the firm profit condition and free-entry decide $\underline{\zeta}$.

So, as the non-union wage increases with efficiency, workers of higher productivity would choose not to join the union as their efforts are better rewarded elsewhere. Therefore, the gains from joining the union are not worth the loss of extra wages. As a result, these workers would prefer not to join the union. Similarly, workers of lower efficiency would not be hired by the firm because their productivity does not allow the firm to make non-negative profits as they have to pay them a higher union wage. For these low-efficiency workers, it is better to work than to go unemployed. As all non-union matches lead to hiring, they prefer to bargain individually and not join the union. Hence, both workers and firms have an incentive in deciding the correct efficiency distribution of workers who join the union.

After determining the non-union wages, profit conditions and efficiency threshold for union membership, it is now time to solve the union problem and determine union wages. Unions, as stated before, have two major concerns: equality of pay for all their workers and maximizing total union membership. The union takes the non-union sector wage and thus the formation of the two thresholds in efficiency for membership as given. Therefore, the union knows that for any wage it sets, there would be two workers, one with the highest efficiency and one with the lowest efficiency, who are indifferent between joining the union or non-union sector. Therefore, the objective

function of the union is to maximize total union membership given the two wage thresholds. The tension in the maximizing exercise for the union comes from the fact that if the unions set too low a wage, that would lower the $\underline{\zeta}$ threshold, but then high-skilled workers would choose to leave the union. On the other hand, setting too high a wage would mean high skilled workers would join the union, but low-skilled workers would leave the union as firms would not hire them. Therefore, the maximizing problem of the union can be expressed as follows:

$$Max \quad \int_{\underline{\zeta_L}}^{\overline{\zeta_H}} g(\zeta)\, d\zeta \quad w.r.t \;\; w^u \tag{2.29}$$

where, $G(\zeta)$ is the probability density function of workers over the efficincy parameter, ζ. Also here, $\underline{\zeta_L}$ is determined by solving, $p_L f(\underline{\zeta_L}) = w^u$. And $\overline{\zeta_H}$ is determined from, $w_{ij}^{nu}(\overline{\zeta_H}) = w^u$. Solving the two equations gives:

$$\underline{\zeta_L} = f^{-1}(\frac{w^u}{p_L}) \tag{2.30}$$

$$\overline{\zeta_H} = f^{-1}(\frac{w^u + b_H(1 - \frac{\beta(r+s_i+m(\theta_H))}{r+s_i+\beta m(\theta_H)})}{p_H \frac{\beta(r+s_i+m(\theta_H))}{r+s_i+\beta m(\theta_H)}}) \tag{2.31}$$

It is hard to obtain a closed-form expression for union wage from Eq.(2.29). Especially so if no functional forms are assumed for distribution of workers over efficiency $g(\zeta)$ and the production function given efficiency $f(\zeta)$. I first assume that workers are normally distributed over efficiency, ζ. The unions want to maximize total membership by selecting union wage, w^u. Assuming efficiency is distributed normally over the workers with mean T and standard deviation, σ. Union wage can be obtained by solving the following equation:

$$\frac{1}{\sigma\sqrt{2\pi}} e^{-1/2(\frac{\overline{\zeta_H}-T}{\sigma})^2} \frac{\partial \overline{\zeta_H}}{\partial w^u} - \frac{1}{\sigma\sqrt{2\pi}} e^{-1/2(\frac{\underline{\zeta_L}-T}{\sigma})^2} \frac{\partial \underline{\zeta_L}}{\partial w^u} = 0 \tag{2.32}$$

I further use the values for $\underline{\zeta_L}$ and $\overline{\zeta_H}$ from Eq. (2.30) and (2.31) and assumed $f(\zeta)$ is a log function. I can further reduce solve the get the following expression for w^u.

$$w^u = \frac{1}{2\sigma^2}[(e^{\overline{\frac{w^u}{p_H \frac{\beta(r+s_i+m(\theta_H))}{r+s_i+\beta m(\theta_H)}}} - T)^2 - (e^{\frac{w^u}{p_L}} - T)^2][\frac{p_H \frac{\beta(r+s_i+m(\theta_H))}{r+s_i+\beta m(\theta_H)} p_L}{p_L - p_H \frac{\beta(r+s_i+m(\theta_H))}{r+s_i+\beta m(\theta_H)}}] \tag{2.33}$$

Although it is difficult to get a closed-form solution for the union wage, it can be seen that it is a function of both p_H and p_L. Therefore, a rise or fall in either is reflected in w^u, unlike the non-union sector case. [47]

[47] Açıkgöz and Kaymak (2014) uses a higher bargaining weight for unions to argue for something similar. Equivalently this can also be thought of as the unions giving all their members a higher share of the total surplus.

2.5.8 Effect of Immigration

Having set up and solved the model, we come to the main matter at hand: to analyze the effect of an increase in immigration and how that affects equilibrium values. Essentially, a change in immigrant workers can be decomposed into two channels:

- An impact through prices of the intermediate good $p_i(\zeta)$, where it follows that a change in I would effect L and through that to $p_H(\zeta)$ and $p_L(\zeta)$.
- An impact through the expected employment cost and hence the price, where because I affects θ_{ij}, it impacts the expected cost of hiring the worker.

Now, given the model, I analyze the most general case where the high skill and low skill goods are imperfect substitutes, given by $\sigma < 1$, and we assume as before that $b_{L.N.} > b_{LI}$, which means natives have higher income or lower search costs while unemployed than immigrants. Here, an increase in I impacts both $p_H(\zeta)$ and $p_L(\zeta)$ and also C_{LN}.

When immigrants do not join union

Let us assume that immigrants are not allowed to join the union as the first case of analysis. Here, the impact of an increase in I is on the prices of intermediate output and the cost of hiring native workers alone. Following an increase in I, it leads to an increase in L from Eq.2.21, resulting in an increase in p_H as shown in Eq.(2.27). This in turn increases their wage in the non union sector w_H^{nu} from Eq.(2.26). While the change in C_H is not altered. Therefore, high skilled workers get higher non-union wages given efficiency once immigrants enter the labour market. This is because markets reflect the changes in productivity exactly as is the case when bargaining individually. In a union, productivity changes are not reflected fully since both high and low skilled workers and workers are paid the same. Now, for low skilled native workers, an increase in I leads to an increase in L and, therefore, a fall in p_L through 2.28. As low skilled markets for immigrants and natives are separate, an increase in I leads to lower tightness in the native low skilled market as $\theta_{L.N.}$ goes down; this leads to a fall in $m(\theta_{L.N.})$ as firm post more vacancies in the immigrant market because $b_{lN} > b_{LI}$. This increases u_{LN} and from Eq.(2.26) we know w_{LN}^{nu} falls.

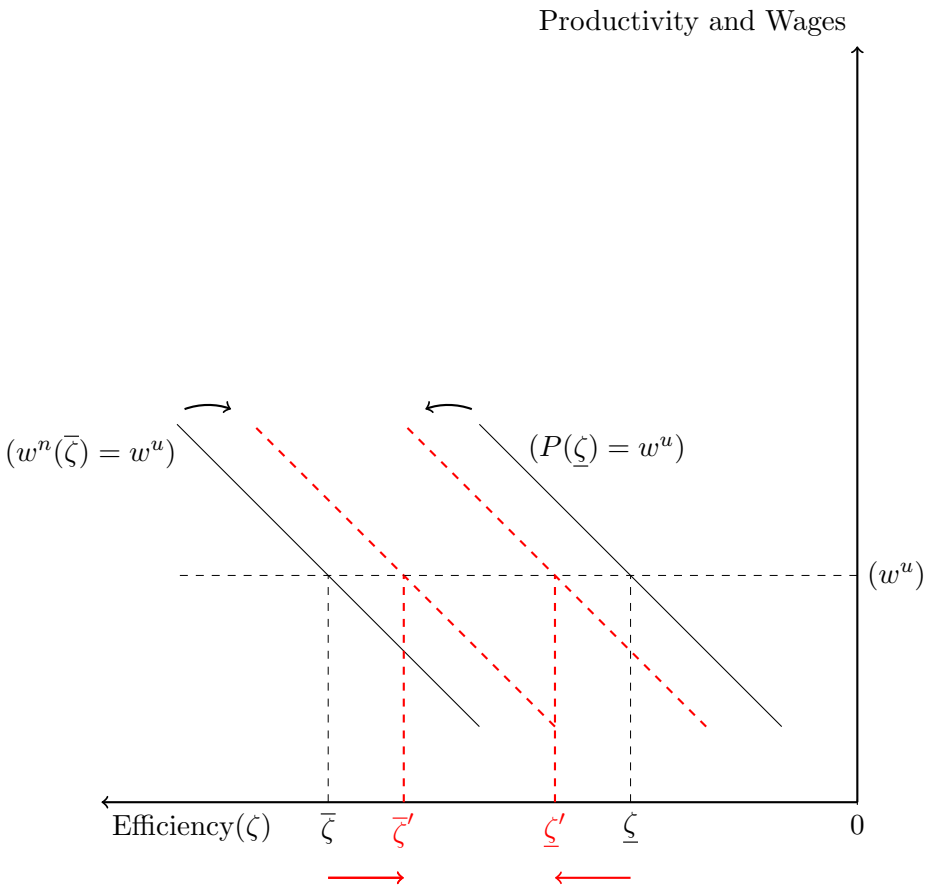
Now, after immigrants enter the market such that I goes up, unambiguously, we see that high skilled workers get higher non-union wages and low skilled workers get lower non-union wages given efficiency, as p_H is higher and p_L is lower. Therefore, the wage curve in the non-union sector for high skilled workers shifts out, and the wage curve in the non-union sector for low skilled workers shifts inwards. Thus, the highest productivity high skilled workers would choose to leave the union and prefer to join the non-union sector and hence move $\overline{\zeta}$ inwards because they are better compensated in the non-union sector and do not consider sharing wages worthwhile for their efficiency level. Similarly, low skilled workers would choose to leave the union and hence move the

$\underline{\zeta}$ inwards because the firm would not hire them once they join the union and charge a union wage with their now lower productivities. Therefore, a simultaneous fall in $\overline{\zeta}$ and rise in $\underline{\zeta}$ would lead to a shrinking of the workers covered by the unions and effectively reduce its size.

When immigrants do join union

The previous analysis follows that immigrants reduce the union's size by making high efficient high-skilled and low-efficiency, low-skilled workers leave the union. The effect explained above is generated by just immigrants entering the economy. Now, once immigrants enter unions, they increase the size of workers in the union with lower efficiency, which increases the tail of the efficiency distribution of the workers in the union. Given that the union maximizes workers' total membership, as more workers earn lower market wages and must be hired when joining the union, unions are forced to reduce the union wage size to accommodate the workers.This is especially more so as we might recall, that $b_{LN} > b_{LI}$, which will imply $w_{LN}(\zeta) > w_{LI}(\zeta)$. A fall in w^u leads to the reduction in the efficiency amount required to equate the wages; therefore, we have more highly skilled workers leaving the unions once immigrants join the union to allow for the lowered union wage. Alternatively, high skilled native-born workers or low skilled native-born workers must leave the union if the union wage is kept constant. Thus, immigrant workers joining the union compounds the reduction in union coverage of native workers. Thus equivalently, we can think of $[\underline{\zeta}, \overline{\zeta}]$ shrinking even more from the case when immigrants do not join the union and thus reducing the total population covered by unions. A useful diagram to illustrate the model findings and the comparative static exercise outlined in the model is as below.[48]

[48]In the Appendix, the model has been extended to consider the case where there is the same market for immigrant and low skilled native workers. In this case, as in the model presented above, high skilled workers see an increase in wage rate but the wage change in low skilled workers is ambiguous. This extended model is calibrated, and the results show that between 1980 and 2000, low skilled native workers saw a decrease in wages and employment on the entry of immigrants.



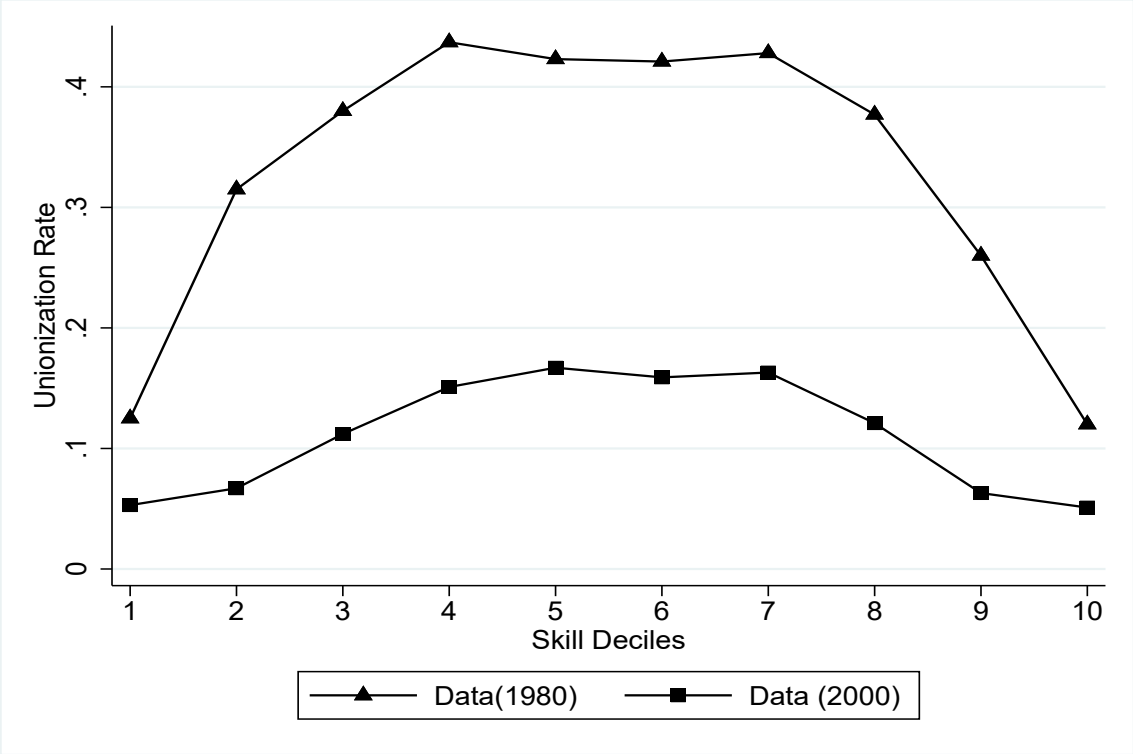
2.6 Testing the Model's Predictions

As described in the previous section, the model is intuitive and straightforward and thus can be utilized to get a qualitative understanding of how low skilled immigrant entry can lead to a fall in union density. Besides allowing for qualitative exploration, the model also makes some valuable predictions that can be tested in the data. Besides being novel in their own right, these predictions also allow us to be more confident in the model and the causal mechanism explained in the section. In the section below, I list these predictions and carry out simple regression-based explorations:

- Firstly, the model predicts that efficiency and union membership is inversely proportional to the high skilled sector and directly proportional to the low skilled sector.

In other words, the model predicts an inverted 'U' shape between skills and unionization rates. Higher efficiency high skilled workers do not join the union as they are more productive once immigrants enter the economy, and lower efficiency low skilled workers are not profitable for the firm once they enter the union. So on average, it is more likely that we find higher efficiency, low skilled and lower efficiency high skilled workers to join the union. This matches the predictions of other papers looking at unionization like, Abowd and Farber (1982), Farber (1983) and Açıkgöz and Kaymak (2014), although their definitions of efficiency and skills differ from mine. This is further

confirmed in the data as shown in figure 2.16 below, where I show an inverted 'U' shape pattern between skill deciles and unionization rate.



Note: Unionization rates in 1980 and 2000. Data Source: Based on calculations from the CPS. Each Skill decile represents education and experience cell.

Figure 2.16: Unionization Rate Across Skills (1980-2000)

The model also predicts that unionization reduces faster towards the two tails of the skill distribution of union rates but testing that is difficult for two reasons. Firstly, due to the economy's evolution, the skill distribution of workers across different deciles has changed, especially so between 1980 and 2000. This leads to data shortages where we cannot follow the same person over 20 years and observe their union choice as their skills change. Secondly, the entry of low skilled immigrants is not the only reason for falling union rates. Other reasons exist and have played an important part, and thus these reasons together have shaped the union rate across skill deciles patterns.

- Secondly, as immigrants enter the labour market, the wage in the non-union sector of the high skilled workers increases and the wage in the non-union sector of the low skilled workers' decreases. Also, more highly skilled and low skilled native workers join the non-union sector in equilibrium as they prefer to leave the union. Therefore, we should see a higher rise in wage inequality in the non-union sector where immigrants enter the labour market. However, the relatively lower efficiency high-skilled workers and higher efficiency low-skilled workers

joining the non-union sector; therefore, I check to see the overall impact on non-union wages.

To check if this prediction of the model works, I use a reduced form regression where I regress the change in wage rates between high and low skilled workers in the non-union sector on the immigrant to native-born ratio changes in the same region.[49] The specification and the further controls used are similar to the one used in the previous empirical section of this paper for ease of comparison. The results are provided below in table 2.11. As the results show, I find a significant negative relationship between the wage gap between high and low skilled non-union workers and the entry of low skilled immigrants. Given the log-log nature of the specification considered, I find a 0.19% fall in the wage gap among non-union workers after a 1% increase in immigrant to the native-born ratio in the MSA. This result, in general, is significant because the literature has found scare evidence of entry of immigrants leading to an increase in the skill wage gap among natives, Card (2009).[50]

Table 2.11: Estimates of the impact of low-skilled immigrant entry on wage gap betweem high and low skilled workers, 1980-2000 (MSAs)

Dependent Variable:			Full Sample		IV-1970	JRS-IV
Δ Wage (H-L) Non-union	(1)	(2)	(3)	(4)	(5)	(6)
(Immigrant/Native) Ratio	0.097***	0.102***	0.107**	0.135**	0.191***	0.211***
	(0.03)	(0.04)	(0.05)	(0.06)	(0.03)	(0.04)
Region Dummy	x	x	x	x	x	x
Log Population	-	x	x	x	x	x
Average Income	-	-	x	x	x	x
Average Education	-	-	-	x	x	x
R^2	0.25	0.26	0.27	0.28		
N	162	162	162	162	162	162

Note: The results are obtained from March CPS (1994-2004) and Census 1960, 1970, 1980, 1990 and 2000. Robust standard errors are in paranthesis, adjusted for clustering at MSA level. $^{*}p < 0.10$; $^{**}p < 0.05$; $^{***}p < 0.01$.

- Finally, as we saw in the model, immigrants entering unions amplifies the effect of natives leaving the unions. This is to compensate for the now lower union wage. Therefore, we can test the geographical impact of more immigrant workers joining the union on union wages. The model predicts a fall in union wages when more immigrants join the union.

[49] I use as the measure of wages the real weekly wages for full-year, full-time workers, constructed by dividing annual earnings by weeks worked and then deflating using a GDP deflator. Full-time workers are individuals who usually work 35 or more hours per week and work at least 40 weeks in a year. As suggested and adopted in the literature, I chose to work with weekly wages due to a reduced chance of measurement errors.

[50] Although alternate specifications at time series level, Borjas (2003) and IV specifications, Jaeger et al. (2018) and Gould (2019).

To check if this prediction of the model works, I again use a reduced form regression where I regress the union wages on the immigrant to the native-born ratio in unions across states.[51] The results are discussed below in table 2.12. I find a substantial reduction in union wages in regions with a higher percentage of immigrant workers in a union. The IV estimates point to a 0.24% fall in union density when the immigrant to native-born ratio increases by 1%.

Table 2.12: Estimates of the impact of low-skilled immigrant entry on union wages, 1994-2006 (States)

Dependent Variable:			Full Sample		IV-1970	JRS-IV
Δ Mean Union Wage	(1)	(2)	(3)	(4)	(5)	(6)
(Immigrant/Native) Unions	-0.127***	-0.116***	-0.163***	-0.225**	-0.228**	-0.241**
	(0.03)	(0.04)	(0.04)	(0.095)	(0.09)	(0.10)
Region Dummy	x	x	x	x	x	x
Log Population	-	x	x	x	x	x
Average Income	-	-	x	x	x	x
Average Education	-	-	-	x	x	x
R^2	0.18	0.19	0.23	0.24		
N	51	51	51	51	51	51

Note: The results are obtained from CPS (1994-2004) and Census 1960, 1970. Robust standard errors are in paranthesis, adjusted for clustering at state level. $^{*}p < 0.10$; $^{**}p < 0.05$; $^{***}p < 0.01$.

