



5

Immigration and Job Creation

Andri Chassamboulli

5.1 Introduction

Large inflows of immigrants to the United States and other Western countries have put immigration at the centre of the recent political debate. Proposals for increasing immigration restrictions are becoming more common in recent years, while opposition to immigration has been rising in many countries. This backlash to immigration may to a large extent be cultural, resting on issues that have little to do with economics, but anti-immigration politics are often based on the argument that immigration has a negative effect on natives' employment and wages. This argument, however, is often not consistent with findings in the literature. There is no consensus that immigrants indeed take jobs from natives. Some studies find, by contrast, that immigrants help create new jobs for natives. In order to understand the potential of these anti-immigration policies to benefit the native workers, we need to address first the basic

A. Chassamboulli (✉)
University of Cyprus, Nicosia, Cyprus
e-mail: andrichassamboulli@ucy.ac.cy

question of whether or not immigrants indeed take jobs from native workers or help, instead, create new jobs, some of which are taken by natives. In light of rising anti-immigration politics, addressing this question has become even more important.

A large empirical literature on the effects of immigration on labour market outcomes has not reached a clear conclusion (see for an overview e.g. Lewis and Peri 2015; Peri 2016). The debate has centred mainly on the elasticity of substitution between immigrants and native workers. Findings consistent with the view that immigrants hurt natives' wages and employment are based on the idea that immigrants and natives 'compete' for the same jobs, because they have similar skills. Others find a negligible or even a positive effect on natives' labour market outcomes and argue that immigrants' labour services complement those of native workers. That is, immigrants increase demand for native workers in complementing sectors. But the link between immigration and job creation is not that simple. This idea, which is based on the canonical model of labour demand and supply, omits several important features of reality, crucial to our understanding of how immigration affects the labour markets.

Recent literature examining the effect of immigration on the labour market departs from the neoclassical approach and uses models that allow for search frictions in the labour market (e.g. Pissarides 2000). In these models, job creation responds to the incentives provided by the market. Firms will open more vacancies and create new jobs when labour costs are low, while potential gains from new jobs are large. Within such a framework, we can account explicitly for the effect of immigration on job creation incentives. New findings show that various types of immigrants can have, for different reasons, a positive impact on employers' incentives to post vacancies and a positive job creation effect on even competing natives, that is on natives who search for jobs similar to those that immigrants take. We discuss in this chapter recent studies of the labour market effect of immigration based on the search and matching model and explain how the search-equilibrium approach can improve our understanding of how immigration policies affect the labour market.

The neoclassical approach does not account for the effects of immigration on job creation incentives and the employment opportunities of native workers. In the canonical model, there is always full employment

and workers are paid their marginal product, meaning that the same wage is paid to all workers with similar skills. In reality, however, wages are not set competitively. Employers cannot immediately fill their job vacancies and have to incur recruitment costs. Similarly, it takes time for workers to find jobs and unemployment exists. Given that search frictions exist, matches of employers with workers generate rents to be shared between them, and thus wages are bargained. Wages reflect not only the worker's marginal product, but also his outside option. Incentives for sectors to grow and firms to expand by opening new vacancies and create new jobs depend also on workers' outside option, wages, recruitment costs, and other labour costs, which influence the rents that matches (jobs) generate. Such effects, which are not present in the neoclassical model, may generate a positive relation between immigration and job opportunities for native workers, in not only complementing sectors, but also in sectors that employ mainly immigrant workers.

A common perception about immigrants, also used in policy debates, is that they take jobs that natives with similar skills and qualifications would otherwise take. That is, immigrants crowd out competing natives. But this is not necessarily the case if large benefits from hiring immigrant labour induce employers to open more vacancies per unemployed worker, so that some of these new jobs go to natives. Immigrants come to a foreign country mainly to find a job and they will choose to stay as long as they can find a job. Coming from disadvantaged countries, they benefit in terms of better labour market prospects, only because employers in the host country are willing to offer them jobs. Employers, on the other hand, are willing to employ immigrant workers only if they can benefit from it. The long-lasting existence of immigration documents that immigrants can indeed find jobs, which means that employers also benefit from their presence in the labour market. This advantage that employers gain from hiring immigrants may in turn translate into higher job creation that benefits also competing natives. There is clearly a link between the presence of immigrants in the labour market and the possibility of a positive job creation effect. Despite the common perception that immigration takes jobs away from natives, deeper thinking into the forces supporting the long-lasting existence of the immigration phenomenon may reveal that there is more to it than just simple competition for jobs.

While most of the empirical research on immigration focuses on its impact on natives' wages, there are a few studies showing evidence of a positive impact of immigration on job creation and employment of native workers. Zavodny (2011) finds that high-educated immigrants, especially those working in science, technology, engineering and mathematics (STEM) fields, and immigrants on temporary work permits, skilled or unskilled, boost employment for US natives. Further, she finds no evidence that other types of immigrants, either undocumented or on family unification visas, hurt the employment of US natives. Recently, Orrenius et al. (2020), using data from the National Establishment Time-Series (NETS) database, show that immigrants contribute to job creation, business survival and growth.

Another important dimension often overlooked in the literature is the heterogeneity that may exist among immigrants themselves. The neoclassical approach focuses mainly on the skill characteristics of immigrants; whether they complement or substitute for native labour, and views immigration as an exogenous shift in labour supply that changes the skill composition of the labour force. But there are also important differences among immigrants themselves, which cannot be captured by a simple shift in the relative supply of certain skills. Immigrants can be documented or undocumented, they can be former students who obtained education in the host country, or new entrants that lack the language skills and face limited skill transferability, they can be entering through different pathways either accompanying family or simply to work, documented or not, either with a job or without a job facing different labour market prospects, different conditions for staying in the country, different visa durations and different return probabilities. Besides immigrants' skills, other characteristics relating to immigrants' entry paths and conditions for stay are also important for our understanding of how immigration and policies used to control it affect natives' labour market outcomes. We need to understand what types of immigrants can generate more jobs for native workers and which characteristics or conditions, beside skills, are responsible for this.

The literature examining the consequences of immigration sometimes distinguishes between undocumented and documented immigration. For instance, Palivos (2009) and Liu (2010) focus on the welfare effects

of illegal immigration while Chassamboulli and Peri (2015) examine the consequences of policies restricting illegal immigration. More recently, interest in studying the consequences of high-skilled immigration to the US has grown as the number of high-skilled immigrants in the US has been increasing. Bound et al. (2017) and Jaimovich and Siu (2017) emphasize the strong impact of highly skilled foreigners entering the US labour force through the H-1B programme on innovation and economic growth in the long run. However, there is room for further research on the potentially differential effects of different types of entry paths and immigrant characteristics on natives' labour markets. One such attempt, by Chassamboulli and Peri (2019), discussed further below, differentiates among the most relevant channels of immigration to the US: employment-based, family-based and undocumented.

Finally, research on the effects of immigration should not overlook the role of immigration policies and the design of the immigration system. Most studies on the effects of immigration consider changes in the number of immigrants as if immigrants are an exogenous policy variable. But the government cannot control directly the number of immigrants entering or staying in the country. It can only set the rules for admitting foreigners into the country, the possible channels of entry (e.g. employment-based or family-based), the conditions to remain in the country (e.g. stay conditional on having a job or the right to remain indefinitely in the country) and decides the degree of enforcement of these rules. When considering the potential effects of reducing immigration on native workers, we need to take into account, first, whether actual immigration policies can effectively reduce the number of immigrants and, second, whether the policies themselves, irrespective of how they affect the number of immigrants, will have any disrupting effects on the labour market. Moreover, the rules and conditions the government sets, together with immigrants' incentives, generate the observed number of immigrants, but more importantly, they shape their composition in terms of skills/productivity, bargaining power, duration of stay and other features, which are important for how immigrants affect the host economy. For instance, an immigration programme can be 'merit-based', admitting immigrants based on productivity or skill selective, directing immigrant inflows towards the sectors and the jobs that are mostly needed. Likewise,

immigrants' access to welfare benefits, employment conditions or conditions for stay in the country, can influence their bargaining position in wage setting, and thus the employers' surplus from hiring them, with important consequences on incentives to open new vacancies and create new jobs. Research examining the impact of immigration or the design of immigration policies should not overlook such dimensions.

The rest of the chapter is divided into two main sections. In Sect. 5.2 we discuss the recent literature that analyses the labour market effects of immigration using the search and matching model of the labour market. We explain how analysing immigration within this framework offers new insights into the effects of immigration and of immigration policies on the labour market. Next, in Sect. 5.3 we develop a model of immigration between two countries, representing the US and the rest of the world, and we use it to analyse the effects of a specific policy combination that aims to reduce illegal immigrants in the US, while increasing opportunities for unskilled foreigners to enter the US on temporary work permits. The model that we develop is based on existing literature that applies the search and matching framework to the immigration context.

5.2 Immigration in a Simple Search and Matching Model

5.2.1 The Job Creation Effect of Immigration

A recent strand of literature uses models of the labour market that account for search frictions to understand the effects of immigration on natives' labour market outcomes (e.g. Liu 2010; Chassamboulli and Palivos 2013, 2014; Chassamboulli and Peri 2015, 2019; Moreno-Galbis and Tritah 2016; Battisti et al. 2018; Liu et al. 2017). In these models, unemployment exists due to search frictions, and wages are the outcome of bargaining and reflect not only the workers' productivity (marginal product) but also their outside option. Job creation responds to the incentives provided by the market and the unemployment rate changes accordingly. We explain here how analysing immigration within this framework offers

new insights into the effects of immigration and of immigration policies on the labour market.

Within the standard search and matching model, the job creation condition—the condition that describes how job creation responds to the incentives provided by the market—equates the expected cost of posting a job vacancy (the expected recruitment cost) to the expected profit of a new job (an employer-employee match). The expected recruitment cost increases as the number of vacancies per unemployed worker increases, because then it will take longer for employers to find workers to fill their vacancies. That is, a higher ratio of vacancies to unemployed means a lower job filling rate for firms and therefore higher recruitment costs on average. The expected profit of a new job, on the other hand, depends on: (i) the worker's marginal product (productivity),¹ (ii) the worker's outside option (the value of searching for a job), and (iii) the expected duration of the job (match). Apparently, larger productivity and expected job duration imply larger profits to the employer, while the worker's outside option affects the employer's profits negatively. A better outside option allows the worker to bargain for a higher wage, which in turn lowers the employer's share of the match surplus. When expected profits increase relative to the expected recruitment costs, firms open more vacancies per unemployed worker and job creation increases. More vacancies per unemployed worker then mean higher job finding rates and lower unemployment rates for workers participating in that market. It also implies higher wages, since with higher job creation workers' outside option improves, which means they can bargain for higher wages.

The presence of immigrants in the labour market can alter incentives to create jobs through all these channels: recruitment costs, productivity, wages, job duration. Consider a labour market that consists of n sub-markets. Sub-market i of this labour market recruits workers of skill type i and produces a labour input y_i , which is then used together with other labour inputs to produce the final good. The production structure is such that the different labour inputs produced in each of these sub-markets are complements. Suppose that in this sub-market i there are natives and different types of immigrants (e.g. documented, undocumented, temporary, permanent), all of skill type i searching for jobs. Let t denote the type of worker. Assume that firms cannot direct their search towards the one or

the other type of worker (due to legal restrictions or incomplete information). If this is the case, then firms may match with either type of worker at rate $\frac{u_{it}}{u_i}$ where u_{it} is the number of unemployed workers of type t searching for jobs in market i and u_i is the total number of unemployed workers searching for a job in that market. With the presence of immigrants, the job creation condition takes the following form:

$$\frac{c_i}{q(\theta_i)} = \sum_t \frac{u_{it}}{u_i} J_{it} \quad (5.1)$$

where c_i is the flow recruitment cost (i.e. the flow cost of keeping a vacancy open), θ_i is the tightness in market i (i.e. the ratio of vacancies to unemployed), $q(\theta_i)$ is the job filling rate and J_{it} is the value of a match with a type t worker to the firm. The left-hand side represents the average recruitment cost and the right-hand-side the expected profit from a new job. If expected profits increase relative to recruitment costs, then θ_i increases, meaning that workers searching in this market can more easily find jobs, and their unemployment rate decreases.

Notice that the expression for expected profits is the weighted average of the value of each possible match J_{it} . In its simplest form, the value of a match with a type t worker is given by:

$$J_{it} = \frac{p_{it} - w_{it}}{r + s_{it}} \quad (5.2)$$

where p_{it} is the worker's productivity, w_{it} the worker's wage, r is the interest rate and s_{it} the separation rate (i.e. the probability that the match will break up). The presence of immigrants in the market can alter the expected profits of new jobs through two main channels. First, immigration-induced changes in the skill composition of the labour force will alter workers' productivities p_{it} . An increase in the relative supply of skills i will lower p_{it} and vice versa, when the relative supply of skills i decreases. Second, through changes in the weights $\frac{u_{it}}{u_i}$ put on each type

of match in the right-hand-side of Eq. (5.1). An increase in the share of a certain type of immigrant in the pool of unemployed workers of skill type i will shift weights in Eq. (5.1) away from all other values and towards the value of a match with that type of immigrant. Employers' expected profits will increase if the surplus they generate from employing that immigrant is larger than from employing any other type of worker and vice versa.

If all types of workers (immigrants or natives) participating in this market generate the same surplus (i.e. $J_{it} = J_i \forall t$), meaning that wages, separation probabilities and productivity are all the same across all worker types (that is, $w_{it} = w_i$, $p_{it} = p_i$, and $s_{it} = s_i$) then the presence of immigrants affects job creation incentives only through its impact on p_i . An immigration-induced increase in the relative supply of skills i will lower the marginal product of skill type i , p_i , and vice-versa if the relative supply of skills i decreases. The latter occurs when the new immigrants have different skills than the natives participating in this market, which means that they are searching in a different market, or when immigrants just choose to direct their search in a different market that produces a different labour input. This is the standard channel present in the canonical model. The only difference here is that we know explicitly that a decrease in productivity will increase the unemployment rate of workers participating in the market, because it will lower employers' profits and induce them to open fewer vacancies per unemployed worker. If, however, the increase in immigration is skilled balanced, that is, it leaves the relative supply of skills intact, then it will have no effect on marginal product, nor on employer's profits, and job creation will remain the same. Notice that immigration-induced changes in the relative supply of skills involve distributional effects. They might hurt one type of labour whose supply becomes relatively more abundant, but benefit that whose supply becomes more scarce, as long as complementarities between different skill types exist. For instance, an immigration-induced increase in the relative supply of skill i will lower p_i but may increase productivity in sub-market j , p_j , given that skills j and skills i complement each other in the production process.

It is very unlikely, however, that immigrants are identical to natives in all other aspects, even if they have the same skills. In fact, employers may

benefit from the presence of immigrant workers in the labour force in several different ways depending on immigrant type (employment-based, family-based, undocumented etc.). So even when an immigration influx is skill-balanced, meaning that it does not affect workers' marginal product, it can still have a positive effect on job creation incentives. If the advantage that employers gain from the presence of immigrants in the labour market is large, a positive job creation effect is possible, even when the immigration influx lowers workers' marginal product. In terms of Eqs. (5.1) and (5.2), an inflow of immigrants in market i will decrease p_{iN} , but also shift weights in the right-hand side of (5.1) from J_{iN} to J_{iI} , where subscripts N and I denote 'immigrant' and 'native', respectively. If $J_{iI} > J_{iN}$ then the right-hand side of Eq. (5.1) may increase, despite the decrease in p_{iN} , leading to higher job creation in market i that benefits also the natives participating in that market.

One way of employers benefiting is by using immigrant labour to cut on labour costs. Immigrants, and especially undocumented immigrants, may be willing to accept lower wages than their similar natives because they have a worse outside option. There are many reasons why immigrants' outside option is smaller than that of natives with similar skills. Being in a foreign country, immigrants may have more difficulty finding a job due to lack of social networks, for instance. But, in addition, immigrants' unemployment income may be lower, since they do not qualify for the same unemployment insurance benefits as natives. Undocumented immigrants are often not eligible for any unemployment insurance benefits, but even legal immigrants may qualify for significantly fewer benefits than natives.² These differences in outside option may be a key factor explaining the observed wage gaps between seemingly identical native and legal or illegal immigrant workers. Borjas and Friedberg (2009) estimate a 20% wage gap between legal immigrants and natives in the US for the year 2000, after controlling for observed abilities such as education and age.³

This feature generates also the possibility that immigration improves the employment and wages of competing natives. An immigration influx of immigrants of skill type i in market i will lower the average wage that firms expect to pay, will increase the expected profits from a new job (right-hand-side of Eq. (5.1)) and will induce more job entry and

consequently lower unemployment and a better bargaining position for native workers. This advantage that employers gain from having access to the cheaper labour provided by immigrants may be especially important in labour-intensive industries in which jobs are mainly manual and productivity depends less on the type of skills that immigrants may have a disadvantage on, such as language proficiency.

The labour cost effect of immigration has been emphasized in Chassamboulli and Palivos (2014). They develop a search and matching model of a labour market with differential search costs between natives and immigrants, reflecting the lower outside option of the latter due to the difficulties mentioned above. In their set up, an immigration influx has the standard effects on the productivity of skilled and unskilled native workers, also present in the canonical model, owned to complementarity and substitutability effects, but lowers in addition the average wage that firms expect to pay, leading to more job entry and consequently a better bargaining position for native workers. They calibrate the model to the US economy and find that the impact of the skill-biased increase in immigration that took place between 2000 and 2009 is positive on the overall net income to natives. They find that it lowered the unemployment and raised the wage rate of unskilled native workers, because, as expected, it increased the marginal product of unskilled labour, but also because it lowered employers' labour costs due to the lower wages paid to immigrants, inducing unskilled job entry. However, what is less expected is that they also find that it encouraged skilled job entry. Despite being skill-biased, meaning that it lowered the marginal product of skilled labour, the 2000–2009 immigration influx, had a positive impact on the employment of not only unskilled but also skilled natives. The increase in skilled job entry is again due to firms anticipating that, with a higher number of skilled immigrants searching for jobs, they will have to pay lower wages on average, which dominated over the negative productivity effect.

But the advantage that employers gain from the presence of immigrants in the labour market is sometimes more than just access to cheaper labour. Immigrants are sometimes more productive than natives especially in cases where their admission into a country is based on skills and merit. In such cases, with more immigrants in the labour force employers

may anticipate higher productivity on average. This can drive the growth of jobs and increase the employment of also natives. The H-1B programme in the US, for instance, admits only skilled foreigners with exceptional abilities and skills. Admissions through this programme are employment-based meaning that all individuals applying for an H-1B visa must already have a job and an employer who is willing to sponsor their immigration to the US. It is meant to fill skill-specific gaps and unlike other immigration programmes and entry channels, foreigners entering on an H-1B visa are screened for their qualifications and are selected based on productivity. There is evidence of a positive impact of high-skilled employment-based admissions on US productivity. Kerr and Lincoln (2010) find that increasing H-1B admissions in the US increases the amount of US patenting, especially for firms and cities that depend highly on the programme. Similar results are also found in Hunt and Gauthier-Loiselle (2010) for immigrants who are college graduates. Peri et al. (2015) attribute their finding of a positive effect of foreign-born STEM workers on wages of native college-educated workers across US metropolitan areas to a higher total factor productivity growth driven by these workers. Hunt (2011) shows that immigrants who first entered into the US on a student trainee or a work visa outperform natives in wages, patenting, publishing and other innovative activities, while those who arrived as permanent residents (mainly through the family unification programme) perform similar to natives. The high productivity of H-1B workers is also supported by evidence in Lofstrom and Hayes (2011) that this group of workers earns more than natives. Chassamboulli and Peri (2019) also find that immigrants on employment visas earn significantly more than skilled immigrants on family visas or skilled natives.