So, in summary, this section finds that the model predictions considered hold when evaluated in the data. There is a robust inverted 'U' shaped relationship between skills and union rates, which has been pointed to before in the literature and predicted in this paper. Secondly, this paper finds that an increase in the entry of low skilled immigrants into a region leads to a rise in wage inequality among skilled and unskilled workers in the non-union sector. It also verifies that the entry of low skilled immigrants leads to a reduction in average union wages. After confirming these predictions in the data, the following sections undertake a calibration exercise where the model presented in section 6 is analyzed quantitatively and then used to predict if and how much of the fall in union rate can be explained using the model and the mechanism considered.

2.7 Union Calibrations

This section calibrates the model discussed in section 6 and tries to see if the model can predict the fall in union rates as observed in the data. To begin the calibration exercise and simplify things, I assume an explicit form for the production parameters and justify the basic arguments for the exercise. Then I use a combination of reduced-form estimates and parameter targetting to generate

[51] As with the previous section, I again use a GDP deflator, and real wages are calculated using CPI index from The Bureau of Labor Statistics for the appropriate states and years from (https://www.bls.gov/cpi/)

the changes after accounting for the entry of low skilled immigrants into the U.S. economy and check to see how that impacts union rates.[52] The calibration exercise draws heavily from the works of Açıkgöz and Kaymak (2014), Taschereau-Dumouchel (2020) and Borjas (2003).

I firstly start by assuming a simpler linear structure for individual level of output given by $f(s,\zeta) = exp[\Psi(s+\zeta)]$ where s is used to denote the skill of the worker and ζ the efficiency as previously established in the model. Variable ζ is assumed to be normally distributed with mean μ_ζ and variance σ^2_ζ. Given the wage equation in Eq. 2.26 and using $b_{ij} = \rho w_{ij}$, I assume a log wage function in non-union sector as $log\, w^{nu}(s,\zeta) = logB(\beta) + \Psi(s+\zeta)$.[53] The union wage as established in the model section, from Eq.(2.29) does not have an explicit form solution. However, given the context in the model and drawing from the empirical literature, that union wages have low variance and are far more homogenous across skills, I propose that an explicit form of the union wage would not take into account ζ as in the model and therefore can be written as $log\, w^u = log\, \phi_0 + \phi_1 \Psi s$, where let $\phi_1 \epsilon (0,1)$ denote the relative price of skill in the union sector and ϕ_0 would be obtained as the constant term of the wage equation. I assume the higher wage the unions pay to their members is by taking a higher share of the total product, and thus that would be captured in this constant term.[54] Now, given the wage function and union wage policy characterized by (ϕ_0, ϕ_1), workers would select into the union sector only if their skill level is concentrated towards the middle. For a given level of s, ζ_L which is the lowest level of efficiency which allows for union membership, can be obtained by equating the firm's profit to zero and similarly for ζ_H is determined by equating union and non-union wage at that level of efficiency.[55] Now, given the wage forms assumed in this section and the way the threshold efficiency thresholds are determined in the model, I can get similar thresholds to determine union membership using the following condition:

$$log\phi_0 \leq \Psi(1-\phi_1)s + \Psi\zeta \leq log\phi_0 - logB(\beta) \tag{2.34}$$

Whether a worker would be unionized is based on solving the above equation and normalizing the total workers in a skill decile to get the percentage unionized. The model is calibrated to reproduce the labour market conditions in 1980 and then used to predict the unionization rates in 2000. The parameters from search and matching are mainly derived from the literature, as discussed in the previous section. After estimating the skill prices in the union versus non-union sector, I used them as calibration targets for the remaining parameters. I used a method from Borjas (2003) to generate changes in prices of skills and use that to predict new union rates and see if that can explain the union rate changes between the years considered.

[52] Essentially, this would be an indirect inference approach which shall be explained in more detail later.

[53] Here B is obtained from the wage equation as is given by $\frac{\rho B'}{1-\rho+\rho B'}$ where B' can be written as $\frac{\beta(r+s_i+m(\theta_{ij}))}{r+s_i+\beta m(\theta_{ij})}$

[54] The assumption on how union-wage varies with skill is considered to be log-linear and has been used before in previous papers dealing with unions and is essentially empirically motivated.

[55] More formally, union membership can be accounted for by the equation, $log\phi_0 \leq \Psi(1-\phi_1)s + \Psi\zeta \leq log\phi_0 - logB(\beta)$.

2.7.1 Estimation of Calibration Targets

The productivity distribution and skill index are identified in two steps. Firstly assuming union status is random, skill prices are estimated assuming this, which leads to biased estimates when union status is, in fact, endogenous. Second, using the selection implied by the model then helps us identify the true underlying parameters, which is essentially an indirect inference approach. I have two sectors denoted as non-union (nu) and union (u) sector. I use the wages data from the merged outgoing rotation groups of the Current Population Survey (CPS). For each non-union worker, I use the log of monthly wages (non-union) and regress that on a set of observable and other indicator variables for control as explained in Eq.2.35 below.

$$log\, w_{nuit} = X_{1it}\Gamma_{nut} + X_{2it}\psi_{nut} + e_{nuit} \tag{2.35}$$

Here, X_1 contains variables that reflect skill characteristics for the worker: education and experience and X_2 includes non-skill related controls. The skill composite is obtained by using the above equation at the initial time(t) and calculating a prediction for skill prices, given as:[56]

$$\hat{s}_{it} = X_{1it}\hat{\Gamma}_{nut} \tag{2.36}$$

This skill prediction is obtained for all workers, including those in the union sector. The price of skill in 1980 given as $\Psi_{t=1980}$ can be normalised to 1 which allows us to identify $\sigma_{s,1980}$ by the standard deviation of $\hat{s}_{i,1980}$.[57] The next step would be to calculate the compression in wages paid to skills in the union sector. This is done by projecting the actual wages of only union workers on their predicted skills and other controls as obtained above from Eq.2.36. This is done using the regression equation below:

$$logw_{uit} = \Phi_t\hat{s}_{it} + X_{2it}\psi_{ut} + e_{uit} \tag{2.37}$$

The coefficient Φ measures the degree of wage compression in the model. Among high skill workers, those with low efficiency join the union, whereas, among low skill workers, those with high efficiency join the union. As a result, the skill price is overestimated in the non-union sector and underestimated in the union sector when selection is ignored. Therefore, estimation using Eq.2.35 and 2.36 leads to exaggeration of wage compression by union and overestimation of skills which has to be corrected for selection using the model.

2.7.2 Selection in Union Participation

Three parameters: union and individual share of total product and dispersion of efficiency σ_ζ cannot be estimated directly, and the model's prediction is used to identify these and to correct the

[56] The initial period is 1980, but I use data from 1979-1981 to construct the average values for 1980. This is done to avoid small sample issues.

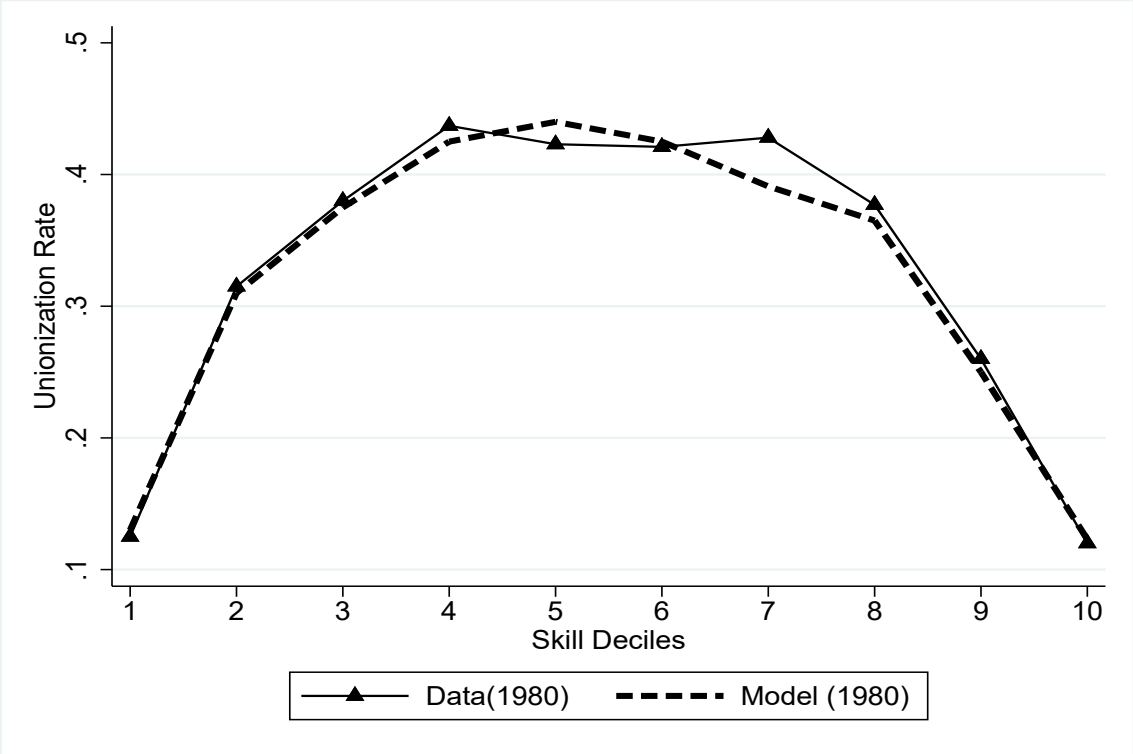
[57] The standard deviation of $\hat{s}_{i,t}$ will be the estimate of $\Psi_t\sigma_{s,t}$.

bias in the estimates in Eq.2.35 and Eq.2.36. The aim was to generate union participation by skills in the benchmark case in 1980. Given the value of σ_s, the value of σ_ζ determines the curvature of the unionization profile. Therefore, the curvature of the slope gives a unique value of σ_ζ. Using a Generalized Method of Moments (GMM) approach, I simultaneously get the values for total income shares β_u and β, the relative price of skill in union sector ϕ_1, the standard deviations of skill and efficiency σ_s and σ_ζ to match the observed rate of unionization by deciles of the predicted skill distribution $\hat{s}_i$, the standard deviation of the skill distribution estimate from Eq.2.35 and wage compression in unions from Eq.2.36. As there are more moments than parameters, each data moment is weighted by the standard deviation. Figure 2.17 shows how the model fits the data from 1980.

2.7.3 Calibration of Search Environment and Results

The data for estimation as specified comes from the outgoing merged rotation group for 1999-2001 data and May supplement files for 1979-1981 data. It is restricted to only male, wage and salaried workers between the ages of 16-and 65. Skill is measured using education and experience, and it is kept the same to match the model estimates to data and to estimate the changes in skill prices. Characteristics like industry, race, marital status and presence of "right-to-work" laws are controlled for in the X_2 variable. The analysis period is one month, owning to the monthly data considered with a monthly discount rate. To ease the analysis, labour market tightness is considered to be unity. The probability of a worker being matched to a worker is taken from the CRS matching function, combined with an average duration of unemployment in 1980, which was 3.10 months. The average unemployment rate in 1980 was 6.01%. Reasonable estimates of income replacement ratio are taken from Shimer (2005).

The standard deviation of skill index as estimated from Eq.2.35 for 1980 is 0.291. Then using the predictions and the wages in the union sector, the wage compression in the union sector is estimated to be $\hat{\phi_1} = 0.531$. These estimates, along with the unionization rate by deciles of predicted skill composite in 1980, are used to obtain the true underlying parameters that are corrected for selection as they are obtained from matching actual data. The model generated prediction to match the original data from 1980 is shown in figure 2.17. The model closely replicates the hump-shaped observed in the data. The corrected estimate for skill dispersion is 0.262, which is slightly lower than the estimate from Eq.2.35. The implied share of total income retrieved from the estimates is 0.25 for individuals and 0.41 for the union. The estimate for efficiency given by $\sigma_\zeta = 0.12$ in 1980. Table 2.13 provides the values for the parameters as taken from the literature and the estimates.



Note: Model vs Data Unionization rates in 1980

Figure 2.17: Unionization Rate Across Skills

Table 2.13: Estimated and Calibrated parameter values

Parameter Values	Value	Targeted Moment	Source
Exogenous Parameters:			
Discount Rate (r)	$0.95^{1/3}$	Annual Interest Rate, US	5%
Unemployment Insurance Benefit (ρ)	0.4-0.6		Shimer (2005)
Matching Compoent (ϵ)	0.5		Açıkgöz and Kaymak (2014)
Skill Premium - 1980 ($\Psi_{t=1980}$)	1		Normalization
Vacancy Cost (c)	1.8		Silva and Toledo (2009)
Jointly Calibrated:			
Skill Deciles (S)	10		See text
Matching Coefficient (M)	0.325	Mean Unemployment Duration	3.10 months
Separation rate (s)	0.019	Mean Unemployment rate	6.01%
Union share of income (β_u)	0.41	Estimate	Figure 2.17
Individual share of income (β)	0.25	Estimate	Figure 2.17
Skill Dispersion (σ_s)	0.262	Estimate	0.28 (0.001) Eq.2.35
Ability Dispersion (σ_ζ)	0.11	Estimate	Figure 2.17
Union Skill price (ϕ_1)	0.6	Estimate	0.54 (0.021) Eq.2.37
Skill premium - 2000 ($\Psi_{t=2000}$)	1.33	Estimated skill dispersion	Eq. 2.35 for 2000
Estimates from Eq.2.38: (Θ)			
Less than high school	-1.566 (0.38)		
High School Dropuots	-1.314 (0.29)		
High School Graduates	-0.766 (0.31)		
Some College	-0.244 (0.34)		
College Graduates	1.139 (0.41)		

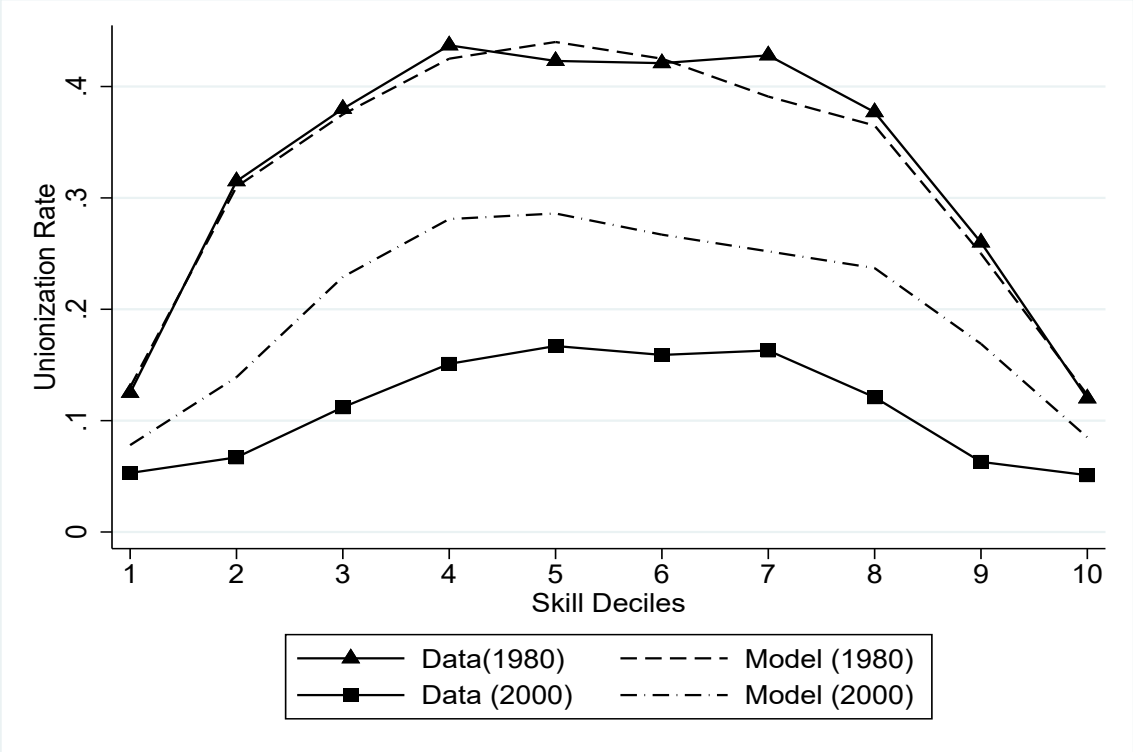
Note: Standard errors are used to weigh the moment where applicable and are mentioned in the parentheses. Standard errors are adjusted for clustering within experience cell. All regressions are weighted by the sample size of the education-experience-period cell. Regression include education, experience, and period fixed effects, as well as interactions between education and experience fixed effects, education and period fixed effects, and experience and period fixed effects.

2.7.4 Estimation of Change in Skill Prices

To obtain an estimate of the change in prices of skill levels in the U.S. economy between 1980 and 2000, I follow Borjas (2003) and estimate the coefficient when I regress the weekly log earnings for native workers by skill and education groups at the national level at time (t) on the relative share of immigrants in that same education-experience bracket. It involves estimating the following by skill groups:

$$y_{ijt} = \Theta\, p_{ijt} + a_i + b_j + \vartheta_{ijt} \tag{2.38}$$

where i stands for education group and j for experience group evaluated for at time t. y_{ijt} denoted log weekly earnings and the main variable is p_{ijt} denoting the immigrant share in education group i and experience level j at time t.[58] I estimate the above regression equations for 1980, 1990 and 2000 and use the estimate of Θ for the years for each education and experience cell corresponding to s (skill) in the original model. These estimates are shown in Table 2.13. To get the final changes, I require a measure of skill prices in the non-union sector in 2000 relative to 1980. This increase in skill price is calibrated to match the standard deviation obtained from Eq.2.35 for 2000, given as $\hat{s}_{i,2000}$. I then use the estimates from Eq.2.38 and add that by skill group to the estimate of $\hat{s}_{i,2000}$. Essentially, this method allows me to calculate $\hat{s}_{i,2000}$ by evaluating how differentially each skill group is affected after the entry of immigrants in 2000. Having estimated the changes in the skill prices, the aim is to find the unionization rate in 2000 using these changes and keeping all other parameters fixed as obtained from the 1980 estimate. Then the aim would be to see if the model can match the actual data for the unionization rate in 2000. The figure 2.18 below provides the main calibration results and compares the change in unionization rates from the data to the predictions of the model.



Note: Model vs Data Unionization rates in 1980 and 2000

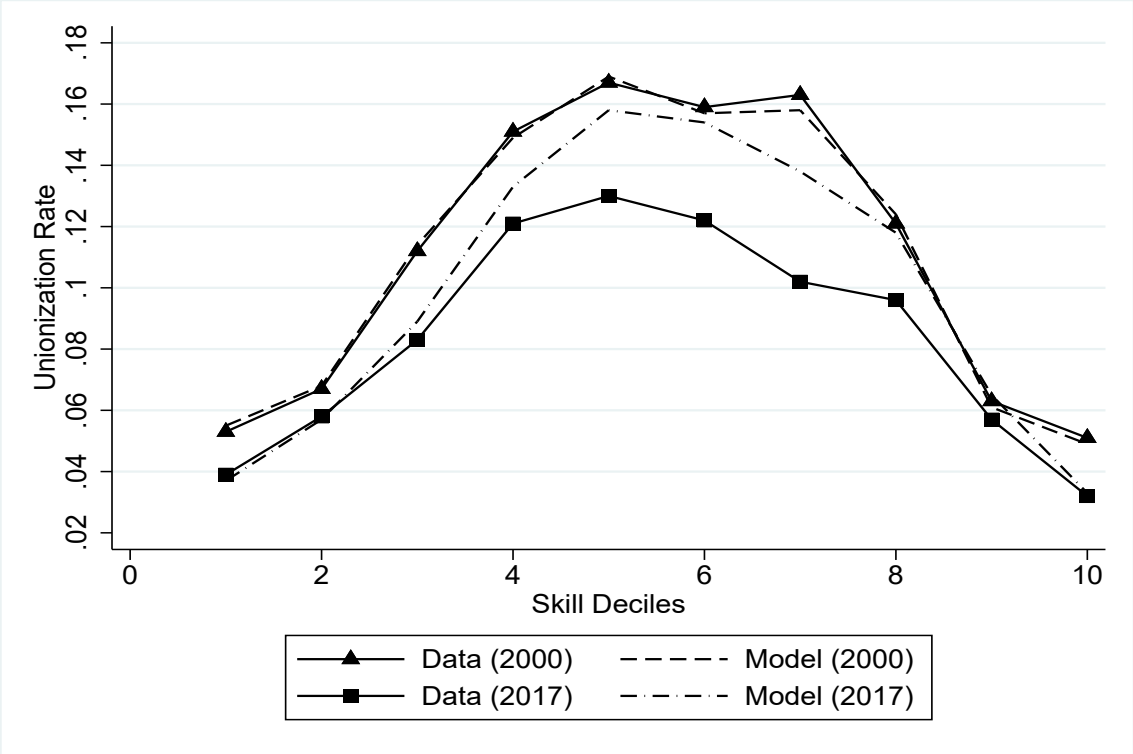
Figure 2.18: Unionization Rate Across Skills (1980-2000)

[58]More formally, following Borjas (2003), I define $p_{ijt} = \frac{I_{ijt}}{I_{ijt}+N_{ijt}}$, where I_{ijt} is the number of immigrants in cell ijt and N_{ijt} is the number of native in cell ijt.

As shown in the figure 2.18 above, the model captures the fall in union rates well. The unionization rate on average decreased from 33% in 1980 to 11% in 2000. Using the estimates as predicted by the model, the model predicts an average unionization rate of 20.3%, which is about 56% of the total unionization fall. At the extreme ends of the skill distribution, the model's predictions are closer to the data than towards the middle of the skill distribution. Based on the calibration strategy explained in this section, I try to see how well the model can explain the changes in union density between 2000 and 2017. The 2000s in the U.S. saw an increase in high skilled immigrant entry, and the model would predict an increase in union rates following this increase. As high-skilled immigrants enter the economy, there is a fall in the price paid to skill, leading to higher efficiency high-skilled workers now ready to join the union. On the other hand, low skilled workers are now better, and even lower efficiency workers can demand higher union wages from firms. Therefore, there should be increased union entry among both high and low skilled workers. As a comparative exercise, it is essential to consider the case of Canada and how immigrant entry and union rates have changed there. In Canada, the immigrant entry has mainly been highly skilled. As a result, although both countries have seen similar union rates leading up to the 1970s, they diverge after that, with the U.S. undergoing a pronounced fall in union rates once immigrants started entering the labour market.[59] A description of the entry of high skilled immigrants and the effect on U.S. productivity and native outcomes can be seen in Kerr and Lincoln (2010), Borjas (2009) and Greenwood and McDowell (2011). So I use the data on union membership from 2000 and re-estimate the parameters of interest using the model predictions in 2000. Using the estimated values, I again calculate the changes in the wages of different education-experience cells and calibrate the model for finding the union rates in 2017. Interestingly, the income shares between unions and individuals are a lot closer at 0.27 and 0.24 compared to the figures in 1980, suggesting how the power enjoyed by the unions has decreased over time. The results and the comparison between the model and data are shown in figure 2.19 below. As the figure shows, the model again explains about 55% of the total fall in union rates between 2000 and 2017.[60] The model does better at predicting the fall at the two ends of the skill deciles and does not explain the fall in the middle as much.

[59]Riddell (2009) for a detailed study of the difference in the union rates of the U.S. and Canada and Fortin et al. (2012) for an analysis of the impact of union rates on differences in wage inequality between the US, Canada and the U.K.

[60]I again use the average rates between 2016-and 2018 to construct 2017 data.



Note: Model vs Data Unionization rates in 2000 and 2017

Figure 2.19: Unionization Rate Across Skills (2000-2017)

2.8 Conclusion

This paper analyzes the rapid fall in unionization rates in the U.S. and the rise in wage inequality. Farber et al. (2021) claim an inverse relationship between unionization and wage inequality in the U.S. using high-frequency survey data. At the same time, immigrant entry, especially low skilled, fell after World Wars when union rates increased and steadily increased from the mid-1960s when union rates started declining. This paper proposes low skilled immigrant entry as causal to falling union rates. As seen in the data, it puts forward a mechanism that can explain this phenomenon and the resulting rise in wage inequality. Empirically, higher immigrant entry leads to a higher fall in union rates which is valid across states and MSAs. At the state level, a 1% increase in immigrant to population ratio leads to a 0.42% fall in union rates in the 1980-1990 decade. The results correct long-term adjustments when using the standard 'ethnic enclaves' IV and the more modern JRS-IV approaches. I also hold other causes as put forward by the literature to closer empirical scrutiny and find a lack of evidence to support their claim. Though plausible, these reasons cannot explain the entire fall in union rates, whereas, in this paper, I find that immigrant entry can lead to a 45-46% decline in union rates. The novel empirical finding of immigrant entry leading to a fall in unionization rates is the essential contribution of the paper.

The paper then proposes a general equilibrium search and matching model with assumptions

motivated by data facts, where firms hire workers who differ in skills (observable) and efficiency (unobservable). Unions operate separately from firms and workers and follow an egalitarian approach. All workers are paid the average productivity but are afforded a higher bargaining weight than the individual bargaining case. Workers decide in equilibrium based on their efficiency if they want to join the union or not. An entry of low skilled immigrant increases the productivity of high skilled workers and decreases that of low skilled workers. This prompts high skilled workers to leave the union as they are now more productive and better paid in the non-union sector for their given efficiency level. Simultaneously, low skilled workers are now worse off and would not be hired if they charge the extra union wage. Therefore, as they prefer to be employed than not, they prefer to leave the union and bargain individually. The model predicts that higher efficiency high skilled workers and lower efficiency low skilled workers leave the union.

The model predictions are then taken to the data for numeric evaluation. The calibration exercise helps figure out the changes in wages paid to high-skilled and low skilled workers after the influx of low skilled immigrants between 1980-and 2000. After matching the moments from the data in 1980, the model is used to predict the union rates in 2000. It predicts 45-55% of the total changes but for better explains the differences towards the tails of the distribution of union rates across skill deciles. A similar exercise between 2000 and 2017 also suggests similar findings. The research conducted here, though rich, can be extended through the use of better data and can be used to answer more questions. Specifically, from the lens of occupations and industries and creating an index to quantify how much natives and immigrants compete for certain occupations or compete in specific sectors can be a valuable way to see if immigrant entry affects industries or occupations differently. Also, the literature on immigrants is rich. Certain aspects like outmigration and immigrant assimilation should be brought in to evaluate the model and dive deeper into how immigrants impact union rates.

Chapter 3

The impact of exchange rate fluctuations on earnings and labour supply of immigrants

3.1 Introduction

In a globalised world, the movement of people between different countries has increased tremendously. Despite the slowdown in recent years, with countries opening their border once again, it is crucial to understand how immigrant workers behave in a foreign country and what determines their success. Immigrants often have meaningful and substantial ties with the source country, and it becomes vital for policymakers to decipher if these ties affect their labour market outcomes. Do immigrants consider their income's current home country value when deciding on labour supply? Therefore, would exchange rate fluctuations impact the labour market outcomes of immigrants because they affect the purchasing power of income earned in the host country? The paper contributes to this literature by looking at exogenous changes in the exchange rate between different countries and Canada to identify causal implications of exchange rate fluctuations on immigrants' labour market and earnings outcomes. This paper demonstrates this effect by showing that immigrants change their labour market behaviour based on the purchasing power in their home country.

In this paper, I use data from the Survey of Labour Income and Dynamics (SLID) and the Longitudinal Immigration Database (IMDB) to find that a 10 per cent appreciation of the Canadian Dollar leads to a 0.36% fall in labour earnings for the average immigrant. I further see that 70% of the fall in annual earnings can be explained by a fall in hours worked. I corroborate this fact by showing that the fall in labour supply occurs in both hours worked in a usual week and total weeks worked, suggesting that immigrants cut back at both the intensive and extensive margin of labour supply. I also find that a relative appreciation of the Canadian dollar accentuates the likelihood of immigrants taking up part-time work. Naturally, I check to see if there is heterogeneity in this effect? I find that newer immigrants are unequivocally more reactive to exchange rate fluctuations. I see the impact of exchange rate shocks dissipate to zero as immigrants stay longer in Canada, thus suggesting that the exchange rate effect is higher for immigrants who are more likely to have close ties to their source country. I further evaluate the above point by considering immigrants from two central source countries in Canada: India and China. I consider immigrants from these

two countries but differentiate them based on their location choice. Immigrants settled in ethnic enclaves are more likely to have closer links to their families in the source country, and I find that they are more affected by exchange rate shocks.[61] Additionally, exchange rate fluctuations has a higher impact on earnings and labour supply for immigrants who reported family members, especially spouses living in their source country, further supporting how links to a source country are the key to getting at this impact. I also find that an appreciation of the Canadian exchange rate affects less educated people at the lower end of the income distribution.

I propose a simple but intuitive intrahousehold model of consumption to understand the exchange rate fluctuations and how that can affect the labour supply. In the framework, the exchange rate acts as a price for remittances, which can be considered a savings term or another future consumption term. So, appreciation of the Canadian Dollar means a reduction in the price of remittances, which is synonymous with a wage increase. Therefore, the justification for this effect is that immigrants remit a substantial portion of their earnings. Thus, a relative appreciation of the host country's currency can impact labour earnings and the labour supply of immigrants who want to make monetary transfers to their home countries. It is rare to come across data on remittances, especially over a long time horizon and for many source countries. I have access to this data between 2006 - and 2011, where immigrants responded to if and how much remittance they sent to their families in the source countries. The responders are asked this amount in terms of foreign currency, which is crucial considering the exchange rate.[62] I find that the appreciation of the Canadian Dollar affects remitters more than others. However, exchange rate fluctuations do not affect the total remittance sent at the extensive or intensive margin, suggesting that immigrants are remittance targeters and thus do not change the amount of remittance sent in foreign currency.

Remittance forms a substantial part of the total money outflow from developed to developing countries. Osili (2007), using a panel of emerging economies, highlights how immigrants send remittances for two primary purposes: family welfare and savings for investment. The paper also finds that remittances follow an altruistic transfer model where wealthier families receive lower transfers. For Canada alone, estimates of the total remittance outflow (to all countries, including developed) were $ 23.3 billion in 2016.[63] An estimated 1.6 million Canadian households sent at least $ 500 to their relatives or friends living outside Canada, with transfer amounts averaging at $ 1,823 per household.[64] The study on immigrants in the U.S., called The New Immigrant Survey, is the only nationally representative study of immigrants in the U.S. The pilot study interviewed 8,573 legal immigrants in the U.S. in 2003. For the U.S., as documented in the New Immigrant Survey, 20 per cent of immigrants from Mexico and as much as 32 per cent of immigrants from other

[61] Ethnic enclaves are defined as areas which have atleast double the national average of immigrants from a particular country.

[62] The responders are not asked about what they think the current exchange rate is, so it is difficult to find out if they are making errors in judging the correct exchange rate.

[63] Source: World Bank

[64] Source: Canada International Development Platform

Latin American countries seem to remit part of their income to their home countries. This number is significantly lower for immigrants from European countries. Evidence from the literature also points to the importance of remittances in other countries. Dustmann and Mestres (2010) report that immigrants in Germany remit around 10 to 12 per cent of their income. For Canada, the Longitudinal Survey of Immigrants to Canada (LSIC) documents both the incidence of remitting and the amounts remitted by immigrants from a wide range of countries. The dataset concentrates on newly arrived immigrants and follows them over 48 months. During the two years after landing, 29% of all immigrants remitted funds, sending $ 2,900 on average. On an annual basis, the average amount sent by remitters was approximately 7% of total personal income before taxes and about 4% of total family income before taxes.[65]

The importance of the immigrant population and the substantial attention given to their economic well-being, and in turn, how this well-being links to the remittance channel, makes this study even more crucial.[66] Another significant part of the population is second-generation immigrants who still may have significant links to their home country. Thus, how the macroeconomic conditions of the home country may affect them is vital for their well-being and prospects. This question also has a direct policy implication regarding immigrant entry and duration of stay in the Canadian context. Unlike the U.S., which prioritises family ties and networks, the Canadian immigration policy is more inclined towards high-skilled labour and productivity. However, the behaviour of these immigrants can vary substantially given their family background and their links to their home country.

The remainder of the paper is organised as follows. Section 2 describes a brief theoretical framework for the analysis. Section 3 outlines the data, and section 4 provides the empirical strategy for the study. Section 5 provides the main result thus far and outlines the mechanism by looking at the remittance channel. Finally, section 6 concludes and looks at avenues for further analysis.

3.2 Theoretical Framework

In this section, I use a straightforward theoretical framework to break down the effect of exchange rate fluctuations on the labour supply of an immigrant. First is the remittances channel, where the purchasing power of remittances depends on the real exchange rate between the home and foreign country. Second, most immigrants face the possibility of returning to their home countries after a period in the host country. The higher the possibility of returning to the home country, the stronger the effect of the home country's situation on an immigrant's intertemporal economic decisions, namely saving.

[65] Houle and Schellenberg (2008)

[66] Source: Statistics Canada- https://www12.statcan.gc.ca/nhs-enm/2011/as-sa/99-010-x/99-010-x2011001-eng.cfm

Following Osili (2007) and Nekoei (2013), I use a simple static model to capture the inter-temporal effect of the exchange rate on immigrants' decisions through its impact on remittances. Consider an individual living in a foreign country connected to another person living in the home country. Assuming efficient intra-household allocation of resources, the household will maximise the weighted sum of individual utilities.

$$Max_{c^1,z^1,c^2,z^2} \quad u(c^1, z^1/w^1) + \eta u(c^2, z^2/w^2) \tag{3.1}$$

where all superscript 1 denotes the wage rate (w), consumption (c) and earnings (z) of the immigrant and superscript 2 denotes the same for the immigrant's family abroad. The point of departure now between a standard household maximization problem and the one where a family member is in a foreign country is that the exchange rate will multiply all home country variables in the budget constraint. Now let the indirect utility function be given by $v(y, w^1) \equiv Max_{c^1 \leq z^1 + y} u(c^1, z^1/w^1)$. This allows us to rewrite the household optimization exercise as follows:

$$Max_{c^1,z^1/w^1} \quad u(c^1, z^1/w^1) + \eta v(ER, w^2) \;\; \textit{such that} \quad C^1 = z^1 - R. \tag{3.2}$$

Where R represents remittances sent from immigrants to a family member back home. Now Equation 2 gives the following intuition. The real exchange rate multiplies with the remittances term, and I can separate a change into a substitution and income effect. The substitution effect of an increase in E (relative appreciation of the Dollar) implies an increase in labour supply because a reduction in the price of remittances equals an increase in the relative cost of leisure. However, the income effect of this currency appreciation entails a decrease in labour supply because a reduction in the price of remittances makes the household richer overall. The total impact of an appreciation depends on the relative magnitude of income and substitution effects.

An equally consistent explanation of the income effect argument is based on reference-dependent preferences. Let immigrants be targeting a certain amount of remittance in terms of their home or source currency. That implies that R becomes fixed, and any increase in E due to home currency depreciation can lead to a fall in z given R is fixed. This would support the target earnings hypothesis. Also, one can think of household optimisation as a two-step decision process, where agents share their non-labour income and then decide upon labour and consumption choices. Therefore, as a result, the exchange rate affects each member's consumption and labour supply through its effect on remittances.

3.3 Data

The project uses the restricted-use panel data of the Survey of Labour and Income Dynamics (SLID) for all the available years between 1993 to 2011. The SLID is a rotating panel where an individual has been present in the database for six years. The panel nature of the data is of critical importance for the regression specifications and identification strategies. The SLID complements traditional survey data on labour market activity and income with an additional dimension of changes experienced by individuals over time, making it ideal for the analysis. More importantly, the data provides the accurate nationality of an individual and their year of immigration to Canada, which is key to the research design and the basic questions on income, hours worked, and household characteristics. The database asks respondents if they send remittances abroad, to which country, how much, and in which currency.[67]

The other dataset I use is the Longitudinal Immigrant Database (IMDB), which is available from 1982-to 2016. The IMDB comprises the tax records of the universe of immigrants in Canada. It also matches the tax record of immigrants with their detailed characteristics at the time of landing, including variables like country of birth, level of education, skills and intended occupations and destination.[68] Given the longitudinal nature and the cross-sectional variation, this dataset is ideal for understanding any heterogeneity that may exist in the response of different immigrant groups. Lastly, I use two kinds of country variables for the analysis. First, I use macroeconomic variables from the World Bank's World Development Indicators and the International Monetary Fund's (IMF) International Financial Statistics databases.[69] The real exchange rate here is constructed using IMF data, as $ER_i = e_i.(p_{CAD}/p_i)$, where e_i *and* p_i are the nominal exchange rate (units of home country currency per Canadian dollar) and the CPI index of country i, respectively.[70] Table 3.1 below provides descriptive statistics from the sample considered in the SLID:

[67] Although a public version of the SLID is available, access to the restricted source at the Research Data Center is essential to form the longitudinal panel. The restricted access data also has more variables and a larger sample size.

[68] Of immigrants admitted between 1980 and 2019, 68.1% were linked to at least one T4 record, while, on average, 62.2% of non-permanent residents with active permits from 1997 to 2019 were linked.

[69] country specific data taken instead from OECD do not affect the results.

[70] For example, consider the exchange rate between India and Canada, it would be 50 Rupees/dollar multiplied by the CPI index of India

Table 3.1: Table-Descriptive Statistics

	All Immigrants	Native-born Canadians
Male (%)	52%	49%
Age	39.1	40.9
Years since Arrival (Average Years)	11.8	-
Education (Average Years)	11.3	13.4
Unemployment Rate (%)	7.9	5.2
Annual Earnings ($)	37,411	43,798
Weekly Hours Worked (Average Hours)	30.61	33.52
Full time employed (%)	73.21	80.8
Hourly Wage ($)	25.2	29.8
Observation (%)	22,850	133,599

Note: The statistics are based on the sample of immigrants and natives aged 15-64. Applicable standard deviations in parentheses. Earnings variables are condition on being employed for more than 30 weeks a year. Observations are weighted by the personal weights from the SLID.

3.4 Empirical Strategies

In the analysis, I first use the SLID and consider immigrants born outside Canada and migrated to Canada. I restrict the empirical sample to countries with enough observations and countries with exchange rate data from 1993-to 2011. I further restrict the sample to individuals of working ages, between 16 and 64. These sample restrictions result in 22,850 individual-year observations from immigrants from Canada's top 40 immigrant sending countries. Unlike the USA, the Canadian immigrants' diversity provides the analysis with a significant source of exchange rate volatility during the study period.

The data analysis will involve two empirical strategies. The first step uses an Ordinary Least Squares (OLS) strategy where the relationship of interest can be analysed using the following regression specification:

$$Y_{c,t,i} = \alpha_c + \alpha_t + \beta e_{c,t} + \gamma X_{c,t,i} + \epsilon_{c,t,i} \tag{3.3}$$

where $Y_{c,ti}$ is an individual level observable (log of earnings, weeks worked, hours in different jobs) belonging to country (c) in time (t). α_c captures country-level fixed effects and α_t measures time fixed effects. $e_{c,t}$ is the log of the exchange rate between Canada and the country of the immigrant in question. $X_{c,t,i}$ controls for individual time-varying characteristics, including remittances sent to the home country. This allows me to get at the mechanism, such that if a person sends more remittances, will they be more affected by exchange rate fluctuations? A similar specification will

also allow me to analyse spousal responses and intra-household decision making. A significant nonzero β would show that an immigrant's earnings are affected by the economic situation of her home country. In this case, the relative earnings of two otherwise similar immigrants from two different countries are correlated with the exchange rate between their home countries' currencies. The panel nature of the data set will further allow for the possibility of having individual-level fixed effects and thus control for unobserved heterogeneity in the specifications.

Another vital aspect to investigate is the process of disintegration from the home/source economy when a person migrates to a foreign country. In a balanced panel dataset, it is possible that the longer a person stays away from his home country, the weaker the remittance channel would become, and hence any effect of exchange rate fluctuations may disappear with time. The following regression specification can allude to this:

$$Y_{c,t,i} = \alpha_c + \alpha_t + \beta_1 e_{c,t} + \beta_2 e_{c,t} \,.\, YSA + \beta_3 YSA + \gamma X_{c,t,i} + \epsilon_{c,t,i} \tag{3.4}$$

In the above specification, I interact the real exchange rate term with the term of years since immigration (YSA). In the empirical investigation to follow, I use a similar specification to evaluate different labour market variables as outcomes and evaluate how exchange rate fluctuations affect them. Specifically, I consider weeks worked; hours worked part-time, full time and self-employed hours and earnings. Finally, in the last part of the analysis and to specifically analyse the remittance channel, I interact the real exchange rate dummy with a dummy for sending remittances. I use the usual control for individual characteristics, time and country fixed effects and individual level fixed effects.

3.5 Results

Below I provide my first set of results. I consider immigrants from the top 40 immigrant supplying countries to Canada.[71] So, the relative earnings of two otherwise similar immigrants from two different countries are correlated with the exchange rate between their home countries' currencies. I provide the results for the first regression specification in the table 3.2 below. The first three columns use log earnings as the dependent variable, whereas the last three columns use annual log hours worked as the dependent variable. The first column of the table 3.2 looks at the change in log earnings of immigrants to a change in log real exchange rate of their home country while controlling for year and country fixed effects. The result is a significant and negative coefficient of -0.036. This specification also controls various individual-level characteristics like gender, age, marital status, and years since immigration. The results from Table 3.2 imply, for instance, that,

[71] This accounts for about 90% of the total immigrant based in Canada. I impose restrictions to avoid small sample issues pertaining to the small number of observations from certain countries in the SLID.

in response to a 10 per cent depreciation of the home currency relative to the Canadian Dollar, an average immigrant reduces her annual earnings by 0.36 per cent. The intuition is that a depreciation of the home currency increases the value of the immigrant's wage in home currency terms, and through the income, the effect induces her to work less. The estimates for Canada are smaller than Nekoei (2013) estimates but higher than the ones found by Nguyen and Duncan (2017). Intuitively, this might be because the immigrants in Canada stay for longer, unlike in the US, where many Mexican immigrants work temporarily and often cross the border more frequently.