Another advantage that employers may gain from immigration is access to a larger supply of workers, readily available to work, which helps keep recruitment costs down, especially in sectors where the supply of native labour is relatively low. Enabling employers to hire foreign workers when they have difficulty finding native workers, helps them avoid long and costly search periods, keep hiring costs low and preserve their jobs or even expand. The main goal of the US temporary employment-based immigration system is exactly that. The H-1B programme, mentioned above, admits highly skilled foreigners to work in specialty occupations,

in which supply of workers is low. Foreigners are admitted through the H-1B programme on the basis of employers' demand for their skills. Two other programmes, the H-2A and H-2B for agricultural and non-agricultural workers, respectively, allow less educated foreigners, again on the basis of employers' needs.

5.2.2 The Labour Market Effects of Immigration Policies

As mentioned above, the government cannot directly control the total number of immigrants. A change in immigration can be achieved through policies that either restrict immigrant entry (e.g. visa quotas) or increase immigrant exit (e.g. deportations). We show here that the various policies that can be used to reduce a certain group of immigrant workers can have different effects on labour markets, even if they produce exactly the same decrease in the number of immigrants.

A restrictive immigration policy can be direct, such as tighter visa quotas, enforcement of deportations or shorter visa durations, or indirect, affecting immigrant entry or exit through its impact on foreigners' incentives to enter or remain in the country. Such indirect policies could be, for instance, restricting immigrants' access to welfare benefits, restricting their right to employment in certain sectors and so on. Such policies can reduce the migration benefit and discourage foreigners from entering into the country or encourage those already in the country to return.

In a labour market with search frictions in which wages are the outcome of bargaining, the latter indirect policies are likely to have less negative (or more positive) effects on job creation, compared to direct policies. In particular, policies that reduce immigrants' value from staying in the country, especially while unemployed, will put downward pressure on their wage. They will make it costlier for immigrants to be unemployed and induce them to accept lower wages by worsening their bargaining position in wage setting. As shown in Eq. (5.2), and as discussed above, lower wages mean more profits for firms. Such indirect policies that reduce the migration incentive by putting downward pressure on immigrants' wages, reduce immigrant entry (and increase exit), but increase

also the employers' surplus from employing immigrants with a positive impact on incentives to post vacancies and create jobs. Direct policies, on the other hand, such as shorter visa durations or deportations, are more likely to have a negative effect on employers' profits. What such policies effectively do is to increase the discount factor used to evaluate the value of a job that is occupied by an immigrant worker. In terms of Eq. (5.2), shorter visa durations or a higher return probability (for instance, due to enforcement of deportations) can be captured by an increase in the rate of separation s_{ib} , which affects the value of a match negatively, since a higher separation rate means that the match is expected to last less. By reducing the presence of immigrants in the labour force all types of restrictive policies reduce the weight $\frac{u_{iI}}{u_i}$ put on the value of matching with immigrant worker, but direct policies may also decrease that value of a match with an immigrant worker J_{iI} , while indirect policies may increase it. If for the reasons discussed above firms generate more surplus from employing immigrants than natives $J_{iI} > J_{iN}$, then shifting weights in Eq. (5.1) from J_{iI} to J_{iN} will lower employers' profits and in turn job creation. But this negative job creation effect is likely to be smaller if this shift is achieved through indirect, instead of direct, policies.

The effects of immigration policies on job creation have been explored in Chassamboulli and Peri (2015). The question they ask is how to deal with the presence of a large number of illegal immigrants in the US. In particular, what policy should be used to reduce the presence of illegal immigrants in the US and how would this affect the US labour market. They develop a search model of two countries linked by migration flows representing the US and Mexico. In the model, unskilled workers from Mexico can find both legal and illegal opportunities to migrate to the US. The decision to take up such an opportunity depends on the benefit from migrating to the US, which in turn, depends on labour market conditions and immigration policies in the US. They analyse both direct policies, such as increasing border enforcement and increasing the frequency of deportations, and indirect policies, such as increasing illegal immigrant's cost of searching for a job, which could reflect for instance, limited access to benefits. However, they consider in addition, the alternative option of reducing illegal immigration through legalization. In line with Chassamboulli and Palivos (2014), in this study also

immigration benefits US firms by allowing them to pay a lower cost. More illegal immigrants actually encourage firms to create more unskilled jobs per unemployed worker, and increase the employment of unskilled natives. The skilled natives also benefit in terms of job creation and employment through complementarities in production. The relevant question then is which policy can reduce illegal immigration with the least negative effect on native workers. They find that the legalization of illegal immigrants is the only policy among those considered that does not have a depressing effect on the employment of native workers. This is because this policy, unlike the other policies, does not decrease total immigration. It decreases illegal immigration, but at the same time provides higher incentives for new immigrants to enter as their chances of becoming legal increase, and as a result, the total number of immigrants increases. The increased presence of legal immigrants helps firms maintain lower labour costs and create new jobs. It dominates over the depressing effect of fewer illegal immigrants in the market.

We see here the importance of allowing in our analysis for immigration to be an equilibrium outcome, instead of treating it as an exogenous policy variable. To a large extent, the positive effect of a legalization programme comes from its positive impact on entry incentives, which helps increase the inflow of new immigrants as the number of illegal immigrants decreases. Such effects are overlooked when considering exogenous decreases in the number of immigrants.

5.2.3 The US Immigration System

Studies of the effects of immigration in the US have typically focused on the two major entry channels, legal and illegal, or have focused mainly on unskilled immigration. But there are two main channels of legal entry into the US, family-based and employment-based, that admit not only unskilled but also skilled immigrants. The family-based immigration system, introduced in 1965, was based on reuniting immigrant families while abolishing national-origins quota. While admission on a family visa is not skill selective, skilled foreigners are also admitted through this route. Employment visas, on the other hand, are targeted towards highly

skilled foreigners who are in high demand for US firms. Legal immigrants admitted on family visas can stay and work in the country indefinitely while most of the employment immigrants are initially admitted on temporary work permits and may transition to a permanent residence status subsequently. Moreover, while family entries are not conditional on having a job in the US, all immigrants entering with a work permit must already have a job in the US, and unless they transition to permanent residency, their stay in the US is conditional on having job. There are therefore reasons to expect that immigrants admitted through these two channels, although all legal, may influence the US labour market differently.

When it comes to their labour market effects, the employment-based system has two main advantages over the family-unification system. First, through the employment-based system US employers can gain access to a highly skilled labour force, readily available to work, without having to engage in time-consuming search in the US labour market. Second, admissions through the employment-based system are based on the demand for skills by US employers; workers entering on work permits are petitioned by their employers whereas those entering on family visas are petitioned by their relatives. Thus, employment immigrants are more selected on the productivity dimension, as supported by the evidence mentioned above that they receive higher wages and contribute more to innovation and productivity growth. Thus, considering only immigrants' skill characteristics or only their legal status and not differentiating between family and employment immigrants may leave out important aspects for how immigration affects the US labour market.

Another distinctive characteristic of the US immigration system is its strong network dependence. It allows, in a sense, for legal migration to the US to be a "self-sustained" process, since opportunities for new entries through each of the two legal routes depend strongly on networks, which means incumbent immigrants. To be eligible for a family visa, a foreigner must have a relative who is a legal permanent resident of the US. This effectively means that admitting more immigrants generates more opportunities for future entries through the family unification route. A foreigner can apply for a permit to enter and work in the US only if he has already been offered a job in the US. Such job offers are presumably made

available to workers abroad through referrals from their network of co-ethnics who are legal residents of the US. This also means that as the network of legal immigrants expands, opportunities for entry through each of the two legal routes become more frequent. This feature of the US immigration system implies that small changes in immigration policies can have unintended long-run equilibrium effects, since networks and family linkage effects may increase substantially the immigration opportunities in the future. For instance, the introduction of the family-based immigration system in 1965 allowed over time the largest increase in immigrants in the US.

The only study that differentiates among the two most relevant channels of legal entry to the US and in addition accounts explicitly for the role of immigrant networks in generating opportunities for legal entry is Chassamboulli and Peri (2019). They develop a two-country economy that represents the US and the rest of the world and model in detail the three main immigrant entry routes to the US: illegal, family-based and employment-based. They also use a search and matching model to describe the labour market in which firms post vacancies for skilled and unskilled workers and unemployed workers search for jobs. An innovation of their approach is that they allow for immigration from each entry route to be an equilibrium outcome reflecting entry incentives and network effects. For instance, they can increase border enforcement to decrease illegal immigration, while leaving all other immigrant entry routes unchanged, and then examine what would happen in equilibrium to the other groups of immigrants. Similarly, they can decrease the approval rate of petitions for family unification entries and then analyse what would happen to employment-based entries and illegal entries. Hence, in their model immigration policies targeting one immigrant group will also affect natives' outcomes through their impact on entry incentives and entry opportunities for other immigrant groups.