Intuitively, when time dummies control Canada's economic situation, the variation in the exchange rate may be correlated with variation in the home country's macroeconomic variables. Columns 2,3,5, and 6 offer a measure for the latter after controlling for the log of GDP per capita. The coefficient of interest remains almost unchanged. This suggests that the exchange rate effect as measured does not contain the effect of other macroeconomic variables—finally, columns (3) and (6) control individual-level fixed effects. The individual-level fixed effects in this regression specification can account for unobserved heterogeneity among the immigrants. The coefficient of importance is still negative and significant. A concern in regression models with a mixture of individual and group-level data is that failure to account for common group errors can generate biased standard errors. To address this issue, all standard errors reported in this paper are clustered at the country-year level.[72] It is crucial to understand if the described reduction in an immigrant's earnings comes from changes in hours worked or changes in other dimensions of labour supply. The second part of Table 3.3 measures how much of the difference in earnings can be explained by the change in working hours. The negative and significant coefficient of -0.025, which is unchanged by the inclusion of individual controls or individual fixed effects, implies that an average immigrant facing a 10 per cent depreciation of the home currency relative to the Canadian Dollar reduces her annual hours worked by 0.25 per cent. The coefficient of change in annual hours worked due to fluctuations in exchange rate falls slightly even considering individual fixed effects but is still negative and significant at -0.0227. So, about 70 per cent of the change in earnings can be explained by the change in hours worked by the individual. The residual can be understood as a change in hourly wages that the immigrant receives in the foreign country.

[72]Standard errors are also clustered at the year-state level, and that does not change the significance of the results.

Table 3.2: Exchange Rate Fluctuations and Immigrant Earnings and Labour Response

	Log of Annual Earnings Estimates			Log of Annual Hours Worked Estimates		
	(1)	(2)	(3)	(4)	(5)	(6)
Log (real exchange rate)	-0.0360***	-0.0347***	-0.0357***	-0.0246***	-0.0232***	-0.0227***
	(0.013)	(0.013)	(0.010)	(0.01)	(0.01)	(0.009)
Years since arrival (YSA)	0.0281***	0.028***	0.009***	0.011***	0.011***	0.001*
	(0.003)	(0.003)	(0.002)	(0.002)	(0.002)	(0.001)
YSA squared	-0.0004***	-0.0004***	-0.0003***	-0.0004***	-0.0004***	-0.0003***
	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)
Age	0.177***	0.177***	0.282***	0.115***	0.115***	0.151***
	(0.006)	(0.006)	(0.021)	(0.005)	(0.005)	(0.018)
Age Squared	-0.0019***	-0.0019***	-0.0027***	-0.001***	-0.001**	-0.001***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Sex (Female)	-0.551***	-0.551***		-0.263***	-0.263***	
	(0.019)	(0.019)		(0.021)	(0.012)	
Married	0.084**	0.084**		0.044**	0.044**	
	(0.032)	(0.033)		(0.02)	(0.02)	
Time Dummy	Yes	Yes	Yes	Yes	Yes	Yes
Industry & Occupation fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Country Dummy	Yes	Yes	Yes	Yes	Yes	Yes
log (GDP)		Yes	Yes		Yes	Yes
Individual fixed effects			Yes			Yes
Observations	22,850	22,850	22,850	22,850	22,850	22,850
R^2	0.26	0.26	0.81	0.16	0.16	0.70

Note: The results are obtained from the Survey of Labor and Income Dynamics (SLID, 1993-2011). The unit is age and time since arrival is one year. The sample is limited to all foreign citizens in Canada who are between the age of 16-64. Robust standard errors are in parentheses, adjusted for clustering at country year level. Number of observations have been rounded to the nearest 10 digits to comply with confidentiality rules. *** Significant at 1 percent level ** Significant at 5 percent level * Significant at 10 percent level.

Given that a change in labour hours worked cannot wholly explain a change in earnings, it is essential to consider whether earnings reduction comes from changes in other dimensions of labour supply, like effort. Do immigrants adjust more on the extensive margin or the intensive margin? Are there spousal labour supply considerations? These questions can be answered more effectively by looking at other measures of labour supply which the following table 3.3 highlights in more detail. After controlling for individual characteristics, log GDP, and individual fixed effects, I obtained all the coefficients.

Table 3.3 indicates hours worked in a usual week also react significantly and negatively following a real exchange rate depreciation of the home currency of the immigrant. The coefficient is close to annual hours worked at -0.0213. Table 3.3 also reports the corresponding number in levels. There is a significant reduction in weeks of work in a year following the Canadian Dollar appreciation. A 1% appreciation in Canadian currency can lead to an immigrant working by almost a week less on average. When looking at secondary jobs, I find that the hours worked in the second job increase

with a positive significant coefficient of 0.022. Using a logit specification, I find that the probability of working in a part-time job increases. The odds ratio of working part-time is 1.44. The results indicate that immigrants tend to work more hours in part-time jobs and are more likely to work part-time than full-time when the Canadian Dollar appreciates. So, a 10% appreciation in the Canadian real exchange rate leads to a 0.18% increase in part-time hours. Nekoei (2013) finds a similar result and explains it to be a measurement error. However, it also might be that immigrants may want more flexibility in their work and prefer working part-time when the Canadian Dollar appreciates. These individuals do not need to work as hard to send home remittances. There is no significant impact on hours worked by other family members of the immigrants' household.

Table 3.3: Exchange rate effect on other labour supply variables

Dependent Variable	In Log	In Level	Logit
	(1)	(2)	(3)
Hours worked in a usual week	-0.0213***	-58.3***	
	(0.01)	(17.02)	
Weeks worked	-0.019***	-0.868***	
	(0.001)	(0.04)	
Hours worked in Secondary jobs	0.022***	40.01**	
	(0.01)	(20.01)	
Hours worked part time	0.018***	27.03***	
	(0.01)	(0.16)	
Working part time		0.45***	1.44
		(0.01)	odds ratio
Hours worked by other family members	0.014		
	(0.13)		

Note: The results are obtained from the Survey of Labor and Income Dynamics (SLID, 1993-2011). The unit is age and time since arrival is one year. The sample is limited to all foreign citizens in Canada who are between the age of 16-64. Robust standard errors are in parentheses, adjusted for clustering at country year level. *** Significant at 1 percent level ** Significant at 5 per cent level * Significant at 10 percent level

A controversial concept in immigration studies is assimilation. The gap between a native's earnings and a new immigrant's earnings closes as the immigrant stays longer in the host country. As assimilation happens, an immigrant invests in host-country-specific human and social capital; we might also consider the possibility that they simultaneously disinvest from home-country-specific counterparts. To explore this idea, I define "disintegration" as a process by which an immigrant

loses ties with her home country. Specifically, if immigrants' home country ties weaken over time, i.e., the amount of remittance and the likelihood of return decrease, the effect of home-country variables on immigrants should diminish. This allows me to use the exchange rate effect over time to measure the speed of the disintegration process and, thus, uncover a previously overlooked facet of assimilation. The following table 3.4 provides the results.

Using Eq (1.4) as the regression specification, table 3.4 below indicates that β_2 is significant and positive, which implies a process of disintegration among the agents. In other words, as they are farther away in time from their date of arrival in Canada, they are less affected by exchange rate fluctuations. This is especially so in a panel dataset with individual fixed effects, as it could have alternatively meant attrition in a cross-sectional dataset. Column (1) indicates a slow disintegration dataset, but it remains significant when including individual fixed effects in column (2). The results suggest that a 10% appreciation of the Canadian Dollar leads to a 0.63% fall in earnings, and this effect falls as the person stays more years in the foreign country. The results indicate that it may take an immigrant about 21 years to have no impact of exchange rate fluctuations on earnings. This also leads to a little higher estimate of exchange rate fluctuations on earnings than previously found in table 3.1. In columns (3) and (4), I repeat the specification but with the log of annual hours worked as the primary dependent variable, where I have similar findings as in the case of the annual log earnings.

Table 3.4: Disintegration Process

Coefficient	Log of Annual Earnings Estimates		Log of Annual Hours Worked Estimates	
	(1)	(2)	(3)	(4)
log (ExR)	-0.063***	-0.041**	-0.036***	-0.019*
	(0.010)	(0.015)	(0.008)	(0.02)
log (ExR) x YSA	0.003***	0.0013*	0.0014**	0.0003
	(0.001)	(0.0005)	(0.0001)	(0.004)
Controls	Yes	Yes	Yes	Yes
Individual fixed effects		Yes		Yes
Observations	22,140	14,280	22,140	14,280
R^2	0.25	0.81	0.15	0.71

Note: The results are obtained from the Survey of Labor and Income Dynamics (SLID, 1993-2011). The unit is age and time since arrival is one year. The sample is limited to all foreign citizens in Canada who are between the age of 16-64. Robust standard errors are in parentheses, adjusted for clustering at country year level. Number of observations have been rounded to the nearest 10 digits to comply with confidentiality rules. *** Significant at 1 percent level ** Significant at 5 percent level * Significant at 10 percent level

Given the response to exchange rates, it is essential to understand any heterogeneity in the response, especially concerning income. I run the exact specification as expressed in Eq. (1.4) but look at heterogeneity by income group to understand this. I estimate the effect of exchange rate fluctuations on earnings and hours worked using quantile regression estimates at the median, upper and lower quartiles and the upper and lower deciles by income. For comparison purposes, I also report the estimates from the entire sample. Table 3.5 below provides the results. The effect of the exchange rate seems to have a higher magnitude for the lower part of the income distribution. For the first decile on the income group, earnings and labour supply elasticity is highest at -0.0966. It goes down for the first quartile of the income category with a coefficient of -0.0424. For the 50th income quantile, the effect is still significant but lower in magnitude than the average at -0.017. However, for the highest income quantile and the 90th decile of income, I find no significant impact of exchange rate fluctuations on earnings and hours worked annually. Nekoei (2013) finds similar evidence. The coefficients retain their significance and magnitude when controlling for individual fixed effects. Results for the log of annual hours worked are similar but lower in magnitude than the results for log earnings. This is consistent with the previous findings in table 3.1.

Table 3.5: Quantile Regressions-income groups

	OLS	Quantile Regressions				
Dependent Variable:	Estimates	10	25	50	75	90
	(1)	(2)	(3)	(4)	(5)	(6)
log of annual earnings	-0.0347***	-0.0966***	-0.0424***	-0.017**	-0.010	-0.013
	(0.011)	(0.026)	(0.010)	(0.007)	(0.03)	(0.11)
log of annual hours worked	-0.0232***	-0.055***	-0.027***	-0.004***	-0.001	-0.004
	(0.001)	(0.015)	(0.005)	(0.001)	(0.0001)	(0.002)

Note: The results are obtained from the Survey of Labor and Income Dynamics (SLID, 1993-2011). All regression coefficients include the same set of control variables and have individual fixed effects. Robust standard errors are in parentheses, adjusted for clustering at country year level. *** Significant at 1 percent level ** Significant at 5 percent level * Significant at 10 percent level

Finally, I document heterogeneity by marital status in the effect of exchange rate fluctuations, where I specifically look at male immigrants. The theoretical foundation for the exercise builds on the fact that immigrants send remittances back to their families abroad. Hence, the money they send would be of a different value if the exchange rate changes. Thus, I run a similar specification as given in Eq (1.3) but consider separately single immigrants have their spouse with them or have a spouse but not in the foreign country. The following table 3.6 presents the results for the same. Immigrants who are married but whose spouse does not stay with them react more strongly to exchange rate fluctuations. For them, a 10% appreciation of the Canadian real exchange rate with respect to the home country leads to a 0.71% decrease in earnings. The exact figure for immigrants who have their spouse with them is 0.19%. The effect for single immigrants is somewhere in the middle at 0.32%. I get very similar numbers for the log of annual hours worked. For the log of hours worked part-time, I find a higher increase for single immigrants (0.031), followed by immigrants who are married but the spouse is not staying with them (0.019), and for immigrants who have their spouses living with them, the effect is insignificant. For hours worked part-time, it is again significant and positive, consistent with results in table 3.2, but the magnitude is higher for single immigrants followed by those whose spouses do not stay with them.

Table 3.6: Exchange rate effect by marital status

Dependent Variable	Single	Spouse Present	Spouse Absent
Log of	(1)	(2)	(3)
Annual Earnings	-0.0321***	-0.019**	-0.0710***
	(0.01)	(0.006)	(0.01)
Hours worked in a year	-0.019***	-0.009*	-0.039***
	(0.001)	(0.004)	(0.01)
Hours worked part time	0.031***	0.011	0.019**
	(0.01)	(0.12)	(0.01)

Note: The results are obtained from the Survey of Labor and Income Dynamics (SLID, 1993-2011). The sample is limited to all foreign male citizens in Canada who are between the age of 16-64. Robust standard errors are in parentheses, adjusted for clustering at country year level. *** Significant at 1 percent level ** Significant at 5 percent level * Significant at 10 percent level

The next section of this paper investigates heterogeneity in response among the different immigrant groups to exchange rate fluctuations. Unlike the US, for which Nekoei (2013) conducts his study, Canada has more diverse immigrant groups. This is especially important because Carroll et al. (1999) highlights how cultural origins affect immigrant saving behaviour. They find significant statistical differences in immigrants' saving behaviour, especially in high saving Asian countries. It is, therefore, worthwhile to explore heterogeneity in the response of various immigrant groups, especially in the Canadian context. Do immigrants from a country respond more strongly than others? Are there immigrants from certain countries for whom the substitution effect dominates the income effect? Therefore, I turn to the Longitudinal Immigration Database (IMDB) to avoid small sample issues and measurement errors in answering these questions. The following table 3.7 lists the top 40 immigrant country groups in Canada and estimates the change in log earnings to a 1% appreciation of log of real home exchange vis-a-vis the Canadian Dollar. Most countries tend to have a significant negative coefficient. Countries like Italy, Germany, Romania, Netherlands, Guyana, and Ukraine have an insignificant impact on their earnings to change their home country exchange rates. Countries like Iran, Portugal, Trinidad & Tobago, South Africa, and Croatia show a significant positive exchange rate impact on earnings. Most countries from Asia, which are traditionally high savings, show a higher negative effect on earnings of Canadian Dollar appreciation. Countries like India, China, the Philippines, Pakistan, and Hong Kong, which constitute about 30% of the entire immigrant share in Canada, have a significant negative impact on earnings.

Table 3.7: Heterogeneity by Country

Country	Log Earnings	Percentage of total immigrants in Canada
	(1)	(2)
India	-0.45***	8.87
China	-0.12***	8.61
Philippines	-0.072***	7.80
United Kingdom	-0.044***	6.62
United States of America	-0.058**	3.36
Italy	0.08	3.14
Hong Kong	-0.082**	2.77
Pakistan	-0.561***	2.68
Vietnam	-0.071**	2.24
Iran	0.072**	2.05
Poland	-0.002*	1.94
Germany	0.061	1.93
Portugal	0.071***	1.85
Jamaica	-0.053**	1.84
Sri Lanka	-0.093**	1.83
South Korea	-0.005*	1.64
France	-0.022**	1.4
Haiti	-0.112**	1.24
Romania	0.053	1.2
Lebanon	-0.039*	1.18
Netherlands	0.051	1.17
Guyana	0.049	1.16
Mexico	-0.078***	1.07
Russia	-0.001**	1.04
Ukraine	0.019	0.97
Colombia	-0.021**	0.93
Morocco	-0.044***	0.92
Iraq	-0.99*	0.91
Algeria	-0.039*	0.86
Egypt	-0.13**	0.86
Trinidad & Tobago	0.052**	0.86
Taiwan	-0.073**	0.85
Greece	-0.061*	0.83
Bangladesh	-0.18***	0.78
Syria	-0.14**	0.7
Afghanistan	-0.008**	0.69
El Salvador	-0.039*	0.64
South Africa	0.044***	0.59
Nigeria	-0.013*	0.56
Croatia	0.09**	0.53
Average	-0.032*	

Note: The results are obtained from the Longitudinal Immigrant Database (IMDB, 1993-2011). Robust standard errors are in parentheses, adjusted for clustering at country year level. Immigrants from countries in red have a positive significant change in earnings when the Canadian Dollar appreciates where countries in blue show an insignificant impact. *** Significant at 1 percent level ** Significant at 5 per cent level *

An essential aspect of immigrant labour literature is the existence and gains from living in enclaves. Immigrants tend to concentrate in enclaves for a variety of reasons, and this, in turn, affects their behaviour in the foreign country and their rate of assimilation with the economy, Edin et al. (2003). Papers that have looked at the remittance sending behaviour of immigrants have specifically looked at how differently they behave if they live in an enclave. Fenoll and Kuehn (2018) find that immigrants who live in ethnic enclaves in Spain tend to send more remittances and remit more frequently.[73] Antoniades et al. (2018) find that Indian immigrants in Qatar tend to send more remittances if they work for firms where there are more Indians. It might also be that immigrants who choose to settle in enclaves are more attached to their home country and therefore remit more. Thus, given the country-level estimates of exchange rate fluctuations affecting earnings, I test to see if these are different for people living in enclaves or not.[74] Therefore, for the two most prominent immigrant groups in Canada, Indian and Chinese, I check to see if exchange rate fluctuations differently affect these people as compared to the rest of the population. Table 3.8 below presents the results.

The Indian immigrants who live in ethnic enclaves include the areas Brampton (Ontario), Burnaby (British Columbia), Surrey (British Columbia) and Thistletown (Ontario). Similarly, for Chinese immigrants, the areas include Brossard (Quebec), Richmond Hill (British Columbia, Ontario and Alberta), and Richmond (British Columbia). For Chinese and Indian immigrants, the estimate is larger for those staying in enclaves. For a 10% appreciation of the Canadian Dollar, the earnings for an Indian immigrant fall by about 7% in an enclave compares to 2% in other regions. For Chinese immigrants, a 10% appreciation of the Canadian Dollar leads to a 2.1% fall in earnings for immigrants in enclaves and 1% for immigrants in other locations. These findings are new as other papers like Nekoei (2013) have not been able to look at this heterogeneity in great detail.

[73] Again, here ethnic enclaves are areas which have double or more of the national average of immigrants from a certain country of origin.

[74] Here, enclaves are defined as a region where the population of residents of a particular country is double that of the national average, Damm (2009).

Table 3.8: Exchange rate effect by location- Indian and Chinese immigrants

Dependent Variable	National	Enclaves	Non-Enclaves
Log of Annual Earnings	(1)	(2)	(3)
India	-0.451***	-0.711**	-0.204***
	(0.01)	(0.02)	(0.01)
China	-0.122***	-0.213***	-0.101***
	(0.001)	(0.001)	(0.001)

Note: The results are obtained from the Longitudinal Immigrant Database (IMDB, 1993-2011). Robust standard errors are in parentheses, adjusted for clustering at country year level. Immigrants from countries in red have a positive significant change in earnings when the Canadian Dollar appreciates where countries in blue show an insignificant impact.*** Significant at 1 percent level ** Significant at 5 per cent level * Significant at 10 percent level

Lastly, I document heterogeneity using education in Table 3.9. The results seem to mirror the finding obtained in Table 3.5. The regression coefficients by the education group imply different exchange rate effects concerning potential income. For immigrants who have less than 12 years of education, earnings decrease by as much as 0.96% following a 10% appreciation of the Canadian Dollar. The effect is slightly smaller for immigrants who have completed their schooling and 12 years of education at 0.59%. The coefficients for immigrants with more than 12 years of schooling seem insignificant. A similar result holds for annual hours worked, with the coefficients smaller than we observe for earnings.

Table 3.9: Exchange rate effect by Education

Dependent Variable	< 12 years	12 years	12-16 years	> 16 years
Log of	(1)	(2)	(3)	(4)
Annual Earnings	-0.0961***	-0.0592**	-0.0201	-0.0108
	(0.01)	(0.01)	(0.12)	(1.11)
Annual Hours Worked	-0.077***	-0.037***	-0.0061	-0.0072
	(0.01)	(0.01)	(0.056)	(1.12)

Note: The results are obtained from the Survey of Labor and Income Dynamics (SLID, 1993-2011). The sample is limited to all foreign male citizens in Canada who are between the age of 16-64. Robust standard errors are in parentheses, adjusted for clustering at country year level. *** Significant at 1 percent level ** Significant at 5 percent level * Significant at 10 percent level

3.5.1 Remittance Analysis

It is important to understand the mechanism behind this robust finding of a fall in earnings of immigrant groups to an appreciation of the Canadian Dollar. As previously discussed, remittances form an important portion of immigrants' income in the foreign country. In 2017 about $5.2 billion was remitted from Canada alone.[75] The Longitudinal Survey of Immigrants to Canada (LSIC) interviews newly arrived immigrants in 2001, 24-36 months post-arrival. The survey asks, among other things, asks questions related to remittances. Philippines, India, the United States, China, and Pakistan are the highest remittance receiving countries from Canada as evaluated from the SLID. It also finds 'transfers for family', 'for livelihood', and 'for welfare purposes dedicated to family and friends' main factors behind sending remittances. Further, it finds that economic immigrants average a higher amount of remittance sent than refugees. People staying in major cities are also more likely to send remittances. Given the theoretical framework, immigrants remit a substantial portion of their earnings to their home country and, as a result, react to changes in exchange rate fluctuations. Therefore, the effect we observe so far should be higher in magnitude if the individual is sending remittances back home. Using the Survey of Labor and Income Dynamics, I use a question that directly asks its respondents if and how much remittance they sent back home. However, many respondents did not answer the question and were asked only between 2006-and 2011. For all the immigrants in the survey, about 60% answered the question. Below I provide the findings in Table 3.10. From columns (1), (2) and (3), it is clear that immigrants who send remittances to their home country are more sensitive to changes in real exchange rate fluctuations. I find that a 10 per cent appreciation of the Canadian Dollar results in a 0.9 per cent fall in annual earnings for these immigrants. Even when I control the immigrants' country of birth and individual fixed effects for GDP, the effect is similar. The effect on hours worked annually is

[75]Study on International Money Transfers from Canada by Zacharie Tsala Dimbuene and Martin Turcotte.

lower and insignificant when controlling for individual fixed effects. This might be since there are not enough people responding to this question. A 10% appreciation of the Canadian Dollar results in a 0.03% fall in annual hours worked for the initial specification.

Table 3.10: Remittances

	Log of Annual Earnings Estimates			Log of Annual Hours Worked Estimates		
	(1)	(2)	(3)	(4)	(5)	(6)
Log (real exchange rate)*Remittances(YES)	-0.0914***	-0.089***	-0.0913**	-0.0126*	-0.0114	-0.0112
	(0.03)	(0.03)	(0.03)	(0.01)	(0.021)	(0.021)
Log (real exchange rate)*Remittances(NO)	-0.0451***	-0.0378***	-0.0441**	-0.0089	-0.00174	-0.00912
	(0.01)	(0.01)	(0.031)	(0.12)	(0.15)	(0.15)
Years since arrival (YSA)	0.013***	0.014***	0.013**	0.001	0.001	0.001
	(0.004)	(0.004)	(0.007)	(0.002)	(0.002)	(0.002)
YSA squared	-0.001**	-0.001**	-0.001*	-0.0001	-0.0001	-0.0001
	(0.0009)	(0.0009)	(0.0009)	(0.002)	(0.002)	(0.002)
Age	0.0319***	0.027**	0.027**	0.018*	0.019*	0.018*
	(0.02)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Age Squared	-0.0003	-0.0003	-0.0003	-0.0001	-0.0001	-0.0001
	(0.001)	(0.002)	(0.002)	(0.001)	(0.001)	(0.001)
Married	0.181	0.189		0.151	0.151	
	(0.23)	(0.22)		(0.201)	(0.201)	
Sex (Female)	-0.398***	-0.393***		-0.115***	-0.114***	
	(0.058)	(0.060)		(0.04)	(0.04)	
Time Dummy	Yes	Yes	Yes	Yes	Yes	Yes
Country Dummy	Yes	Yes	Yes	Yes	Yes	Yes
log (GDP)		Yes	Yes		Yes	Yes
Individual fixed effects			Yes			Yes
Observations	4890	4890	4890	4890	4890	4890
R^2	0.19	0.26	0.81	0.17	0.22	0.71

Note: The results are obtained from the Survey of Labor and Income Dynamics (SLID, 1993-2011). The unit is age and time since arrival is one year. The sample is limited to all foreign citizens in Canada who are between the age of 16-64. Robust standard errors are in parentheses, adjusted for clustering at country year level. Number of observations have been rounded to the nearest 10 digits to comply with confidentiality rules. *** Significant at 1 percent level ** Significant at 5 percent level * Significant at 10 percent level.

Another aspect to consider is if the fluctuations in the exchange rate affect the behaviour of sending remittances. The previous analysis points to how the income effect dominates the substitution effect, thus resulting in a negative and significant coefficient on earnings and hours worked. An alternative theory that can potentially explain this finding is that immigrants target a certain amount of remittance. Thus, if the Canadian Dollar appreciates, they keep sending the same remittance back home but can work less to earn it. Therefore, it might be expected that there should not be a change in the extensive or intensive margin of sending remittances by immigrants when faced with exchange rate fluctuations. The following table 3.11 presents the results of sending remittances

at the extensive margin and carrying out a logistic regression. Though positive, the reported log odds ratio is not significant, thus suggesting that remittance sending behaviour is unlikely to change when the exchange rate fluctuates. Finally, I use the total remittance sent variables and check if there is any change in the amount of money sent to the remittance senders due to fluctuations in the exchange rate. The coefficient of interest seems to be positive and insignificant, suggesting that the amount of remittance sent does not change when the Canadian Dollar appreciates. The findings support the idea that immigrants are remittance targeters, especially since remittances are measured in foreign currency.

Table 3.11: Remittance at the extensive and intensive margin

	Sending Remittances Estimates			Remittance Amount Estimates
	(OLS)	(Probit)	(Logit)	(OLS)
Log (real exchange rate)	-0.0026	-0.018	-0.039	0.831
	(0.023)	(0.02)	(0.051)	(0.91)
Years since arrival (YSA)	0.002	-0.040***	-0.072***	-113.001***
	(0.013)	(0.006)	(0.01)	(0.004)
YSA squared	-0.0001	0.0001	0.0001	0.908*
	(0.0003)	(0.0003)	(0.0003)	(0.43)
Age	-0.058	0.065***	0.118***	7.28***
	(0.04)	(0.01)	(0.02)	(0.132)
Age Squared	-0.056	-0.0005**	-0.0009**	0.14
	(0.04)	(0.0003)	(0.0003)	(0.14)
Married	-0.055	0.030	0.055	-710.79***
	(0.14)	(0,07)	(0.13)	(0.26)
Gender	-0.25***	-0.003	-0.002	-379.02
	(0.09)	(0.04)	(0.02)	(254.9)
Time Dummy	Yes	Yes	Yes	Yes
Country Dummy	Yes	Yes	Yes	Yes
log (GDP)	Yes	Yes	Yes	Yes
Observations	4890	4890	4890	1280

Note: The results are obtained from the Survey of Labor and Income Dynamics (SLID, 1993-2011). The unit is age and time since arrival is one year. The sample is limited to all foreign citizens in Canada who are between the age of 16-64. Robust standard errors are in parentheses, adjusted for clustering at country year level. Number of observations have been rounded to the nearest 10 digits to comply with confidentiality rules. *** Significant at 1 percent level ** Significant at 5 percent level * Significant at 10 percent level.

3.6 Conclusion

This paper analyses how real exchange rate fluctuations affect immigrants' earnings and labour market outcomes. Economists have not yet investigated how an immigrant's decisions are influenced in real-time by her home-country economy. Previous work mainly focused on how immigrants are selected and assimilated over time. In contrast, this paper investigates the role of home-country determinants of immigrants' economic behaviour. The intuition is that, given the substantial amount

of remittance that immigrants transfer and their high rate of return, we might also expect that immigrants' decisions are affected in real-time by the price of their home country's currency and thus by their home country's economy. Hence, an immigrant's intra and intertemporal decisions are affected by her home country. I develop a means to investigate this question by exploiting exchange rate variation as exogenous price shocks to the purchasing power of immigrants' earnings. The results suggest that immigrants earn less when the Canadian Dollar appreciates with respect to their home currency. A 10% appreciation of the Canadian Dollar leads to a 0.36% fall in the earnings of an average immigrant. About 70% of this fall can be explained by a fall in labour hours worked. The results also highlight how part-time work increases the heterogeneity among immigrant groups. The effect is higher for immigrants whose spouses are not staying with them, for immigrants in the bottom quartiles of the income distribution and in immigrant enclaves. Even though the amount sent is not affected, immigrants who send remittances abroad are affected more by exchange rate fluctuations. This supports the theory that immigrants are remittance targeters, and hence once the exchange rate for their home country depreciates, it becomes easier for them to send the same amount of money home. They react to this by reducing income which comes from reducing labour hours.

Chapter 4

Unlucky Immigrants: The short and long-run implications of entering the labour market in a recession.

4.1 Introduction

The process of economic assimilation by immigrants and how their career and labour market earnings trajectory evolves is of obvious concern to policymakers. The concern is further justifiable because a large proportion of the immigrant population in many developed economies performs poorly in the labour market (OECD, 2011). Economists have long looked at whether immigrant earnings differ from natives', why they differ, and how that gap changes over time.[76] Evidence on employment and scarring among immigrant groups mainly depending on their year of entry can potentially shed light on this regard. On the other hand, a seemingly unrelated strand of the literature looks at the effect of graduating in a recession on short-term and long-term labour market earnings and different labour market outcomes. It is widely agreed upon that the early years of a worker are crucial for wage growth and long term prospects, Topel and Ward (1992). It is also a concern among economists and policymakers alike that interruptions of the initial career progression process caused by recessions can have lasting consequences on earnings and other relevant outcomes, including health effects, human capital investment and household formation. This offers in the style of McDonald and Worswick (1999) combines these two strands by looking at affect of initial conditions at labour market entry on current earnings for immigrants.[77]

The labour literature has given substantial interest to the impact of immigrant entry and their subsequent movement on the foreign economy. Borjas (2001) claims that new immigrants "grease the wheels" of the labour market. Given they have already incurred the fixed cost of moving, they are very responsive to regional differences in economic opportunity and accelerate local population adjustment. Further focussing on the Great Recession period, Cadena and Kovak (2016) argues further that foreign-born workers (or at least low skilled Mexicans) continue to "grease the wheels" even some years after arrival. Amior and Manning (2020) finds that new immigrants account for a

[76] Papers include Borjas (1985); LaLonde et al. (1992); Borjas (1995a); Hu (1999); Card (2005); Lubotsky (2007); Lubotsky (2011); Abramitzky et al. (2014)

[77] They use data from Australia for evaluating this affect. Junankar and Mahuteau (2005) on the other hand evaluates the quality of jobs these immigrants get on entry.

substantial portion of the average population response to local demand shocks since 1960. Therefore, the suggestion of the literature thus far that immigrants migrate as a response to local labour demand conditions is both a challenge and an opportunity for the proposed study of looking at how initial labour market conditions affect immigrants' earnings outcomes. The proposed study can document if immigrant labour mobility is substantial, especially in areas facing economic downturns, and, in turn, control it in evaluating the long-term effects. Finally, the literature is mainly silent concerning reverse migration decisions due to the lack of high-quality data. One of the first papers to study outmigration, Lubotsky (2007), uses Social Security records linked to immigration data and finds that emigration by low-wage immigrants has systematically led past researchers to overestimate the wage progress of immigrants who remain in the United States. The other paper addressing this is by Akee and Jones (2019), who documents that in the U.S., by ten years after arrival, almost 40 per cent of immigrants leave the economy. They also experience downward earnings mobility over the final years before their emigration decision. Therefore, it is crucial to control for and document how emigration choice is affected by labour market conditions at the point of entry. While most work in this literature has been with repeated cross-section data. With the panel data, I can track the same individuals over time, which allows me to control for compositional change and measure how persistent the effects of such fluctuations are. The information on outmigration, inter-provincial migration, and welfare use further helps me understand the mechanism behind the impact and duration.

4.2 Data

The individual-level data for this study comes from the IMDB. The IMDB combines immigrant landing records and annual tax records for immigrants who have, arrived in Canada since 1980. Immigrants who have filed at least one tax return since 1980 appear in the database. The database retains rich information on immigrant characteristics at landing from immigrant landing records, including age, education, marital status, and immigration category (e.g., skilled workers, family, and refugees). The database derives information on earnings and other income components from the tax records, taxes paid, current marital status and geographical location of residence. The tax records currently cover the 1982-2016 period. More importantly, given the longitudinal nature of the dataset, it is possible to know which region they enter.[78] And consequently, if and where they migrate. The database also provides accurate information about immigrant outmigration dates.

I confine the analysis to immigrants between the age group of 18 and 60 who entered Canada between 1987 to 2011.[79] I additionally exclude immigrants who land as students, obtain a degree

[78] Up until the census metropolitan area and postcode.

[79] I can extend the year from 1982 to 2016, but I do not do it now because of confidentiality agreements with Statistics Canada.

in Canada and then start working.[80] The primary reason for this is that the literature points to how different returns to foreign versus home country education can be to immigrant earnings and assimilation. Chiswick and Miller (2002) document for the U.S. labour market that immigrants who know the English language tend to do better on average than immigrants who don't. I focus on two outcome variables for preliminary analysis: (log) annual earnings and (log) total income, including all employment earnings and government transfers in terms of tax benefits and unemployment insurance receipts. In the immigrant tax form, each immigrant at the point of entry reports the destination province and exact destination economic region of the country. I use this variable to identify the province of entry for the immigrant.

4.3 Econometric Specification

The preferred regression specification should relate different outcomes such as labour income, unemployment insurance usage and outmigration decision to varying years of experience to economic conditions an immigrant faced at market entry. For the baseline specification, I follow the established literature and especially, Schwandt and Von Wachter (2019) and look at how outcomes vary at the level of the province of entry (p), year of entry (g), calendar year (t) and education or skill group (d). I also control the year of entry fixed effects and state and year fixed effects. The main aim of the specification would be to regress the outcome on the applicable initial unemployment rate with the controls specified above. Therefore, the first regression specification is as follows:

$$Y_{i,p,g,t} = \alpha + \beta_{t-g} u_{p,g} + \gamma_{t-g} + \delta_p + \theta_t + \epsilon_{i,p,g,t} \tag{4.1}$$

where, $u_{p,g}$ is the unemployment rate in the state of current residence p at the year of entry g. Then, t represents the current year, and hence the variable $t - g$ represents the years of experience in the foreign country. Therefore the coefficient of interest β_{t-g} captures the effect of graduating in a recession, given the subsequent regular evolution of local labour market conditions. I cluster the standard errors at the level of year of entry by the province to account for possible entrant specific serial correlations in the labour market outcomes. Given the fixed effects, the coefficient captures deviations from typical experience profiles related to entrant state-specific variation in the unemployment rate.

A point to highlight here is that in the analysis thus far, I consider unemployment at the provincial level. Given the specification above, if the geographical area is too small, then there might be terms unaccounted for, which end up as part of the error term, which affects both the dependent variable, log earnings and the primary explanatory variable, unemployment rate in the province at the point of entry. Finally, it is essential to consider the above specification with controls for individual characteristics, especially vital because there is substantial heterogeneity among immigrant

[80] This would be a useful extension especially in light of the work in Oreopoulos et al. (2012)

groups in Canada. Controlling for individual-level observables is essential because these observables would affect the initial job placement of the immigrant. Thus, the analysis would have to be done within these groups to understand the specific question better. So, the specification of interest is

$$Y_{i,p,g,t,d} = \alpha + \beta_{t-g} u_{p,g} + \gamma_{t-g} + \delta_p + \theta_t + \pi_i + \phi_d + \epsilon_{i,p,g,t} \tag{4.2}$$

Where again $u_{p,g}$ is the unemployment rate in the state of current residence p at the year of entry g, with t representing the current year, and hence $t - g$ refers to the years of experience in the foreign country. The primary specification difference between Eq(1) and (2) is the control for individual-level characteristics π_i which includes country of origin, education level, sex, marital status and age. I also control for the immigrant's skill and education group d. Besides earnings from employment, I also want to look at family earnings. I consider the fraction receiving welfare benefits as another potentially important variable of interest. I consider heterogeneity in terms of sex, education and official languages known to understand further the variations in the potential impact of entry during economic slowdowns.

4.4 Concerns & Possible Remedies

4.4.1 Timing of Entry

The baseline specification thus far treats the year of labour market entry as exogenous. This data is the year the immigrant enters the country and starts paying taxes. However, at least some immigrants may have the ability to delay their labour market entry when they think they are likely to face an economic downturn. I use the same month and year of entry of the concerned immigrant and the average unemployment rate of a 6-month following market entry to deal with this situation. The identifying assumption here is that immigrants cannot accurately predict the province's unemployment rates on entry for half or whole years. More generally, given the lags in the Canadian visa processing system, endogeneity due to immigrants choosing their arrival time is likely not an issue. The delay in visa processing was especially more severe in the 1990s and 2000s, and has been highlighted in the work of Hum and Simpson (2004a). They also point out how these differences and lack of choice of entry time can lead to differential assimilation rates by the immigrants in the economy. Most immigrants in Canada are documented where many low-skilled Mexican and Latin American immigrants can cross a border and join the U.S. workforce.

4.4.2 Out-Migration and Inter-Provincial Migration

The argument put forward by the literature is that immigrants are more likely than native-born to migrate inter-provincially when faced with economic downturns. Such directed migration would

lead to a bias in the results. Immigrants in poorly performing states would be erroneously assigned poorer conditions even when they migrate to better areas in their new province of residence. If there is selection into who relocates from a region and who does not, the bias can go either way. Immigrants can also leave the country and migrate back to their home or another country. However, it would be possible to control inter-provincial migration because of the data in hand, which follows an individual across all years when they are working. Therefore, I can separately estimate the impact of entering an economy in a recession on immigrants depending upon those who migrate and those who don't. The data also makes it possible to observe the people who out-migrate. Therefore, I analyse how immigrants out-migrate if they enter the labour market in poorer economic conditions and accordingly control them.

4.4.3 Selection into Regions

To deal with the endogenous selection of location choice of immigrants, I consider variations in national unemployment rates while at the same time controlling for the province and local unemployment rates. I can also look at smaller economic regions within each province and use variations in the unemployment rate at the local level to analyse the question at hand. Finally, the analysis can be undertaken for different immigrant categories to deal with the selection issues. Many province-specific immigrant programs, especially in Quebec, can address the location endogeneity. Finally, the database at hand provides the exact classification of the immigrant category, so estimating the effects separately for people who enter as the main applicant's spouse, refugees, skilled versus unskilled, foreign versus home educated, can shed valuable light on the question at hand.

4.5 Results

The following table 4.1 and corresponding figure 4.1 show the effects of the initial unemployment rate on log earnings in the first 15 years in the labour market. Over the period considered from 1987 to 2011, the average annual earnings for an immigrant is $ 10,330. The sample over the time frame contains about 2.5 million immigrants with over 20 million individual-years observations. Figure 4.1 displays the coefficient of interest β_{t-g} where $t-g$ represents years since entry. This figure is estimated using the baseline specification given in Eq (2.1). The point estimates are reported with standard errors for provincial unemployment rates in the table 4.1. The results for specification two, which includes individual level controls, are reported in Column (2) of the Table and displayed in figure 4.1.

As the table 4.1 and figure suggest, immigrants earn significantly less when they enter the economy in a downturn. The effects obtained from the specification are substantial. The results suggest that an increase in the unemployment rate by 3% points, roughly the typical increase from peak to

trough of the business cycle, leads to an initial reduction in earnings by 7%. This effect only slowly declines with time spent in the labour market, with the effect still significantly different from zero ten years after entry. A 3-point rise in unemployment leads to a 2% reduction in earnings; however, it becomes statistically insignificant post the ten-year mark. These estimates align with previous findings, mostly based on college graduates and specifically focus on recessions. The results here are similar but slightly higher for the first few years. The trend is similar as well, but the results for the immigrants seem to be more persistent and long-lasting. For example, for Canadian graduates, Oreopoulos et al. (2012) find an initial earnings loss of 6% for a 3-point rise in local unemployment rates. The estimates here are higher because of the focus on more vulnerable groups, immigrants. The estimates also seem to be similar when controlling for individual-level observables.

Table 4.1: Effects of unemployment rates at labour market entry on earning

Variable, Experience Group	Full sample (Without controls)	Full Sample (With Controls)
Log Employment Earnings	(1)	(2)
Year, 1	-0.0232***	-0.0235***
	(-0.027,-0.018)	(-0.028,-0.018)
Year, 2	-0.0196***	-0.0201***
	(-0.026,-0.014)	(-0.027,-0.015)
Year, 3	-0.0157***	-0.0167***
	(-0.023,-0.009)	(-0.024,-0.01)
Year, 4	-0.0135**	-0.0149***
	(-0.022,-0.007)	(-0.021,-0.007)
Year, 5	-0.0124***	-0.0138***
	(-0.021,-0.006)	(-0.020,-0.06)
Year, 6	-0.0110***	-0.0125***
	(-0.020,-0.004)	(-0.019,-0.004)
Year, 7	-0.0095***	-0.0117***
	(-0.017,-0.003)	(-0.018,-0.003)
Year, 8	-0.0078**	-0.0103***
	(-0.014,-0.0001)	(-0.014,-0.002)
Year, 9-10	-0.0063*	-0.0075**
	(-0.006,0.0001)	(-0.010,-0.00003)
Year, 11-12	-0.0021	-0.0051*
	(-0.004,0.001)	(-0.005,0.0001)
Year, 13-14	-0.0001	-0.0002
	(-0.003,0.001)	(-0.004,0.007)

Note: The results are obtained from the Longitudinal Immigrant Database (IMDB, 1987-2011). All robust standard errors are adjusted for clustering at province year level. 95% confidence intervals are in paranthesis. *** Significant at 1 percent level, ** Significant at 5 percent level, * Significant at 10 percent level.