Chassamboulli and Peri (2019) find that the job creation effects of policies restricting any of the three entry routes are negative, but for different reasons. Unskilled family and undocumented immigrants allow firms to cut on labour costs by accepting lower wages than natives due to their worse outside options. Employment immigrants, on the other hand, receive higher wages than natives, but still generate larger surplus to firms

because their productivity per unit of wage is higher than that of skilled natives or family immigrants. Their higher productivity is owed to the fact that, unlike natives and other immigrants, they are selected based on ability. Interestingly, they find that although firms are almost indifferent between hiring skilled natives or skilled family immigrants, decreasing the approval rate of family admissions can have a depressing effect on job creation mainly because it reduces also employment-based admissions. With fewer family immigrants there are also fewer opportunities for highly skilled individuals to enter through on the job referrals. In fact, because the two legal routes depend strongly on networks, restricting any of the two routes turns out to have very similar negative job creation effects and very similar effects on the skill composition of immigrant labour force. Given that the job creation effects of all types of immigrants benefit natives, their analysis suggests that policy combinations that restrict one entry route but relax the other will be more beneficial to natives compared to purely restrictive policies that restrict one entry channel only.

5.3 Reducing Illegal Immigration Via a Temporary Visa Programme

The decreasing supply of native workers in low-skill sectors as they are becoming older and choosing to become more educated, together with the high demand for these low-skill labour services (e.g. in construction, landscaping, housekeeping etc.), may have resulted in recent decades in stronger pressures to hire undocumented immigrants, thereby also creating incentives for unskilled foreigners to seek entry into the US through illegal channels. By implementing policies that reduce illegal immigration while shifting toward a “merit-based” immigration system that grants permanent residency to more skilled and highly educated foreigners, a number of sectors in the US economy that rely mainly on low-cost labour from low-skill and undocumented immigrants are expected to shrink, hurting this way the employment of also natives in these sectors. The low-skilled and undocumented immigrants provide, in addition,

important services that complement the work of more skilled natives. They also support the growth of sectors that employ mostly native workers in jobs that require more skills and education. Thus, reducing their presence will also hurt the employment of natives in jobs requiring more skills. While the common perception is that some of the low-skill manual jobs freed up will be taken by native workers, as shown in Chassamboulli and Peri (2015), the negative job creation effects in low-skill sectors due to increasing labour costs and the negative impact on job creation in complementing sectors will dominate over this small positive effect.

Based on the studies discussed above, which explore the positive labour cost and productivity effects of different types of immigrants, the immigration policies that benefit natives the most are not those that decrease immigration, but instead, those that change the composition of immigrants towards the types of immigrants that are most beneficial to natives. Chassamboulli and Peri (2015) show that the legalization of undocumented immigrants provides the best alternative solution to the problem of reducing illegal immigration, because it maintains the supply of important low-skill and relatively cheaper labour services to US firms. Based on the results shown in Chassamboulli and Peri (2019), the employment-based visa programme is particularly valuable to US firms, so that a programme that replaces family-based with employment-based immigration is more beneficial to natives compared to a programme that reduces immigration overall.

In what follows, we explore an alternative policy combination that aims to reduce illegal immigration while avoiding the negative job creation effects. The policy that we explore attempts to offset the negative job creation effects of fewer illegal immigrants in the market by maintaining the supply of low-skill foreign labour through a temporary employment programme. That is, we analyse a policy combination that eliminates illegal immigration, but introduces, at the same time, the possibility of hiring unskilled foreigners directly from abroad on temporary work permits. With the introduction of temporary work permits employers gain access to a large pool of low-skill foreigners who are available to work, presumably at a lower wage than natives, since their outside option—the option of searching for a job in their home country—yields a much lower return. The temporary visa programme helps to maintain

the advantage that employers gain from having access to cheaper labour, it maintains the supply of low-skill labour in the market and allows employers to save on recruitment costs. We examine whether these effects are strong enough to outweigh the negative job creation effects of reducing illegal immigration. We quantify these effects by simulating these policy changes in a two-country search model that represents the US and the rest of the world and accounts for the two main types of immigrant entry: illegal and legal. The model developed here borrows elements from Chassamboulli and Peri (2015, 2019).

5.3.1 The General Set-up

We describe here the main features of the model. Details of the equilibrium conditions and Bellman equations are described in the Appendix. The model consists of two countries: country 1 and country 2. Country 1, which represents the US, offers better labour market prospects (wages and employment opportunities) than country 2, thus workers have incentive to migrate from country 2 (the rest of the world) to country 1 (the US). Each period some of the individuals born in country 2 will migrate to country 1. The labour force of country 1 thus consists of both natives and immigrants. The size of the native labour force of country 1 is normalized to 1 and it is divided into skilled workers of measure S and unskilled workers of measure $1 - S$. The size of the native labour force in country 2 is of measure F and is also divided into skilled and unskilled workers of measures F_s and F_u , respectively. We keep the overall size of the labour force (native of country 1 and 2) constant by assuming that individuals from either country enter and exit the labour force at a common rate τ . New individuals enter the labour force as unemployed, all agents are risk neutral and discount the future at a common rate r equal to the interest rate, and time is continuous.

Migration to country 1 can be legal or illegal, and such opportunities arise as random events occurring at rates x_l and x_i , respectively. Opportunities for legal migration arise for both skilled and unskilled natives of country 2 at equal rates.⁴ Opportunities for illegal migration arise only for the unskilled natives of country 2, in line with evidence that most of the undocumented immigrants in the US are unskilled.⁵ There

are two labour markets in country 1, one for skilled and one for unskilled workers, each producing a different labour input. Skilled and unskilled immigrants (documented or not) enter the corresponding market and search for jobs. Illegal immigrants face the risk of deportation, while legal immigrants have the right to stay and work in country 1 indefinitely. Legal immigrants still have a positive probability of returning home for personal idiosyncratic reasons. Illegal immigrants face, in addition, the risk of deportation. Let d_L and d_I denote the instant return rate of legal and illegal immigrants, respectively. We set $d_I > d_L$ and the difference between the two is the deportation risk.

Besides migrating to country 1 in order to search for a job, an unskilled native of country 2 can also apply for a permit to enter and work in country 1 temporarily, provided that he has found an employer in country 1 who is willing to offer him a job. To be qualified for a work permit an individual must have a job in country 1. Thus, all individuals entering on work permits enter with a job and do not have to search for a job in the market. We assume that a firm in the unskilled sector of country 1 hires a temporary worker from country 2 at rate x_T . This may reflect both the rate at which opportunities to hire a temporary worker arise, but also the rate at which petitions for temporary work permits are approved. To hire a temporary worker from abroad the firm does not have to post a vacancy and search for a worker. Instead, it just expands, by hiring the new temporary worker and creating a new temporary job. The advantage of temporary work permits is that firms can expand by gaining access to unskilled workers from abroad, who are readily available to work, without having to engage in time-consuming search for such workers in the local labour market. For workers on temporary work permits, stay in country 1 is conditional on having a job in country 1. They return home at rate d_T , reflecting the end of their employment contract, the expiration of their work permit or other personal reasons.

The total labour force of country 1 thus consists of natives (N) and immigrants, legal (L) and illegal (I) and temporary workers (T) and is of size $1 + N + L + T$. The total number of workers who are natives of country 2 that remain in country 2 is of measure $F - I - L - T$. All illegal immigrants and temporary workers are unskilled, while legal immigrants can be skilled (L_S) or unskilled (L_U) so that $L = L_S + L_U$.

5.3.2 Workers and Firms

There are three sectors in country 1: two intermediate sectors that produce intermediate goods Y_u and Y_s using “unskilled” and “skilled” labour, respectively, and the final sector. The production technology in the intermediate sector is linear so that the number of units produced equals the number of respective workers employed. The two intermediate inputs are non-storable. Once produced, they are sold in competitive markets and are assembled for the production of country 1’s final good (Y), the numeraire. The production of the final good is given by:

$$Y = \left[xY_s^\rho + (1-x)Y_u^\rho \right]^{\frac{1}{\rho}} \quad (5.3)$$

where x is a positive parameter that governs income shares and ρ determines the elasticity of substitution between the two inputs. It implies diminishing marginal products and complementarity between the two inputs. Since the two intermediate inputs are sold in competitive markets, their prices, p_s and p_u will be equal to their marginal products, that is:

$$p_s = x \left(\frac{Y}{Y_s} \right)^{1-\rho} \quad (5.4)$$

$$p_u = (1-x) \left(\frac{Y}{Y_u} \right)^{1-\rho} \quad (5.5)$$

For simplicity, and since our focus here is on illegal immigration, we do not differentiate between the two main legal avenues for skilled immigration to the US, the family and the employment. We do, however, take into account that some of the skilled legal immigrants of country 1 (the US) are admitted on employment visas, meaning that they are screened for their occupational qualifications and abilities and thus are selected more on the productivity dimension, compared to skilled natives. We account for this by assuming that each skilled native produces one unit of

the intermediate input, while each skilled immigrant produces $\lambda > 1$ units. In the numerical experiments that follow, we calibrate the value of λ by matching the wage difference between skilled legal immigrants and skilled natives and this parameter turns out to be larger than one. Unskilled workers, on the other hand, are all equally productive. They all produce one unit of the intermediate input. Given a linear production technology for each of the two intermediate inputs, we can write, $Y_u = e_{uL} + e_{uN} + e_{uI} + T$ and $Y_s = \lambda e_{sL} + e_{sN}$, where e_{ij} denotes the number of employed workers of skill type $i = [s, u]$ with $s = \text{skilled}$, $u = \text{unskilled}$ and status $j = [N, L, T]$ with $N = \text{native}$, $L = \text{legal}$ and $I = \text{illegal}$.