Next, to look at outmigration decisions, I consider a specification similar to Eq.(2.2) but the proportion of immigrants out-migrating from the country. I consider how outmigration decision is affected by unemployment rates at the time of labour market entry and look at earnings but now only for people who decided to stay in the country. Thus, table 4.2 below looks at the effect of the unemployment rate at the point of market entry on long term income profiles but only for immigrants who have not migrated out of the country. Due to the nature of the data, I consider immigrants as having out-migrated if they do not file taxes in 5 consecutive years and have not died in Canada, an approach also used in Aydemir and Robinson (2008). The results indicate that the immigrants who have stayed in the country do better.[81] This is especially so as the catch up is a lot faster because the earnings are not significantly affected by the initial unemployment rate after year eight as compared to year ten previously; as table 4.2 below shows, a 3 point rise in unemployment leads to a fall in earnings of about 6% which decreases to about 4% in years 3 and 4 and 3% by the end of year 6. However, beyond year 6, there does not seem to be any significant effect of the unemployment rate at the time of entry on earnings. Thus, as compared to the entire sample, it appears that the stayers recover more quickly. The estimates with individual level controls are similar, with the effect no longer significant from year 7.

[81] Aydemir and Robinson (2008) find frequent out-migration among male immigrants and link it to their characteristics on landing but not on entry period and province unemployment rate.

Table 4.2: Effects of unemployment rates at labour market entry on earning- Stayers

Variable, Experience Group Log Employment Earnings	Full sample (Without controls) (1)	Full Sample (With Controls) (2)
Year, 1	-0.0221***	-0.0223***
	(-0.026,-0.018)	(-0.027,-0.018)
Year, 2	-0.0191***	-0.0198***
	(-0.025,-0.014)	(-0.024,-0.015)
Year, 3	-0.0141***	-0.0151***
	(-0.022,-0.001)	(-0.023,-0.01)
Year, 4	-0.0132**	-0.013***
	(-0.022,-0.007)	(-0.021,-0.007)
Year, 5	-0.0112***	-0.0119***
	(-0.019,-0.005)	(-0.018,-0.05)
Year, 6	-0.009***	-0.0101***
	(-0.015,-0.003)	(-0.015,-0.005)
Year, 7	-0.0078***	-0.089***
	(-0.013,-0.002)	(-0.014,-0.002)
Year, 8	-0.007**	-0.072**
	(-0.011,-0.001)	(-0.009,0.0008)
Year, 9-10	-0.0041*	-0.0042*
	(-0.006,0.0001)	(-0.010,0.003)
Year, 11-12	-0.0028	-0.0015
	(-0.004,0.001)	(-0.003,0.009)
Year, 13-14	-0.00011	-0.00013
	(-0.003,0.001)	(-0.004,0.007)

Note: The results are obtained from the Longitudinal Immigrant Database (IMDB, 1987-2011). All robust standard errors are adjusted for clustering at province year level. 95% confidence intervals are in paranthesis. *** Significant at 1 percent level, ** Significant at 5 percent level, * Significant at 10 percent level.

Finally, I look at the decision of outmigration itself and consider the fraction of immigrants who out-migrate. Table 4.3 provides the results below after controlling for individual-level observables. Table 4.3 provides the estimates for the effect of unemployment rates at the entry on the fraction of immigrants who decide to leave Canada. Outmigration is defined as individuals who do not file taxes for five years after moving into Canada from 1987 until 2011. The year of outmigration is thus the first year they have not filed taxes. As the results indicate, a significant fraction of immigrants out-migrate in their first year when they enter the country, which increases in years 2 and 3. By year 3, a 3 point rise in unemployment leads to 4% of all immigrants out-migrating. The effect is significant and positive until year 5, where a 3 point rise in unemployment leads to a 1.5% fraction of out-migrating in that year. Still, the estimates are not significant after that. The results from Table 4.2 and 4.3, compared to the effects on the entire sample in Table 4.1, show that immigrants who choose to leave Canada are doing worse than immigrants who decide to stay. It also corroborates findings by Akee and Jones (2019) that immigrants experience a reduction in

earnings before they choose to out-migrate.

Table 4.3: Effects of unemployment rates at labour market entry on fraction outmigrating

Variable	Full sample (With controls)
Log Employment Earnings	(1)
Year, 1	0.009***
	(0.003,0.012)
Year, 2	0.0126***
	(0.005,0.0161)
Year, 3	0.0130***
	(0.004,0.019)
Year, 4	0.0087**
	(0.002,0.015)
Year, 5	0.0051**
	(0.0002,0.007)
Year, 6	0.00007*
	(-0.007,0.00051)
Year, 7	-0.00002
	(-0.0009,0.00024)
Year, 8	-0.00007
	(-0.07,0.0034)

Note: The results are obtained from the Longitudinal Immigrant Database (IMDB, 1987-2011). All robust standard errors are adjusted for clustering at province year level. 95% confidence intervals are in paranthesis. *** Significant at 1 percent level, ** Significant at 5 percent level, * Significant at 10 percent level.

Having established the key finding that immigrants face reduced earnings when entering the economy when unemployment is high and that this effect seems to decrease over time, thus lending support to the 'scarring' hypothesis, it is important to look at the heterogeneous nature of this impact. Numerous papers look at how different immigrant categories perform compared to comparable natives; however, it is also important to analyse immigrant diversity. Looking at the differences within immigrant categories in how slowly they recover from an initial reduction in

earnings can, in turn, help policymakers decide if they should direct welfare plans towards certain categories and not others.

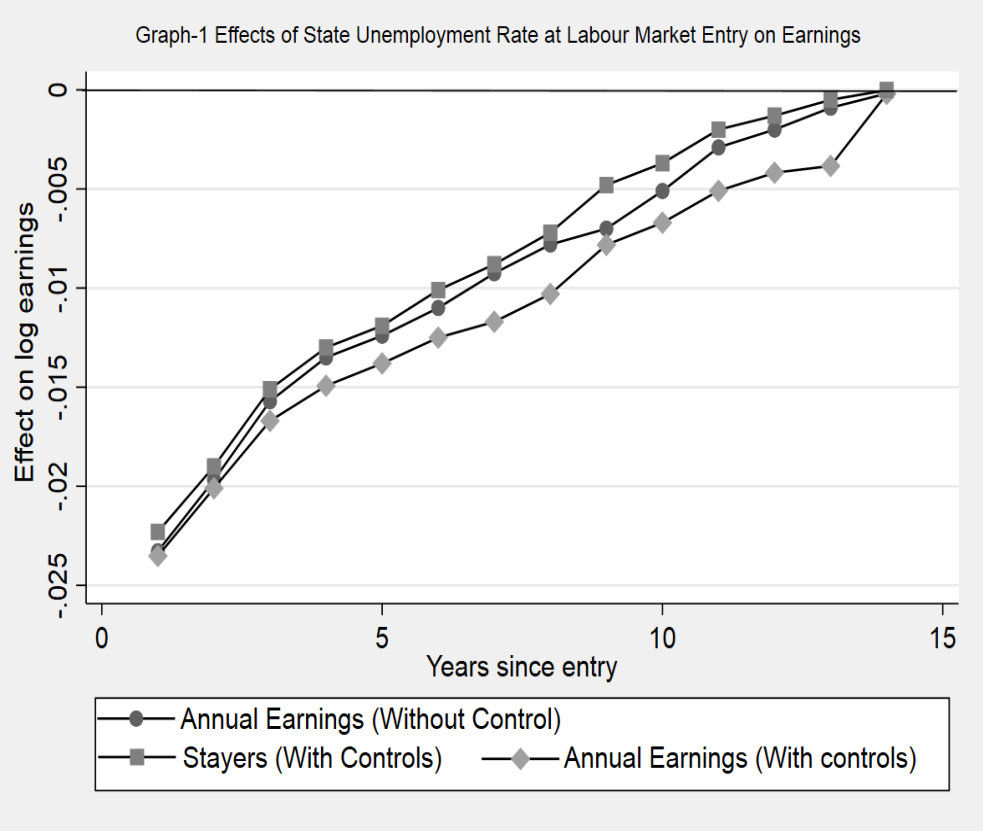


Figure 4.1: Effects of State Unemployment Rate at Labour Market Entry on Earnings

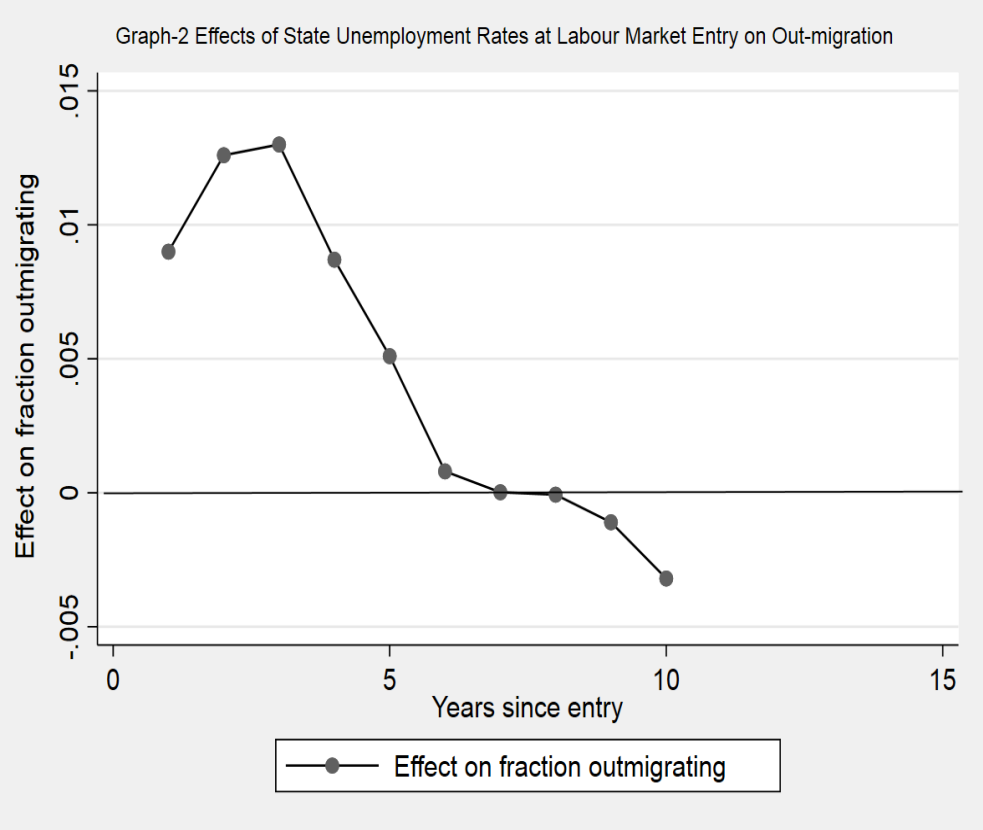


Figure 4.2: Effects of State Unemployment Rate at Labour Market Entry on Out-migration

4.6 Heterogeneity by groups

In this section, I formally turn to analyse heterogeneity in the effects of immigrant subgroups. I first look at the heterogeneous response concerning gender. In the sample considered, an average male immigrant worker earned $ 12,660, whereas an average female worker earned $ 7,910 in a year. The results for men and women appear to be similar in magnitude. In the first two years after entry, a 3 point rise in the unemployment rate leads to a 6.6% decrease in earnings for men and a 7% fall in earnings for women. The impact decreased over time for both groups, with men facing a reduction of 3% by the end of year six and women facing a decrease of about 4%. The difference between the two groups is substantial after year 8. For men, entering the economy when unemployment is high is insignificant, whereas, for women, the effect is still significant at about 1.7% after year 9. This is consistent until after year ten and shows that the scarring effect of entering the economy in a downturn dissipates much faster among men than women. This is different from Schwandt and Von Wachter (2019) findings, which do not find any substantial difference between men and women in the US. The results here show that males and females start similarly. Still, males do much better with time, and it highlights and lends support to the work by Baker and Benjamin (1997), who find that immigrant husbands work less than natives upon

arrival, but immigrant wives work more. Husbands initially indulge in human capital investments and do better in the long run, whereas wives tend to take up "dead end" jobs to support the family.

Table 4.4: Effects of unemployment rates at labour market entry by gender

Variable, Experience Group	(Male)	(Female)
Log Employment Earnings	(1)	(2)
Year, 1	-0.0223***	-0.0238***
	(-0.026,-0.018)	(-0.028,-0.019)
Year, 2	-0.0194***	-0.0210***
	(-0.025,-0.015)	(-0.027,-0.017)
Year, 3	-0.0151***	-0.0182***
	(-0.022,-0.001)	(-0.023,-0.016)
Year, 4	-0.0123**	-0.0161***
	(-0.019,-0.007)	(-0.021,-0.010)
Year, 5	-0.0112***	-0.0142***
	(-0.017,-0.006)	(-0.018,-0.05)
Year, 6	-0.009***	-0.0121***
	(-0.015,-0.003)	(-0.015,-0.005)
Year, 7	-0.0071***	-0.0103***
	(-0.011,-0.002)	(-0.014,-0.005)
Year, 8	-0.006**	-0.093***
	(-0.011,-0.001)	(-0.012,-0.006)
Year, 9-10	-0.0042*	-0.0081***
	(-0.006,-0.0001)	(-0.010,-0.003)
Year, 11-12	-0.0012	-0.0049***
	(-0.004,0.001)	(-0.006,-0.0018)
Year, 13-14	-0.0001	-0.0013*
	(-0.003,0.0098)	(-0.004,-0.0008)

Note: The results are obtained from the Longitudinal Immigrant Database (IMDB, 1987-2011). All robust standard errors are adjusted for clustering at province year level. 95% confidence intervals are in paranthesis. *** Significant at 1 percent level, ** Significant at 5 percent level, * Significant at 10 percent level.

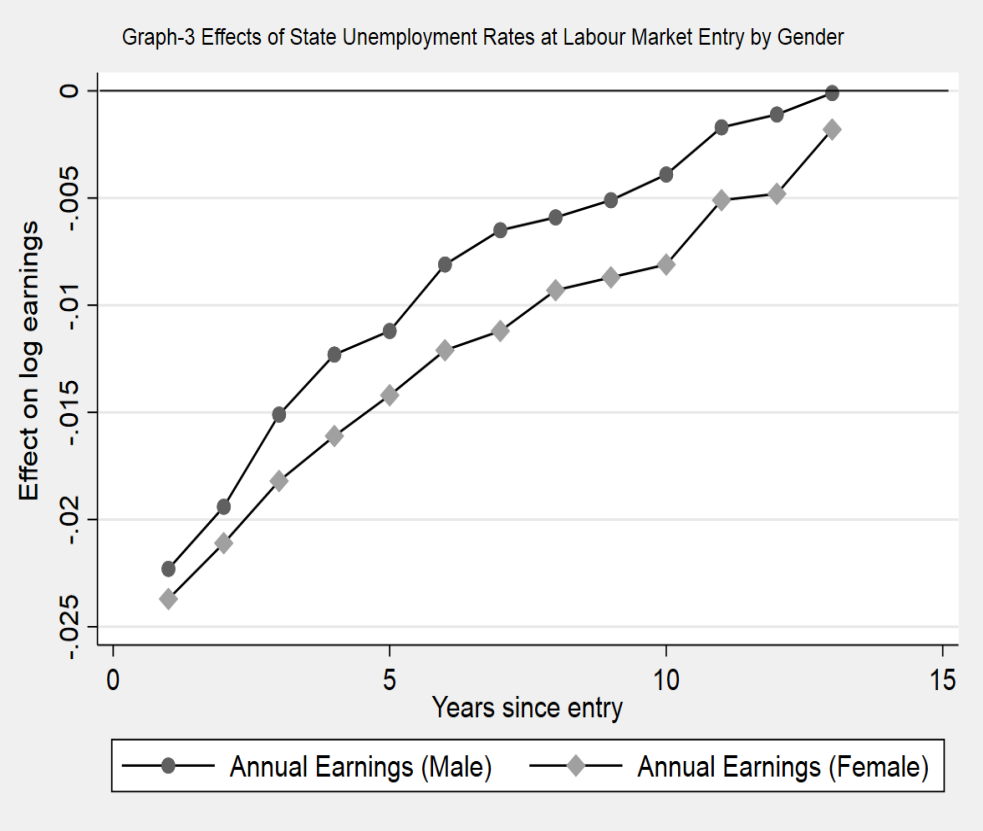


Figure 4.3: Effects of State Unemployment Rate at Labour Market Entry by Gender

Having analysed the heterogeneity between gender groups, I next look at heterogeneity by education group with the results in table 4.5. Entry-level earnings differ substantially based on the amount of human capital investment an immigrant makes before and after arrival (Duleep and Regets (1997), and Green and Worswick (2012). This may be reflected in more significant post-arrival growth in earnings. Therefore, it is crucial to understand how immigrants of different immigrant groups do on entry depending on the conditions they face and if there are adverse effects, then if and how fast they dissipate. In my analysis, I drop from my consideration all immigrants who enter the country as students and thus obtain education from Canada. This is important because papers like Fortin et al. (2016) find that controlling for the source of human capital (Canadian versus foreign) helps account for a large share of the immigrant/native-born wage gap and thus having both in the sample when considering the question of interest would bring in unnecessary bias. I classify immigrants into four broad categories based on the education they receive in foreign countries. The first category considers low educated workers who have less than 12 years of schooling and earn on average $ 7,970 annually. The second category considers middle educated immigrants with a high school diploma and average annual earnings of $ 11,640. The final two

categories include workers with a college diploma or a bachelor's degree and yearly earnings of $ 12,050. The last category consists of immigrants who have a university-level degree which could be a master's or Doctorate. They, in a year, earn on average $ 14,560. As the table 4.5 shows, the effect is very similar across the four categories in the first two years after entering the labour market. By the end of year 2, immigrants who have less than 12 years of education experience the highest fall in earnings of about 7.5% for a 3 point rise in unemployment, whereas immigrants who have a high school degree experienced a fall of about 5.2%. The substantial differences again emerge when it takes for the effects to decrease in magnitude and significance. For low educated immigrants, the time for the impact to dissipate is substantially longer, with the effect falling to 4.2% by the end of year six and 1.5% by the end of year 10. For immigrants who completed schooling, the impact is slightly better than for those who have not, with the effect not being significant post year 10. Immigrants with some university degree, which is category 3 and 4, do better with the effect as low as 2.4% by the end of year 6. For both these categories, the results are not significant after year 6.

Table 4.5: Effects of state unemployment rates at labour market entry on earnings by education

Variable, Experience Group	¡12	12	12-16	16+
Log Employment Earnings	(1)	(2)	(3)	(4)
Year, 1-2	-0.024***	-0.017***	-0.019***	-0.020***
	(-0.03,-0.021)	(-0.027,-0.15)	(-0.028,-0.014)	(-0.029,-0.016)
Year, 3-4	-0.018***	-0.013***	-0.011***	-0.017***
	(-0.024,-0.016)	(-0.019,-0.010)	(-0.015,-0.008)	(-0.022,-0.013)
Year, 5-6	-0.014***	-0.011***	-0.007***	-0.008***
	(-0.019,-0.009)	(-0.015,-0.007)	(-0.011,-0.006)	(-0.011,-0.005)
Year, 7-8	-0.0087***	-0.007***	-0.002*	-0.005
	(-0.014,-0.005)	(-0.011,-0.003)	(-0.005,-0.0001)	(-0.006,0.0008)
Year, 9-10	-0.006***	-0.005**	0.002	-0.0001
	(-0.011,-0.003)	(-0.009,-0.001)	(-0.004,0.0009)	(-0.003,0.0015)
Year, 10+	-0.005**	-0.003*	0.006	0.007
	(-0.007,-0.001)	(-0.004,0.001)	(-0.001,0.009)	(-0.0005,0.011)

Note: The results are obtained from the Longitudinal Immigrant Database (IMDB, 1987-2011). All robust standard errors are adjusted for clustering at province year level. 95% confidence intervals are in paranthesis. *** Significant at 1 percent level, ** Significant at 5 percent level, * Significant at 10 percent level.