5.3.3 Search and Matching

In each of the two labour markets (skilled and unskilled), unemployed workers and job vacancies are matched via a stochastic technology $M(u_i, v_i)$; where u_i and v_i denote, respectively, the number of unemployed workers and vacancies of skill i . We can write the job finding and job filling rates in each market i as $\frac{M(u_i, v_i)}{u_i} = m(\theta_i)$ and $\frac{M(u_i, v_i)}{v_i} = q(\theta_i)$ where $\theta_i = \frac{v_i}{u_i}$ is tightness in market i and $m'(\theta_i) > 0$ while $q'(\theta_i) < 0$.⁶ In each market there is free entry of firms that drives the value of posting a vacancy to zero. That is, firms post vacancies until all rents are exhausted. Each firm opens one vacancy and hires one worker. Vacancies of each skill type are open to both natives and immigrant workers with those skills. Hence, natives and immigrants in market i all find jobs at the common rate $m(\theta_i)$.

Unemployed workers receive a flow of income b_i , representing the opportunity cost of employment. In addition, unemployed legal and illegal immigrant workers pay a search cost π_L and π_I , respectively and $\pi_I > \pi_L$. This means that immigrants' and especially illegal immigrants' flow value while unemployed is lower than that of natives. We account for the fact that legal immigrants have access to significantly fewer benefits than US citizens, especially when unemployed. Undocumented immigrants' flow value while unemployed is even lower (i.e. their search cost is even higher) because they cannot access any unemployment insurance. The cost of maintaining a job vacancy is c_i , representing the recruitment cost.

The flow revenue to an unskilled firm from matching with an unskilled worker (native or immigrant) is p_u (given in Eq. (5.5)). A skilled firm generates revenue p_s (given in Eq. (5.4)) when matched with a skilled native worker and λp_s when matched with a skilled immigrant worker. When a vacancy and a worker are matched, they bargain over the division of the match surplus. The worker's type as well as the revenue that results from a match are known to both parties. The wages, denoted as w_{ij} , differ by skill type i and status $j = [N, L, I, T]$ (native, legal, illegal, and temporary worker), and are determined by Nash bargaining between the two parties over the match surplus. Once the wage is agreed, production commences immediately. Matches dissolve at rate s_j . In the event of a separation, the worker joins the pool of unemployed, the job becomes vacant, and both start searching for a new match.

5.3.4 Optimality Conditions and Free Entry

At each point in time, a worker is either employed (E) or unemployed (U), while a vacancy may be either filled (J) or empty (V). We use the notation E_{ij} ; U_{ij} ; J_{ij} and V_{ij} to denote the present discounted value associated with the state where a worker is employed, a worker is unemployed, a job is filled and a job is vacant, where $i = [s; u]$ and $j = [N; I; L; T]$. Note that we can drop the subscript j from V_{ij} , since a type- i vacancy is open to any worker of skill type i , immigrant or native and is therefore described by the same Bellman equation. We can also drop the subscript i whenever $j = [I, T]$, since all illegal immigrants and temporary workers are unskilled. The full set of Bellman equations that describe the optimal behaviour of workers and firms in country 1 is in the Appendix.

A second set of equilibrium conditions is that of free-entry of firms in each of the two labour markets. Firms open vacancies up to the point that an additional one has zero expected value. In equilibrium this implies the following two conditions:

$$V_i = 0 \quad i = [s; u] \tag{5.6}$$

Wages are then determined by Nash bargain between the firm and the worker. The outside options of the firm and the worker are the value of a vacancy (i.e. of searching for a worker) and the value of being unemployed (i.e. of searching for a job), respectively. Let S_{ij} denote the surplus of a match between a vacancy of skill type i and a worker of status j . With Nash-bargaining the wage is set to a level such that the worker gets a share β of the surplus, where β represents the relative bargaining power of workers, and the share $1 - \beta$ goes to the firm. This implies the following six equilibrium conditions:

$$\beta S_{ik} = E_{ik} - U_{ik}, (1 - \beta) S_{ik} = J_{ik} - V_i, i = [s; u], \kappa = [N; L] \quad (5.7)$$

$$\beta S_l = E_l - U_l, (1 - \beta) S_l = J_l - V_u \quad (5.8)$$

$$\beta S_T = E_T - U_u^2, (1 - \beta) S_T = J_T - V_u \quad (5.9)$$

Notice that for workers on temporary work permits the outside option is the value of searching for a job in country 2, U_u^2 (and not in country 1), because these workers' stay (or entry) in country 1 is conditional upon having a job in country 1. If an agreement is not reached and they are not offered a job in country 1, they will be denied a work permit and they will have to search for a job in country 2. For the rest of the workers, whose stay in country 1 is unconditional, the outside option is the respective value of searching for a job in country 1.

5.3.5 The Immigration Decision and Inflows

A worker will take up an opportunity to migrate to country 1 if the benefit exceeds the cost. Each time an immigration opportunity arises the worker draws a migration cost, z , from a distribution with CDF $F(z)$ and support $[\underline{z}, \bar{z}]$. We assume that only the unemployed natives of country 2 are actively searching for opportunities to migrate illegally, so such opportunities arise only for the unskilled natives of country 2 who are unemployed. We also assume that only unemployed workers are willing

to act upon opportunities to migrate legally. Since all workers deciding whether to migrate or not, either legally or illegally, are unemployed, their benefit from migrating is the difference between their value of searching for a job in country 1 and their value of being unemployed (searching for a job) in their home country. Note that all new immigrants (legal or illegal) enter without a job and must search for a job in the market. An unskilled individual whose migration cost is z will take advantage of an opportunity to enter illegally into country 1 only if $U_1 - U_u^2 > z$. Likewise, a type- i native of country 2 will migrate legally only if $U_{iL} - U_i^2 > z$. The threshold costs, denoted as \tilde{z}_1 and \tilde{z}_{iL} and representing the highest cost a worker is willing to pay in order to obtain illegal or legal entry into country 1, are defined by the following conditions:

$$\tilde{z}_1 = U_1 - U_u^2 \quad (5.10)$$

$$\tilde{z}_{iL} = U_{iL} - U_i^2, i = [s; u] \quad (5.11)$$

These threshold immigration costs give the three rates $F(\tilde{z}_1)$, $F(\tilde{z}_{iL})$ and $F(\tilde{z}_{sL})$ at which natives of country 2 take up opportunities to migrate, illegally or legally. Changes in wage and unemployment conditions, as well as changes in immigration policies in country 1, will affect these threshold costs and in turn the inflows of legal and illegal immigrants. Let u_i^2 denote the number of unemployed workers of skill type $i = [s; u]$ in country 2. Inflows of illegal immigrants are given by $x_1 u_u^2 F(\tilde{z}_1)$ and inflows of legal immigrants of skill type i by $x_L u_i^2 F(\tilde{z}_{iL})$.

Notice that all the conditions of country 2 that can influence the decision to migrate and the flow of migrants from country 2 to country 1 are summarized in only two values: the value of searching for a job U_i^2 and the number of unemployed individuals u_i^2 . The value of searching for a job reflects all home-country labour market conditions that may influence the benefit of migrating, such as wages, employment opportunities and so on, while the number of unemployed gives the pool of potential migrants to country 1. A detailed description of the labour market of country 2 is therefore not necessary. Since our focus is on the impact of immigration policies in country 1, we can simply focus on only these two

values. Further, for simplicity we take these two values as given. The underlying assumption is that labour market conditions in country 2 are independent of immigration and labour market conditions in country 1.

5.3.6 Immigrant Stocks and Unemployment Rates

The last set of equilibrium conditions are the steady-state conditions for the numbers of legal immigrants, skilled (L_s) and unskilled (L_u), the number of illegal immigrants (I), the number of temporary workers (T) and the numbers of unemployed workers of each type in country 1: u_{sN} and u_{uN} are skilled and unskilled natives in country 1, u_{sL} and u_{uL} are skilled and unskilled legal immigrants and u_I are illegal immigrants. The formal conditions defining these steady-state variables (by equating flows in to flows out of each state) are given in the Appendix. We can write the steady-state conditions for unemployed and immigrants as follows:

$$\tilde{u}_{sN} = \frac{u_{sN}}{S} = \frac{s_s + \tau}{s_s + \tau + m(\theta_s)} \quad (5.12)$$

$$\tilde{u}_{uN} = \frac{u_{uN}}{1-S} = \frac{s_u + \tau}{s_u + \tau + m(\theta_u)} \quad (5.13)$$

$$\tilde{u}_{iL} = \frac{u_{iL}}{L_i} = \frac{s_i + \tau + d_L}{s_i + \tau + d_L + m(\theta_i)}, i = [s; u] \quad (5.14)$$

$$\tilde{u}_I = \frac{u_I}{I} = \frac{s_u + \tau + d_I}{s_u + \tau + d_I + m(\theta_u)} \quad (5.15)$$

$$L_s = \left[\frac{x_L \tilde{u}_s^2 F(\tilde{z}_{sL})}{\tau + d_L + x_L \tilde{u}_s^2 F(\tilde{z}_{sL})} \right] F_s \quad (5.16)$$

$$L_u = \left[\frac{x_L \tilde{u}_u^2 F(\tilde{z}_{uL})}{\tau + d_L + x_L \tilde{u}_u^2 F(\tilde{z}_{uL})} \right] (F_u - T - I) \quad (5.17)$$

$$I = \left[\frac{x_I \tilde{u}_u^2 F(\tilde{z}_I)}{\tau + d_I + x_I \tilde{u}_u^2 F(\tilde{z}_I)} \right] (F_u - T - L_u) \quad (5.18)$$

$$T = \left[\frac{x_T \left[(1 - \tilde{u}_{uN})(1 - S) + (1 - \tilde{u}_I)I + (1 - \tilde{u}_{uL})L_u \right]}{\tau + d_T} \right] \quad (5.19)$$

We see from Eqs. (5.12)–(5.15) that the unemployment rates decrease with the matching probability $m(\theta_i)$. A policy that decreases θ_b , and in turn, the matching probability $m(\theta_i)$, will increase natives' unemployment rate. Also it can be easily verified by inspecting expressions (5.16)–(5.19) that the equilibrium numbers of workers of each type depend negatively on the return probabilities (d_b , d_L and d_T), positively on the rates of entry opportunities (x_b , x_L and x_T), and in the case of legal and illegal immigrants also positively on the threshold migration costs (\tilde{z}_I and \tilde{z}_{iL}). Any economic and policy factor that increases the value of searching for a job in country 1 relative to country 2 (i.e. increases the threshold migration costs) encourages immigration and increases the equilibrium numbers of immigrants in country 1.

5.3.7 Key Conditions and Mechanisms

The job creation condition in the unskilled market can be written as:

$$\frac{c_i}{q(\theta_i)} = \frac{u_I}{u_u} J_I + \frac{u_{uL}}{u_u} J_{uL} + \frac{u_{uN}}{u_u} J_{uN} \quad (5.20)$$

Where $u_u = u_{uN} + u_{uL} + u_I$ is the total number of unemployed workers searching for unskilled jobs. Given $\pi_I > \pi_L > 0$ there is reason to expect that $J_I > J_{uL} > J_{uN}$. In fact, as can be verified by inspecting Eqs. (5.57),

(5.59) and (5.60) in the Appendix, this will be the case as long as the deportation risk of illegal immigrants and the return probability of legal immigrants are small enough. On the one hand, the higher search cost of immigrants implies that their wages are lower, which increases the firm's surplus from employing them. On the other hand, the expected duration of a match with an immigrant worker is shorter, due to returns and deportations. Firms benefit more from employing immigrants when their outside option is smaller, but also when the probability of a match break due to returns is smaller.

If $J_I > J_{uL} > J_{uN}$, then removing illegal immigrants from the market will shift weights in the right-hand-side of Eq. (5.20) from J_I to J_{uL} and J_{uN} with a negative impact on the expected profits of a new unskilled job. However, it will also reduce the relative supply of unskilled labour and thus increase the price of the unskilled input p_u , with a positive impact on the expected profits of firms. This is the standard channel present also in the canonical model. Hence, the overall impact on unskilled job creation is in general ambiguous and depends on which of the two effects dominates. But the skilled workers will be definitely hurt, in terms of both employment and wages, by the removal of undocumented immigrants from the market, because their marginal product, and thus the price p_s , will decrease. Again, this is the complementarity effect present also in the canonical model. Firms in the skilled market will react to the decrease in p_s by opening fewer vacancies per unemployed worker, that is by decreasing θ_i . This will in turn lower the matching probability $m(\theta_i)$, will increase the unemployment rate of skilled natives and will force them to accept lower wages as their outside option worsens due to their lower job finding probability.

A policy combination that replaces illegal immigrants with legal unskilled immigrants or temporary workers prevents the relative supply of unskilled labour and thus the price of the skilled labour input p_s from falling. It thus helps repress the negative effects on skilled native workers. When it comes to unskilled natives, however, it is not clear cut that they will be better off when the supply of competing foreign workers remains unchanged. They will be better off only when the unskilled foreigners replacing illegal immigrants generate a significantly larger positive job creation effect, large enough to outweigh the negative effect on the price of the unskilled labour input.

As discussed above, allowing for the option to hire unskilled foreign workers directly from abroad, without having to go through costly search in the market, increases the expected profits of firms. To see this more clearly, consider the case where $d_I = d_L = 0$ so that immigrants legal and illegal and natives differ only with respect to search costs. Substituting the expressions for J_B , J_{uL} and J_{uN} (given by Eqs. (5.57), (5.59) and (5.60) in the Appendix) in (5.20) we get:

$$\frac{c_i}{q(\theta_i)} = \frac{(1-\beta) \left(p_u - b_u + \frac{u_I}{u_u} \pi_I + \frac{u_{uL}}{u_u} \pi_L \right) + x_T J_T}{r + s_u + \tau + \beta m(\theta_u)} \quad (5.21)$$

Evidently, when $x_T > 0$ the expected surplus from a new job increases, since firms anticipate that they will be able to expand by hiring a temporary worker from abroad, which yields surplus J_T without having to pay additional recruitment costs. If this benefit is large enough to dominate over the negative competitive pressure from the new temporary workers on p_u , then unskilled natives also will be better off when the policy implemented is not purely restrictive, but replaces instead illegal immigrants with temporary workers. It should also be noted that the firms' surplus from employing temporary workers, J_T , is higher the longer the duration of temporary work permits, and the lower the wage of temporary workers. The latter depends, in turn, on the value of searching for a job in country 2, which as mentioned above, reflects the outside option of temporary workers (see Eq. (5.61) in the Appendix). Given that some unskilled natives of country 2 are willing to pay the migration cost in order to enter illegally into country 1 and search for a job there (i.e. given $\tilde{z}_i > 0$), then from Eq. (5.10) it must be the case that $U_I > U_u^2$, which ensures that illegal immigrants have a better outside option and thus can bargain for higher wages than temporary workers. This points to significant gains from employing temporary workers for unskilled firms. But still, we need to take into account the negative competitive pressure on p_u before reaching any conclusion.

5.3.8 Policy Experiments

In this section, we simulate the effects on natives' labour market outcomes (wages, unemployment rate and net income) of different immigration policies aiming to reduce illegal immigration. The parameter choice is summarized in Table 5.2 in the Appendix. Our parameter choice follows closely the parameterization in Chassamboulli and Peri (2019), which aims to match as closely as possible moments of the data for the 2010–2015 average. Country 1 represents the US and we consider Mexico as the main country supplying low skilled immigrants and China and India as the two main countries supplying high skilled immigrants. Our measures of F_u and F_s , are therefore the unskilled Mexican labour force and the skilled Indian and Chinese labour force, respectively. Likewise, to calculate our measures of u_u^2 and u_s^2 we use the unemployment rate of unskilled workers in Mexico and the unemployment rates of skilled workers in India and China. We define as skilled a worker who has at least some college education and unskilled workers are those with no college education. We assume that the CDF of the immigration cost, $F(z)$, is uniform. Finally, we use a Cobb-Douglas matching function, $M_i = \xi v_i^\varepsilon u_i^{1-\varepsilon}$, $i = [s, u]$, where ξ is the matching efficiency parameter.

We consider first a “restrictive” policy that eliminates all undocumented immigrants from the unskilled market (i.e. 100% decrease in I). Notice that because we eliminate all illegal immigrants from the market, the policy used, that is, whether increased deportations (increase in d_I), reduced benefits (decrease in π_I) or border enforcement (decrease in x_I), is not important for the results obtained; any policy has the same impact because there are no illegal immigrants left behind, so whether their wages are lower or their return probability higher does not matter for the firms' profits. We then consider a combination of policies that reduce illegal immigration, on the one hand, but allow entry of unskilled foreigners through temporary work permits, on the other hand, so that the total number of unskilled foreigners remains unchanged. In the baseline parameterization we set $x_T = 0$, meaning that there are no temporary work permits for unskilled foreigners. We then examine what happens when we eliminate illegal immigration, but increase x_T so that the total supply of unskilled foreign labour remains the same. We also explore an

alternative policy combination of reducing illegal immigration but increasing opportunities for unskilled foreigners to enter through the legal route (i.e. increasing x_L but only for the unskilled foreigners) so that total unskilled immigration remains the same.

The results are shown in Table 5.1. Removing all illegal immigrants from the US labour market has a depressing effect on both skilled and unskilled natives in terms of job creation. The unemployment rate of both types of native workers increases. The marginal product of unskilled natives increases as the supply of low-skill labour decreases. This means a higher price for the unskilled labour input, which raises firms' profits. But at the same time, without the undocumented immigrants in the market, firms expect to pay higher wages on average. This depressing effect dominates over the positive price effect and firms react by reducing job openings per unemployed worker. The resulting decrease in the production of the unskilled labour input, which complements the production of the skilled labour input, lowers also the price of the skilled labour input. As a result, firms in the skilled sector also open fewer vacancies per

Table 5.1 Results of policy experiments

	Eliminate illegal immigrants	Replace illegal with legal immigrants	Replace illegal immigrants with temporary workers
<i>Tightness</i>			
θ_s	-6.43	-1.07	3.18
θ_u	-17.88	-16.54	7.73
<i>Unempl. rates</i>			
\tilde{u}_{sN}	2.82	0.45	-1.31
\tilde{u}_{uN}	6.71	6.15	-2.48
<i>Wages</i>			
w_{sN}	-1.82	-0.30	0.90
w_{uN}	4.93	0.35	8.95
<i>Net income</i>			
\tilde{Y}	-1.48	-0.70	1.08
\tilde{Y}_1	-2.47	-1.29	1.55

The entries in the Table represent the percentage effects of three policy experiments on market tightness (first 2 rows), natives' unemployment rates (next 2 rows), natives' wages (next 2 rows) and natives' net income (last 2 rows). Column 1 shows the effects of eliminating illegal immigrants, column 2 shows the effects of replacing illegal immigrants with legal unskilled immigrants, and column 3 shows the effects of replacing illegal immigrants with temporary workers

unemployed worker. The impact on wages follows that on prices. The wage of skilled natives decreases because their marginal product decreases but that of unskilled natives increases because their marginal product increases. But the positive effect on unskilled wages is not enough to outweigh the negative employment effects on both types of natives. The net income of natives decreases.