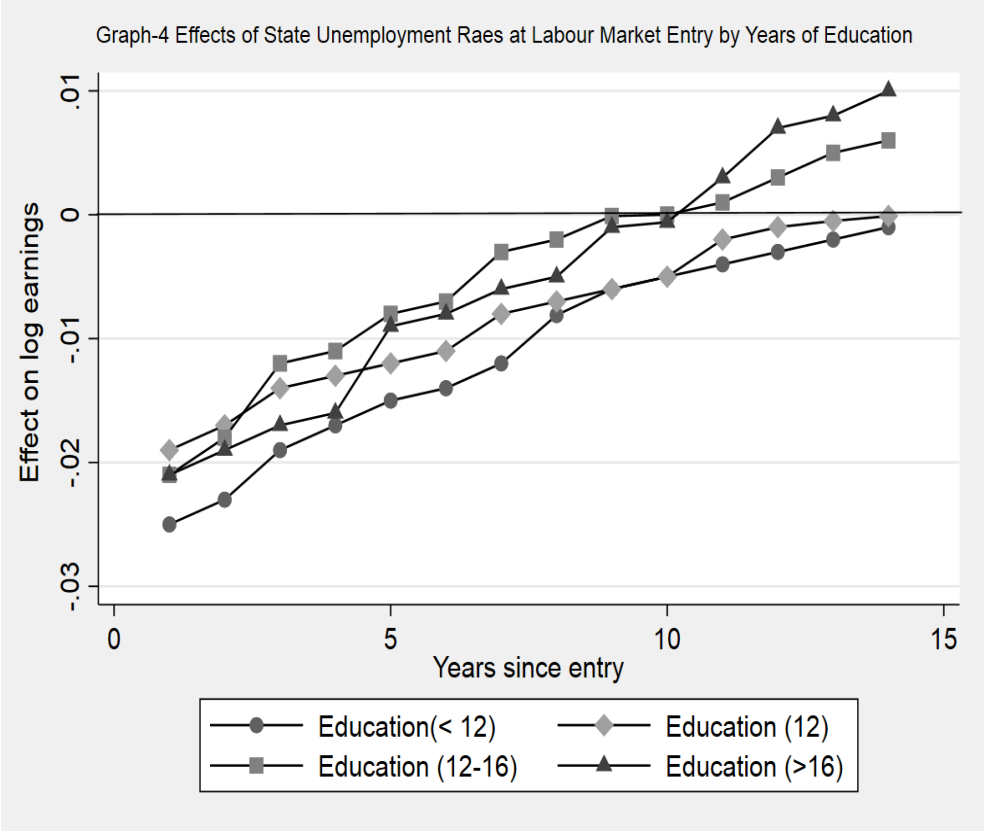


Figure 4.4: Effects of State Unemployment Rate at Labour Market Entry by Years of Education

Next, I consider heterogeneity concerning the age group of the immigrant at the time of landing. Unlike the studies on graduating in a recession, immigrants can enter the economy in various age groups. This heterogeneity is thus essential to consider, especially considering the life-cycle considerations and how the scarring effect might differ for immigrants based on their age. Bellemare (2007) highlights how life cycle considerations are essential for immigrants, especially when considering outmigration decisions. I classify all entering immigrants into three broad categories; group 1 has immigrants between 18-and 30. The second group is immigrants aged 30-45, and the third group is all above 45 when they enter Canada. The average annual earnings for the three categories go from $ 9,960 for age group 18-30, $ 11,060 for age group 30-45 and $ 11,640 for age group 45-60. The results are provided in table 4.6 and show that the older workers do a lot worse and for a more extended period when entering the labour market when unemployment is high. Young immigrant workers face a 4.8% reduction in earnings when the unemployment rate is three percentage points higher. For middle-aged workers, it is higher at 6.6%, which is close to the estimate for the entire sample, whereas, for older workers, it is 9.6% which is substantially higher than the estimate for the whole of the sample. The effect on annual earnings also dissipates differently for the different age

categories. For older workers, entering the labour market when unemployment is high is significant even after ten years, with a reduction in earnings of 4.5% compared to 8.4% after year 4, 7.5% after year six 6% after year 8. For younger workers, the effect initially reduces to 3.6% after year four and becomes insignificant in year seven. For middle-aged workers, the impact is significant till year ten at 2.1%.

Table 4.6: Effects of state unemployment rates at labour market entry on earnings by Age

Variable, Experience Group	Age, 18-30	Age, 30-45	Age, 45-60
Log Employment Earnings	(1)	(2)	(3)
Year, 1-2	-0.016***	-0.022***	-0.032***
	(-0.024,-0.013)	(-0.026,-0.015)	(-0.037,-0.024)
Year, 3-4	-0.012***	-0.015***	-0.028***
	(-0.019,-0.009)	(-0.017,-0.011)	(-0.031,-0.021)
Year, 5-6	-0.010***	-0.012***	-0.025***
	(-0.015,-0.06)	(-0.016,-0.05)	(-0.029,-0.019)
Year, 7-8	-0.008*	-0.010**	-0.020***
	(-0.011,-0.001)	(-0.012,-0.005)	(-0.024,-0.013)
Year, 9-10	-0.005	-0.007*	-0.017***
	(-0.007,0.003)	(-0.009,0.0001)	(-0.021,-0.011)
Year, 10+	-0.002	-0.04	-0.014***
	(-0.003,0.008)	(-0.006,0.003)	(-0.016,-0.007)

Note: The results are obtained from the Longitudinal Immigrant Database (IMDB, 1987-2011).All robust standard errors are adjusted for clustering at province year level. 95% confidence intervals are in paranthesis. *** Significant at 1 percent level, ** Significant at 5 percent level, * Significant at 10 percent level.

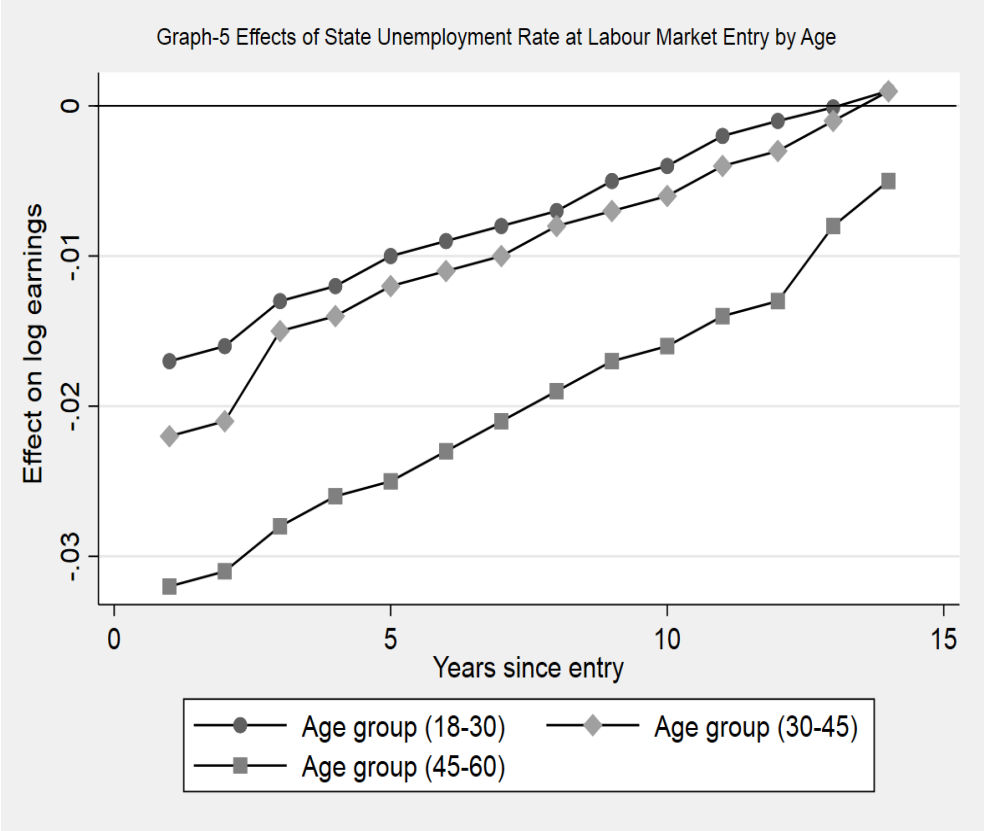


Figure 4.5: Effects of State Unemployment Rate at Labour Market Entry by Age

Finally, to consider heterogeneity concerning the country of origin of the immigrant. As a first pass, I broadly classify a group of 3 countries as developed, which includes the USA, UK and France and look at immigrants from these countries who, on average, earn $ 18,530 annually. To compare them, I consider immigrants from 3 developing economies, including India, China and the Philippines. Immigrants from these three countries earn on average $ 9,870 annually. The literature has shown previously that immigrants from different countries can potentially have very different earnings profiles in a foreign country. These differences have been attributed to other potential theories, including differential human capital formation, differential selection and skill loss, Lagakos et al. (2018). Therefore, it is worthwhile to explore if these workers experience a differential impact on earnings if they enter the economy when it is not doing well. As the results in Table 4.7 indicate, immigrants from more developed countries do much better in Canada than immigrants from developing economies in the long run. Initially, by the end of year 2 in the labour market, immigrants from developed economies face a similar reduction in earnings compared to immigrants from developing economies. A 3 point rise in unemployment rates leads to a 6.5% fall in earnings. However, the effect dissipates far more quickly for immigrants from developed economies

like the USA, UK and France. By the end of year 4, immigrants from developed economies see a 2% reduction in earnings compared to immigrants from developing economies that still face a 3.9% decrease in earnings. The effect continues to be significant with only a slight reduction in the overall magnitude and still at 2.7% after year 10. For immigrants from developed economies, the effect is insignificant after year 4.

Table 4.7: Effects of unemployment rates at labour market entry on earnings by Country of Origin

Variable, Experience Group	USA, UK, France	India, China, Phillipines
Log Employment Earnings	(1)	(2)
Year, 1-2	-0.021**	-0.022***
	(-0.027,-0.017)	(-0.03,-0.019)
Year, 3-4	-0.006*	-0.013***
	(-0.014,-0.003)	(-0.019,-0.009)
Year, 5-6	-0.0001	-0.010***
	(-0.011,0.0009)	(-0.016,-0.006)
Year, 7-8	0.009	-0.012***
	(-0.005,0.011)	(-0.015,-0.004)
Year, 9-10	0.018	-0.009***
	(-0.002,0.023)	(-0.013,-0.002)
Year, 10+	0.031	-0.007**
	(-0.0001,0.039)	(-0.009,0.0001)

Note: The results are obtained from the Longitudinal Immigrant Database (IMDB, 1987-2011). All robust standard errors are adjusted for clustering at province year level. 95% confidence intervals are in paranthesis. *** Significant at 1 percent level, ** Significant at 5 percent level, * Significant at 10 percent level.

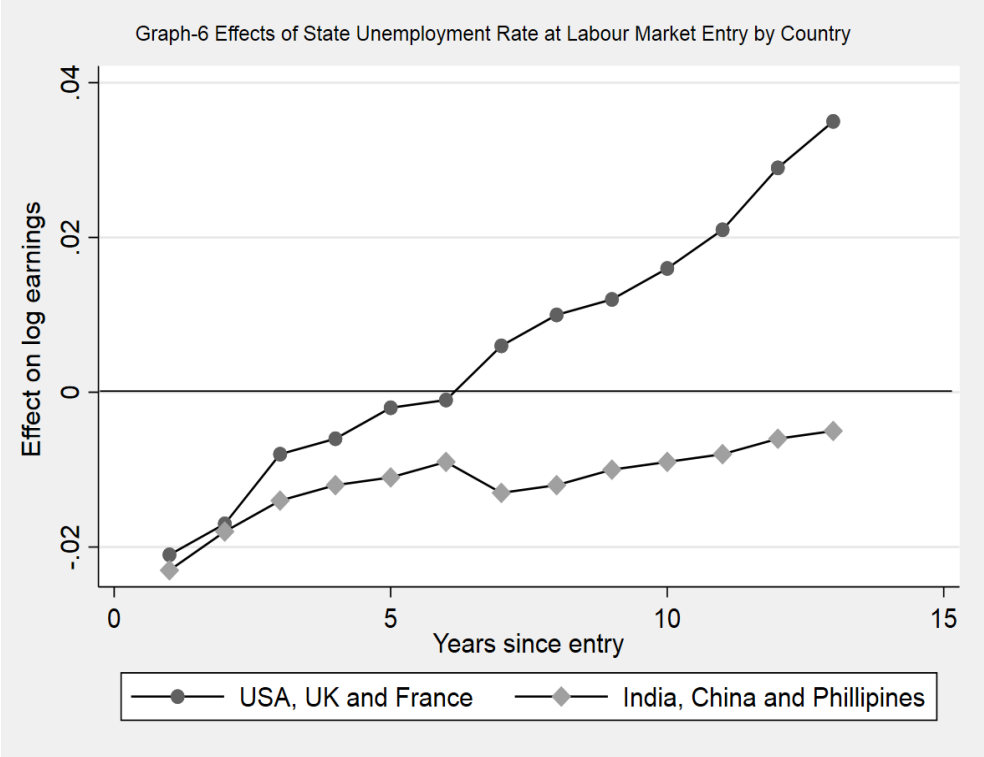


Figure 4.6: Effects of State Unemployment Rate at Labour Market Entry by Country

4.7 Conclusion & Future Work

This paper analyses how immigrants are affected by macroeconomic conditions at the point of arrival in the host country. This project uses a unique administrative dataset IMDB, which documents the tax earnings of all immigrants in Canada and matches them to their entry-level characteristics. Thus, using longitudinal data, this study would avoid the shortcomings usually associated with cross-sectional studies and hence provide more credible estimates. The data also allows the possibility of directly observing inter-provincial migration and outmigration decisions, which will enable it to specifically account for these margins of adjustment in understanding the question at hand. This chapter also documents the substantial heterogeneity in the effects across immigrant groups by gender, education, age and nationality. The analysis shows that there are indeed adverse effects of entering the labour market when unemployment is high on immigrant earnings both in the short and long run. However, the results seem to disappear over time, showing a scarring effect to entering the economy in a downturn. Comparing the estimates to work by Oreopoulos (2011), who look at Canadian native college graduates, the effects are more significant and persistent for immigrants. The results also suggest that many immigrants tend to out-migrate and do worse than those who decide to stay. The results also indicate significant heterogeneity in the effects, with the

vulnerable groups showing more persistent effects of entering the labour market when unemployment is high. Another key result is that the estimates for the specification with individual fixed effects show more persistence than those that do not control it.

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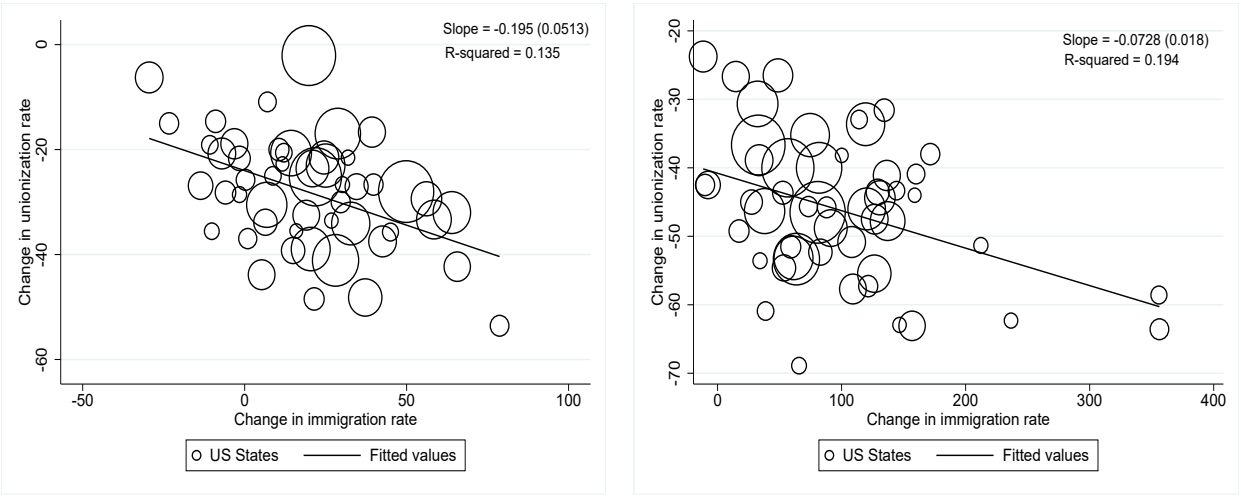
Appendix A

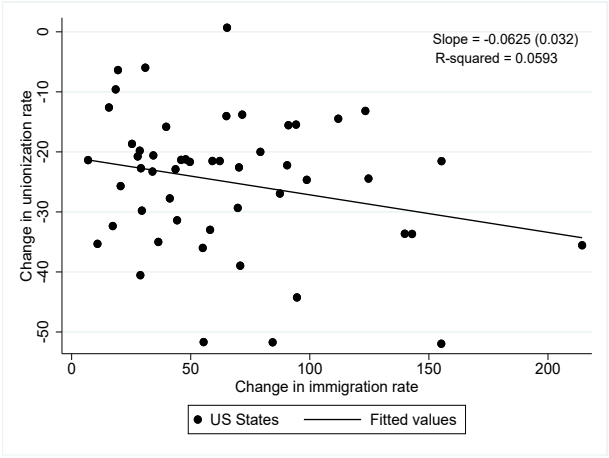
Appendix to Chapter 2

A.1 Figures



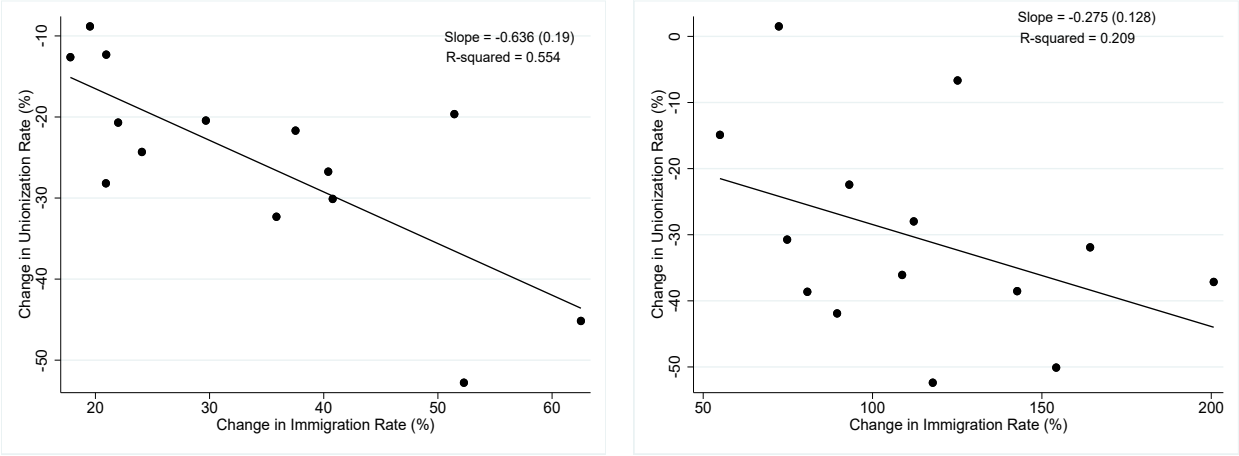
Note: In the left panel: Change in union rates and immigrant population shares across states between 1980 and 1990 with employment shares as weights. In the right panel: Change in union rates and immigrant population shares across states between 1980 and 2000 with employment shares as weights. Data on state level unionization rates comes from CPS and Hirsch and Macpherson (1993). The p-value of the slope coefficient using robust standard errors in reported in parantheses.

Figure A.1: Cross-State Evidence on De-unionization and Immigrant entry, 1980-90 and 1980-2000



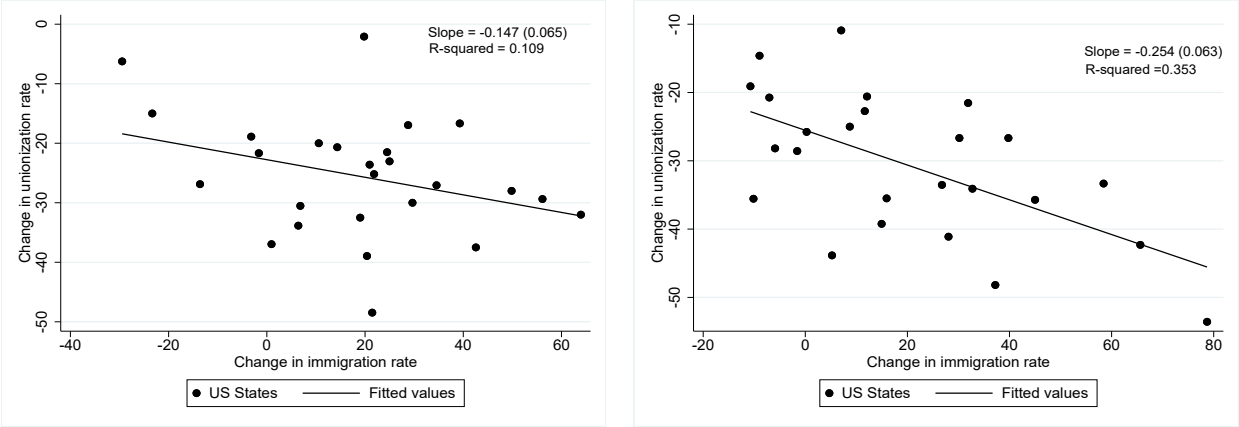
Note: Change in union rates and immigrant population shares across states between 1990 and 2000. Data on state level unionization rates comes from CPS and Hirsch and Macpherson (1993). The p-value of the slope coefficient using robust standard errors in reported in parantheses.