Replacing illegal immigrants with legal unskilled immigrants does little to improve the effects on natives' labour market outcomes, and especially the effects on unskilled natives. This policy combination helps to maintain the supply of unskilled labour which keeps the marginal product of skilled labour from falling too much. The negative impact on skilled job creation is smaller in this case, which implies also a smaller increase and decrease, respectively, in the unemployment and wage rate of skilled natives. The unskilled natives, on the other hand, benefit much less from this shift in the composition of low-skill immigrants towards legal immigrants. It helps to keep the expected labour cost for firms in the unskilled sector lower, since unskilled legal immigrants also receive lower wages than natives. But it also prevents the price of the unskilled labour input from increasing. The negative labour cost effect is smaller in this case, but so is the positive price effect, implying almost the same negative effect on unskilled job creation as a purely restrictive policy that eliminates illegal immigration only.⁷

Among the three policies considered, the only one generating positive job creation effects for both types of native workers is the one that replaces illegal immigrants with temporary workers. Allowing for the option to hire unskilled foreigners to replace the undocumented in the market increases the profits of firms in the unskilled market considerably. Unskilled jobs generate a significantly larger surplus, which also explains why unskilled natives' wages increase significantly. As the match surplus expands, the share of surplus that goes to the worker also expands. Expected profits from opening vacancies in the unskilled market increase and firms open more vacancies per unemployed worker. The unskilled unemployment rate also decreases. As the unskilled sector expands, and the production of the unskilled labour input increases, the price of the skilled labour input also increases. Job creation in the skilled market also expands, and skilled natives benefit both in terms of wages and employment.

Appendix

Model Details

Bellman Equations

The Bellman equations describing the values of job vacancies for unskilled and skilled workers in country 1 are as follows:

$$rV_u = -c_u + q(\theta_u) \left[\frac{u_I}{u_u} J_I + \frac{u_{uL}}{u_u} J_{uL} + \frac{u_{uN}}{u_u} J_{uN} \right] \quad (5.22)$$

$$rV_s = -c_s + q(\theta_s) \left[\frac{u_{sL}}{u_s} J_{sL} + \frac{u_{sN}}{u_s} J_{sN} \right] \quad (5.23)$$

Next, the value of a job depends on the type of worker filling the job:

$$rJ_{sN} = p_s - w_{sN} + (s_s + \tau)[V_s - J_{sN}] \quad (5.24)$$

$$rJ_{uN} = p_u - w_{uN} + x_T J_T + (s_u + \tau)[V_u - J_{uN}] \quad (5.25)$$

$$rJ_{sL} = \lambda p_s - w_{sL} + (s_s + d_L + \tau)[V_s - J_{sL}] \quad (5.26)$$

$$rJ_{uL} = p_u - w_{uL} + x_T J_T + (s_u + d_L + \tau)[V_u - J_{uL}] \quad (5.27)$$

$$rJ_T = p_u - w_T + (d_T + \tau)[V_u - J_T] \quad (5.28)$$

$$rJ_I = p_u - w_I + x_T J_T + (s_u + d_I + \tau)[V_u - J_I] \quad (5.29)$$

The value of unemployment for each worker type satisfies:

$$(r + \tau)U_{iN} = b_i - m(\theta_i) + [E_{iN} - U_{iN}], \quad i = [s, u] \quad (5.30)$$

$$(r + \tau)U_{iL} = b_i - \pi_L + m(\theta_s)[E_{iL} - U_{iL}] + d_L[U_i^2 - U_{iL}] \quad (5.31)$$

$$(r + \tau)U_I = b_u - \pi_I + m(\theta_u)[E_I - U_I] + d_I[U_u^2 - U_I] \quad (5.32)$$

There is no value of being unemployed in country 1 for an immigrant on temporary work permit, since, as already mentioned, stay in country 1, in this case, is conditional on having a job. All immigrants on temporary work permits are employed, otherwise they must return home.

Finally, the value of being employed in steady state is given by the following five conditions relative to each country and worker type:

$$(r + \tau)E_{iN} = w_{iN} + s_i[U_{iN} - E_{iN}], \quad i = [s, u] \quad (5.33)$$

$$(r + \tau)E_{iL} = w_{iL} + s_i[U_{iL} - E_{iL}] + d_L[U_i^2 - E_{iL}] \quad (5.34)$$

$$(r + \tau)E_I = w_I + s_u[U_I - E_I] + d_I[U_u^2 - E_I] \quad (5.35)$$

$$(r + \tau)E_T = w_T + d_T[U_s^2 - E_T] \quad (5.36)$$

Steady-State Conditions

By equating the outflow of immigrants of each type, which includes returns to the home country and labour force exits, to the inflow of new immigrants into each group we obtain the steady-state conditions for the number of legal immigrants, skilled and unskilled, L_s and L_u , respectively, the number of temporary workers, T , and the number of illegal immigrants, I :

$$(d_L + \tau)L_i = x_L u_i^2 F(\tilde{z}_{iL}) \quad (5.37)$$

$$(d_T + \tau)T = x_T (e_{uN} + e_{uL} + e_I) \quad (5.38)$$

$$(d_I + \tau)I = x_I u_u^2 F(\tilde{z}_I) \quad (5.39)$$

where $e_{uL} = L_u - u_{uL}$ is the number of unskilled legal immigrants that are employed, $e_I = I - u_I$ is the number of unskilled illegal immigrants that are employed and $e_{uN} = 1 - S - u_{uN}$ is the number of unskilled natives that are employed.

The conditions for the steady-state unemployment of natives (u_{sN} and u_{uN}), legal immigrants (u_{sL} and u_{uL}) and illegal immigrants (u_I) are as follows

$$\tau S + s_s (S - u_{sN}) = (m(\theta_s) + \tau) u_{sN} \quad (5.40)$$

$$\tau (1 - S) + s_u (1 - S - u_{uN}) = (m(\theta_u) + \tau) u_{uN} \quad (5.41)$$

$$s_i (L_{iL} - u_{iL}) + x_L u_i^2 F(\tilde{z}_{iL}) = (m(\theta_i) + d_L + \tau) u_{iL} \quad (5.42)$$

$$s_u (I - u_I) + x_I u_u^2 F(\tilde{z}_I) = (m(\theta_u) + d_I + \tau) u_I \quad (5.43)$$

Wages

Using the Bellman Eqs. (5.22)–(5.36), the free-entry conditions (5.6), the Nash bargaining conditions (5.7)–(5.9) and the immigration wage conditions in (5.10) and (5.11), we can solve for the equilibrium wage rates:

$$w_{sN} = \beta p_s + (1 - \beta) [b_s + \beta m(\theta_s) S_{sN}] \quad (5.44)$$

$$w_{uN} = \beta [p_u + x_T J_T] + (1 - \beta) [b_u + \beta m(\theta_u) S_{uN}] \quad (5.45)$$

$$w_{sL} = \beta\lambda p_s + (1-\beta)[b_s - \pi_L + \beta m(\theta_s)S_{sN}] \quad (5.46)$$

$$w_{uL} = \beta[p_u + x_T J_T] + (1-\beta)[b_u - \pi_L + \beta m(\theta_u)S_{uN}] \quad (5.47)$$

$$w_I = \beta[p_u + x_T J_T] + (1-\beta)[b_u - \pi_I + \beta m(\theta_u)S_I] \quad (5.48)$$

$$w_T = \beta p_u + (1-\beta)(r + \tau)U_u^2 \quad (5.49)$$

Value of a Job

Setting $V_i = 0$ in (5.24)–(5.29), we get:

$$J_{sN} = \frac{p_s - w_{sN}}{r + s_s + \tau} \quad (5.50)$$

$$J_{uN} = \frac{p_u + x_T J_T - w_{uN}}{r + s_u + \tau} \quad (5.51)$$

$$J_{sL} = \frac{\lambda p_s - w_{sL}}{r + s_s + d_L + \tau} \quad (5.52)$$

$$J_{uL} = \frac{p_u + x_T J_T - w_{uL}}{r + s_u + d_L + \tau} \quad (5.53)$$

$$J_I = \frac{p_u + x_T J_T - w_I}{r + s_u + d_I + \tau} \quad (5.54)$$

$$J_T = \frac{p_u - w_T}{r + d_T + \tau} \quad (5.55)$$

Apparently, the values of jobs to the firms increase with the worker's productivity and decrease with the worker's break up probability and wage, while the possibility of hiring a temporary worker increases the value of unskilled jobs.