Figure A.2: Cross-State Evidence on De-unionization and Immigrant entry, 1990-2000



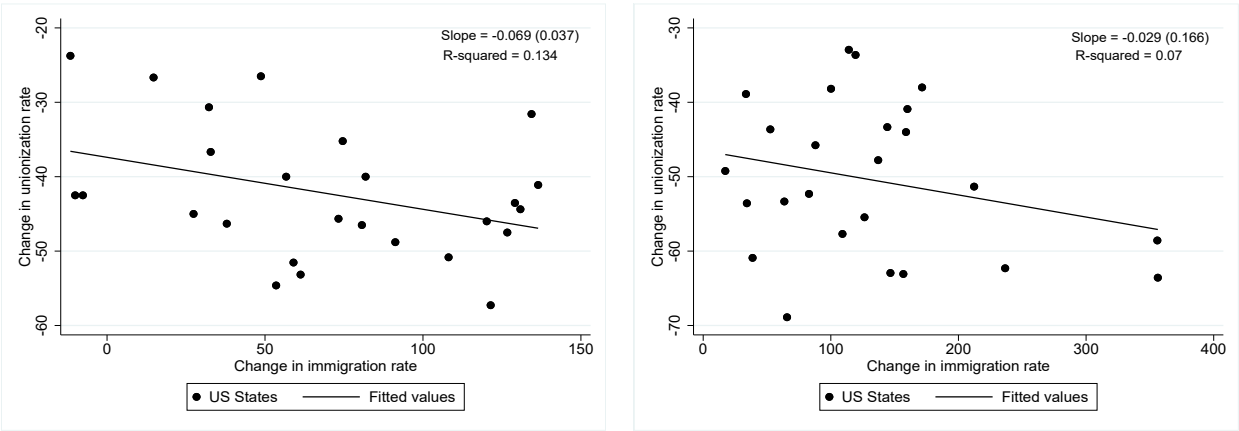
Note: In the left panel: Change in union rates and immigrant population shares across industries between 1980 and 1990. In the right panel: Change in union rates and immigrant population shares industries states between 1980 and 1998. Data on industry level unionization rates comes from CPS and Hirsch and Macpherson (1993). Correlations are unweighted. Slope coefficient and robust standard errors in reported in parantheses.

Figure A.3: Cross-Industry Evidence on De-unionization and Immigrant entry, 1980-1998



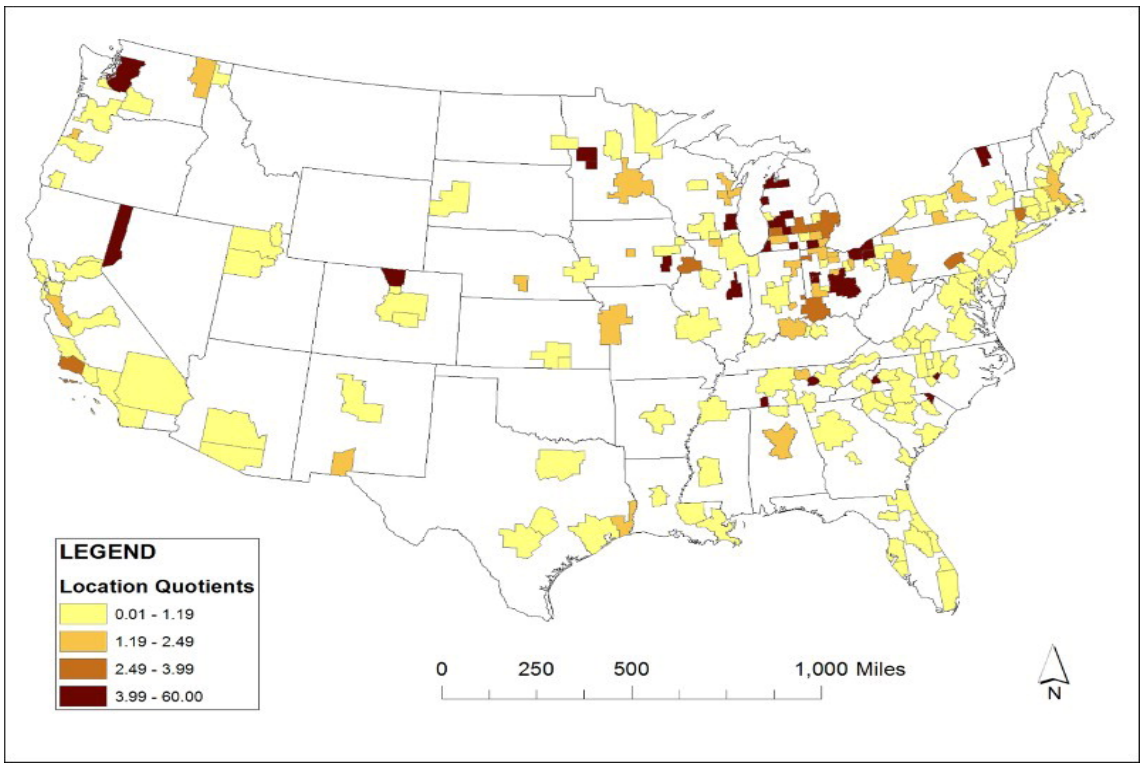
Note: In the left panel: Change in union rates and immigrant population shares across states between 1980 and 1990 in non right to work states. In the right panel: Change in union rates and immigrant population shares across states between 1980 and 1990 in right to work states. Data on state level unionization rates comes from CPS and Hirsch and Macpherson (1993). The p-value of the slope coefficient using robust standard errors in reported in parantheses.

Figure A.4: Cross-State Evidence on De-unionization and Immigrant entry



Note: In the left panel: Change in union rates and immigrant population shares across states between 1980 and 2000 in non right to work states. In the right panel: Change in union rates and immigrant population shares across states between 1980 and 2000 in right to work states. Data on state level unionization rates comes from CPS and Hirsch and Macpherson (1993). The p-value of the slope coefficient using robust standard errors in reported in parantheses.

Figure A.5: Cross-State Evidence on De-unionization and Immigrant entry



Note: Source: Leigh and Kraft (2018)

Figure A.6: Robotics-related location quotients for core-based statistical areas (CBSAs) in the United States.

A.2 Tables

Table A.1: Estimates of the impact of low-skilled immigrant entry on union rates, 1980-2000 (MSAs)

	Full Sample					IV-1970	JRS-IV
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
(Immigrant/Native) Ratio	-0.191***	-0.190***	-0.183***	-0.187**	-0.201**	-0.211**	-0.212**
	(0.080)	(0.087)	(0.075)	(0.09)	(0.10)	(0.10)	(0.10)
Log Population	x	x	x	x	x	x	x
Average Income	-	x	x	x	x	x	x
Average Education	-	-	x	x	x	x	x
Right-to-Work	-	-	-	-0.011	-0.014	-0.07	-0.08
				(0.04)	(0.15)	(0.04)	(0.16)
Right-to-Work X (I/N) Ratio	-	-	-	-0.121	-0.122	-0.09	0.11
				(0.18)	(0.10)	(0.12)	(0.33)
% Services	-	-	-	-	-0.107	-0.11	-0.15
					(0.23)	(0.23)	(0.21)
R^2	0.14	0.16	016	0.21	0.21	0.28	0.27

Note: The results are obtained from the decennial Census, 1970, 1980 and 1990. Robust standard errors are in parentheses, adjusted for clustering at MSA level. $^{*}p < 0.10$; $^{**}p < 0.05$; $^{***}p < 0.01$.

Table A.2: Right-to-work Adoption by States

States	Year of Adoption
Alabama	1953
Arizona	1946
Arkansas	1947
Florida	1968
Georgia	1947
Idaho	1985
Indiana	2012
Iowa	1947
Kansas	1958
Kentucky	2017
Louisana	1976
Michigan	2012
Mississippi	1954
Nebraska	1946
Nevada	1951
North Carolina	1947
North Dakota	1947
Oklahoma	2001
South Carolina	1954
South Dakota	1946
Tennessee	1947
Texas	1947
Utah	1955
Virginia	1947
West Virginia	2016
Wisconsin	2015
Wyoming	1963

Note: Data compiled from the "Right to Work States Timeline". *National Right To Work Committee* Report, July, 2018 and Neuman, Scott (2018) "Missouri Blocks Right-to-Work Law".

Table A.3: Estimates of the impact of low-skilled entry on union/coverage rates-CPS (1980-2000), industry level

	Union Rates	Coverage Rates	IV-1970	IV-1960
	(1)	(2)	(3)	(4)
(Immigrant/Native)	-0.274**	-0.287**	-0.296**	-0.311***
	(0.131)	(0.134)	(0.137)	(0.122)
Average Income	x	x	x	x
Employment Shares	x	x	x	x
R^2	0.272	0.274		

Note: The results are obtained from the decennial Census, 1960, 1970, 1980, 1990, 2000 and CPS (March files). Robust standard errors are in paranthesis, adjusted for clustering at state level. $^{*}p < 0.10$; $^{**}p < 0.05$; $^{***}p < 0.01$..

Table A.4: Estimates of the impact of low-skilled immigrant entry on union rates, 1980-2000, (States)

			Full Sample			IV-1970	JRS-IV
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
(Immigrant/Native) Ratio	-0.220***	-0.205***	-0.201***	-0.228***	-0.227**	-0.229**	-0.231***
	(0.065)	(0.068)	(0.068)	(0.10)	(0.11)	(0.11)	(0.10)
Log Population	x	x	x	x	x	x	x
Average Income	-	x	x	x	x	x	x
Average Education	-	-	x	x	x	x	x
Right-to-Work	-	-	-	-0.18	-0.17	-0.07	-0.03
				(0.10)	(0.16)	(0.05)	(0.14)
Right-to-Work X (I/N) Ratio	-	-	-	-0.132	0.173	-0.06	0.09
				(0.19)	(0.16)	(0.11)	(0.33)
% Services	-	-	-	-	-0.109	0.16	0.03
					(0.18)	(0.14)	(0.22)
R^2	0.18	0.26	0.27	0.31	0.32		

Note: The results are obtained from the decennial Census, 1970, 1980, 1990 and 2000. Robust standard errors are in parentheses, adjusted for clustering at state level. $^{*}p < 0.10$; $^{**}p < 0.05$; $^{***}p < 0.01$.

A.3 Model Extension and Calibrations

In the previously discussed model, I allow firms to post nativity and skill specific vacancies in the low skilled labour market. This has a simple and useful explanation in the sense that it allows us to fully internalize the competition coming from immigrant workers on native low skilled workers. In this model extension, we now do not allow firms to post nativity specific vacancies. Thus, here we are likely to see job competition as well as job creation effect of immigrant entry. From the previous model, we change the following key equations:

- The tightness in the low skilled labour market is now independent of nativity. Therefore, $\theta_L = \frac{V_L}{U_L}$, which gives flow rate of match as $m(\theta_i)$ and for vacancy as $q(\theta_i)$.

- Equation 2.15 is now written as :

$$rV_{ij} = -c_i + q(\theta_{ij})[\int (\phi_i M^f_{iN}(\zeta) + (1-\phi)M^f_{iI}(\zeta))d\mu - V_{ij}] \tag{A.1}$$

  where ϕ_i is the fraction of unemployed workers of type i that are native.

- Equation 2.21 would now be:

$$L = \frac{m(\theta_L)(\lambda + I)}{s_L + m(\theta_L)} \tag{A.2}$$

  And Equation 2.23 would now be:

$$U_{LN} = U_{LI} = \frac{s_L}{s_L + m(\theta_L)} \tag{A.3}$$

The wage and price conditions obtained remain the same as shows in Eq.2.26 and 2.27 and 2.28. The main difference would be in Eq.2.27, where the value of C_L would be now given as:

$$C_L = \phi_L b_{LN} + (1-\phi_L)b_{LI} + \frac{c_L(r + s_L + \beta m(\theta_L))}{(1-\beta)q(\theta_L)} \tag{A.4}$$

where $\phi_H = 1$ and $\phi_L = \lambda/\lambda + I$.

The effect of immigration on natives, now again depends on two things: the price effect through Eq(2.27 and 2.28) and through expected employment cost, (C_L), where a change in I, now changes ϕ. I again analyse the most general and plausible setting concerned where, $\sigma < 1$ and $b_{LN} > b_{LI}$, that is high skilled and low skilled goods are imperfect substitutes and immigrants have lower search costs and thus lower market wages as compared to natives. Now to analyse the effect of a rise in immigrants on high skilled and low skilled natives. We see that through Eq(2.27) that an increase in I still increases L and therefore it increases p_H and a decrease in C_L leaves high

skilled workers unaffected, therefore high skilled workers now given an efficiency level now earn more wages. For the low skilled workers, from Eq(2.28), an increase in I, increases L and therefore, it decreases p_L. However, a increase in I decreases ϕ_L and as $b_{LN} > b_{LI}$, we get a decrease in C_L, therefore, immigrant entry decreases the cost of hiring low skilled workers, this leads to an increase in firms entering the market for hiring low skilled workers, bringing down the unemployment level of unskilled workers and leading to a rise in w_L. Therefore, immigrant entry can lead to an increase in non-union wages for low skilled workers through one channel and decrease it through another channel. Therefore, the effect on immigrants on high skilled workers leads them again to quit the unions, as they are still better paid in the non-union sector for a given efficiency level. However, the empirical question now is will the new non union wage of the low skilled workers be able to compensate for this exit by the high skilled workers. This crucially depends on which effect dominates for the low skilled native workers, it is the price effect which decreases the wages and we revert to the standard model discussed previously or does it lead to an increase in wages through the job creation effect of reduced employment costs. Therefore, to analyse this empirically, I calibrate the non-union sector for the US economy for the period 1980-90 and analyse the impact of immigrant entry of non-union wages of low and high skilled workers.

A.4 Calibration

Here, I describe the parametrization of the non-union sector by using data from the literature, data equivalent or direct estimation. The efficiency parameters in the production function and the matching function, namely A and M are normalized to one. The bargaining weight to individual worker in the non-union setting, β is set to 0.5 and so that the Hosios condition is met, unemployment elasticity in the matching function is assumed to be 0.5 as well.[82] The value of elasticity of substitution between skilled and unskilled labour has been a subject of intrigue and papers like Autor et al. (1998) have claimed it to be 1.6 for the US, whereas Ciccone and Peri (2005) have claimed it to be 1.5 for the US between 1950-1990. Therefore, I use $\sigma = 1/3$ so as to get the elasticity of substitution as 1.5. The annual interest rate between the period of consideration was 4%. The other parameter of interest is the share of unskilled workforce in the US, this is calculated from the decennial census so $\lambda = 0.467$.[83] And also using the census the number of immigrants in 1980 is normalised with respect to natives so, $I = 0.042$. Estimate of US depreciation rate is taken from the Bureau of Economic Analysis and is given as, $\delta = 6.4\%$.[84]

The remaining parameters are jointly calibrated by matching targets from the US economy. The capital to output ratio is calculated using St. Louis Fed data and is equal to 1.216.[85] Following

[82] Hosios (1990)

[83] A skilled worker is defined as someone who has at least a high school graduate as has been the consideration throughout the paper.

[84] The Measurement of Depreciation in the U.S. National Income and Product Accounts By Barbara M. Fraumeni

[85] The definition of capital stock that we used includes nonresidential equipment and software aswell as nonresidential structures. This variable was then divided by a measure of private output that is equal to GDP—gross housing

Borjas (1999), I define entry of "new immigrants" as those having arrived within five years of the Census. I then use the CPS outgoing rotation group to calculate the wage of non-union native workers who are low skilled and compare that to the wage of immigrant worker from the Census.[86] I calculate the native-immigrant wage gap for unskilled workers to be around (-21%). I also need market tightness ratios or the vacancy to unemployment ratio in each market. Here I use the vacancy posting data from Conference Board's Help-Wanted Index (HWI) and unemployment rates from the March CPS for the period of interest.[87] Estimates of the flow payment of unemployment range between 0.4, the upper end of the range of income replacement rates in Shimer (2005), and 0.955 in Hagedorn and Manovskii (2008). I choose a value of 0.7 of average wage for natives and 0.6 of average wage for immigrants as the option value but the results are not sensitive to using 0.4 as the value as suggested by Shimer (2005). Table A.5 is used to summarize the parameters under consideration.

Table A.5: Baseline Parameterization

Parameters	Definition and Source
$A = 1,\ M = 1$	Normalization
$\epsilon = 0.5$	Literature
$\beta = 0.5$	Hosios Condition
$\sigma = \frac{1}{3}$	Literature
Measured from data	
$r = 0.0034$	Annual rate 4%
$\delta = 0.064$	BEA Website
$\lambda = 0.467$	Share of unskilled labour
$I = 0.046$	Normalized number of immigrants
$s_L = 1.5\, s_H$	Separation Rates
Jointly calibrated	
$\alpha = 1.216$	Capital-output ratio 4%
$c_H = 0.556$	Liu (2010), Ortega (2000)
$c_L = 0.421$	Chassamboulli and Palivos (2014)
$\gamma = 0.6$	Normalized number of immigrants
$b_{iN} = 0.7 w_{iN},\ b_{LI} = 0.6 w_{LI}$	Outside Option Value

Note: All variables are monthly

A.5 Calibration Results

Using Census data, the total immigration inflow who were low skilled increased to 5.2% of the total US population, which allows me to calculate an increase in I to be equal to 0.28. The results of

value added—compensation of government employees following Ottaviano and Peri (2012)

[86] Unfortunately, CPS does not allow the identification of immigrants before 1994 and the Census does not identify union status.

[87] The convention in the literature is to use JOLTS data for finding vacancy postings but unfortunately this data is not available for before December 2000. Therefore, I use the HWI data and Abraham and Wachter (1987).

the simulations can be summarized in Table A.6 below.

Table A.6: Effects of immigrant entry, 1990-1980

Category	$\phi_L = 0$	$\phi_L = \frac{\lambda}{\lambda+I}$
Low-skilled Natives		
w_{LN}	-0.18	-0.11
u_{LN}	-4.88	-1.81
High-skilled Natives		
w_{LN}	2.91	2.62
u_{LN}	0.47	0.11
Immigrants		
w_{LI}	-0.33	-0.06
u_{LI}	-0.07	-0.02

Note: The variable w indicates the wage rate, u the unemployment rate, θ the tightness in the labor market. The subscript L stands for unskilled, H for skilled, N for native and I for immigrant. All results are percentage changes.

The increase in the number of unskilled immigrants raises job entry for the high skilled workers. And also improves their wage rates. This is true for both the cases where low skilled markets are different for natives and immigrants or when they are the same. As the immigrants' share of unskilled labor force increases, firms with low-skill vacancies anticipate that they will have to pay lower wages on average. This encourages low-skill job entry. The resulting increase in the unskilled labor input (L) causes the price of skilled labor input to rise (p_H), thereby also encouraging the creation of skilled jobs. This effect is further expanded because as explained previously, due to their higher search costs low-skilled immigrants receive lower wages than low-skilled natives which the fimrs know and is exaggerated when the markets are separate for the two.

Now, to analyse the effect on low skilled natives. We know an increase in the number of immigrants, influences the equilibrium wage through two channels: (1) through its impact on the marginal product of labor and thus the price of the labor input; for example, an increase in the number of unskilled immigrants lowers the marginal product of unskilled labor, thereby lowering the unskilled worker's wage; (2) through its impact on the worker's value of outside option. An increase in I spurs job entry and raises the matching rate and the value of search, thereby strengthening the workers' position in wage setting, and in turn, causing their wage to rise as estimated from the cost function, C_L. From the calibration it is clear that in the case of low-skilled native workers, the first effect, which is negative, dominates on the second, which is positive, causing a small decrease in the unskilled wage w_{LN}. The effect is stronger when the markets are separate. Similarly for

immigrants I observe a small fall in wage and employment once more immigrants come in and the markets are the same for both low skilled natives and immigrants. The impact is slightly larger when markets are separate as the single market absorbs most of the impact of the immigrant influx.