Substituting the equilibrium wages (given in Eqs. (5.44)–(5.49)) into the equations above and using the Nash bargaining conditions in (5.7)–(5.9) we can write:

$$J_{sN} = (1 - \beta)S_{sN} = \frac{(1 - \beta)(p_s - b_s)}{r + s_s + \tau + \beta m(\theta_s)} \quad (5.56)$$

$$J_{uN} = (1 - \beta)S_{uN} = \frac{(1 - \beta)(p_u - b_u) + x_T J_T}{r + s_u + \tau + \beta m(\theta_u)} \quad (5.57)$$

$$J_{sL} = (1 - \beta)S_{sL} = \frac{(1 - \beta)(\lambda p_s - b_s + \pi_L)}{r + s_s + d_L + \tau + \beta m(\theta_s)} \quad (5.58)$$

$$J_{uL} = (1 - \beta)S_{uL} = \frac{(1 - \beta)(p_u - b_u + \pi_L) + x_T J_T}{r + s_u + d_L + \tau + \beta m(\theta_u)} \quad (5.59)$$

$$J_I = (1 - \beta)S_I = \frac{(1 - \beta)(p_u - b_u + \pi_I) + x_T J_T}{r + s_u + d_I + \tau + \beta m(\theta_u)} \quad (5.60)$$

$$J_T = (1 - \beta)S_T = \frac{(1 - \beta)(p_u - (r + \tau)U_s^2)}{r + d_T + \tau} \quad (5.61)$$

Net Income

The net income of natives is given by the following expression:

$$\tilde{Y} = Y + b_s u_{sN} + b_u u_{uN} - c_s v_s - c_u v_u - w_{sL} e_{sL} - w_{uL} e_{uL} - w_I e_I - w_T T$$

The expression above assumes that employers are natives and it shows that net income to natives includes total wage income to natives plus unemployment income to natives minus the cost of vacancy posting and the wages paid to immigrants. An alternative definition can be obtained by omitting the natives' unemployment income.

$$\tilde{Y}_1 = \tilde{Y} - b_s u_{sN} + b_u u_{uN}$$

Parameterization of the Model

Table 5.2 Parameterization and matched moments

	<i>From the literature</i>
$\epsilon = 0.5$	Petrongolo and Pissarides (2001)
$\beta = 0.5$	Satisfies the Hosios (1990) condition
$\varrho = 0.5$	Ottaviano and Peri (2012)
$\bar{z} = 0$	Normalization
$d_L = 0.0023$	Chassamboulli and Peri (2015)
$d_I = 0.0039$	Chassamboulli and Peri (2015)
$s_s = 0.032$	Chassamboulli and Peri (2015)
$s_u = 0.024$	Chassamboulli and Peri (2015)
$x_T = 0$	Benchmark case
	<i>Measured from the data</i>
$r = 0.004$	The monthly interest rate
$\tau = 0.00072$	The growth rate of the population
$S = 0.604$	The share of skilled labour force in the US
$\tilde{u}_s^2 = 0.067$	Average skilled unemployment rate in China and India
$\tilde{u}_u^3 = 0.036$	Unskilled unemployment rate in Mexico
$F_s = 0.562$	Skilled labour force of India and China/US native labour force
$F_u = 0.323$	Unskilled labour force of Mexico/US native labour force
	<i>Jointly calibrated to match moments of the data</i>
$\alpha = 0.699$	The skilled wage premium in the US of 78%

(continued)

Table 5.2 (continued)

$\xi = 0.125$	The vacancy to unemployment ratio in the US of 0.62
$b_s = 0.439$	The ratio of unemployment to employment income of 0.71 for both skill types (Hall and Milgrom 2008)
$b_u = 0.231$	The US wage ratio between:
$\lambda = 1.16$	1. Skilled natives and skilled immigrants of 0.92
$\pi_L = 0.183$	2. Unskilled natives and legal-unskilled immigrants of 1.173
$\pi_I = 0.389$	3. Illegal (unskilled) immigrants and unskilled natives of 0.8
$c_s = 0.0165$	The employment rates of skilled and unskilled native workers
$c_u = 0.0440$	In the US: 0.84 and 0.67
$\frac{x_I}{\bar{z}} = 0.0065 \text{ ¥}$	The ratio of illegal immigrants to the US native labour force of 0.07
$\frac{x_L}{\bar{z}} = 0.0016$	The ratio of legal immigrants to the US native labour force of 0.12
$d_T = 0.0833$	Average duration of a temporary worker visa is 12 months (benchmark case)
$U_u^2 = 7.83$	$U_{sF} = 4U_s^2$
$U_s^2 = 22.66$	$U_{uF} = 4U_u^2$

From Chassamboulli and Peri (2019)

¥ Under the assumption that the distribution of immigration cost is uniform over $[0, \bar{z}]$, the individual values of x_I , x_L , and \bar{z} do not matter. What only matters is the values of $\frac{x_I}{\bar{z}}$ and $\frac{x_L}{\bar{z}}$. We therefore match those

Sensitivity Checks

In the benchmark parameterization we set the duration of work permits to 12 months. In Table 5.3 below we examine how the results of the policy combination of replacing illegal immigrants with temporary workers change when the duration of work permits changes. The effects are robust to changes in the duration of work permits, since in all cases considered, both types of natives benefit in terms of job creation. We see that the positive job creation effect on unskilled workers decreases as the duration increases, mainly because with longer duration of work permits the inflow of temporary workers necessary to replace illegal immigrants is smaller. This means that opportunities to hire temporary workers are less frequent (i.e. x_T is smaller), which implies, in turn, that firms' benefit less from the introduction of the temporary-worker programme.

Table 5.3 Sensitivity analysis with respect to the duration of work permits

	Duration 6 months	Duration 12 months (benchmark)	Duration 36 months
<i>Tightness</i>			
θ_s	3.18	3.22	3.03
θ_u	7.73	8.67	4.40
<i>Unempl. rates</i>			
\tilde{U}_{sN}	-1.31	-1.32	-1.25
\tilde{U}_{uN}	-2.48	-2.77	-1.44
<i>Wages</i>			
w_{sN}	0.90	0.91	0.86
w_{uN}	8.95	9.17	8.14
<i>Net income</i>			
\tilde{Y}_s	1.08	1.08	1.06
\tilde{Y}_1	1.55	1.58	1.45

Notes

1. Firms produce labour inputs by employing workers. The inputs they produce are then sold in competitive markets. Because markets are competitive, the price of the labour input, which represents the firm's revenue from operating the job is the worker's marginal product.
2. In the United States, for example, not all legal immigrants qualify for unemployment benefits extending beyond the period of 26 weeks and are paid during recessions by the federal government. Moreover, since the Personal Responsibility and Work Opportunity Reconciliation Act (PRWORA) of 1996 many federal government benefits (Food stamps, TANF, AFDC and others) were restricted to US citizens only. In some states some of these benefits were reinstated in the 2000s, but not all of them. Overall, immigrants in the US, even the legal ones, either on temporary visas or permanent residency, have access to significantly fewer benefits than US citizens, especially when unemployed.
3. Several other papers (e.g. LaLonde and Topel 1991; Kerr and Kerr 2011) show that immigrants are paid less than natives even after controlling for other observable productivity determinants such as education and language.
4. Most legal immigrants in the US are on family unification visas. A foreigner, irrespective of his skill level, can apply for a family visa as long as a member of his family is a legal permanent resident of the US and those

admitted are not selected based on skills. Given this, we think it is reasonable to assume that opportunities for legal entry arise at the same rate for both skilled and unskilled foreigners.

5. According to estimates reported by the Migration Policy Institute in 2012, more than 80% of undocumented immigrants in the US had at most a high school degree.
6. The function $M(u_i, v_i)$ exhibits the standard properties: it is at least twice continuously differentiable, increasing in its arguments, exhibits constant returns to scale and satisfies the Inada conditions.
7. Compared to a legalization programme, this policy is less beneficial to native workers because it keeps the total number of immigrants that same. With a legalization programme, the entry of new illegal immigrants increases, and they are then legalized to keep the number of illegal immigrants low. As a result, although illegal immigration decreases, total immigration increases.

References

- Battisti, Michele, Gabriel Falbermayr, Giovanni Peri. (2018), Immigration, search and redistribution: A quantitative assessment of native welfare, *Journal of the European Economic Association*, 16(4), 1137–1188.
- Borjas, George, Friedberg, Rachel. (2009), Recent trends in the earnings of new immigrants to the United States. NBER Working Paper No. 1540.
- Bound, John, Gaurav Khanna and Nicolas Morales. (2017), Understanding the economic impact of the H-1B Program on the US, NBER Working Paper No. 23153.
- Chassamboulli, Andri and Theodore Palivos. (2013), The impact of immigration on the employment and wages of native workers, *Journal of Macroeconomics*, 38 (part A), 19–34.
- Chassamboulli, Andri and Theodore Palivos. (2014), A search-equilibrium approach to the effects of immigration on labour market outcomes, *International Economic Review*, 55, 111–129.
- Chassamboulli, Andri, Giovanni Peri. (2015), The labour market effects of reducing the number of illegal immigrants, *Review of Economic Dynamics*, 18, 792–821.
- Chassamboulli, Andri, Giovanni Peri. (2019), The economic effect of immigration policies: Analyzing and simulating the U.S. case, NBER Working Paper No. 25074.

- Hall, Robert E., and Paul R. Milgrom. "The limited influence of unemployment on the wage bargain." *American Economic Review* 98, no. 4 (2008): 1653–74.
- Hosios, Arthur J. "On the efficiency of matching and related models of search and unemployment." *Review of Economic Studies* 57, no. 2 (1990): 279–298.
- Hunt, Jennifer. (2011), "Which immigrants are most innovative and entrepreneurial? Distinctions by entry visa", *Journal of Labour Economics*, vol. 29(3), 417–57.
- Hunt, Jennifer, Marjolaine Gauthier-Loiselle. (2010), How much does immigration boost innovation?, *American Economic Journal: Macroeconomics*, 2(2), 31–56.
- Jaimovich, Nir and Henry Siu. (2017), "High-skilled immigration, STEM employment and non-routine-biased technical change," NBER Working Paper No. 23185.
- Kerr, Sari Pekkala, Kerr, William. (2011), Economic impacts of immigration: a survey. *Finnish Economic Papers*, 24 (1), 1–32.
- Kerr, William, and William Lincoln. (2010), The supply side of innovation: H-1B visa reforms and U.S. ethnic invention, *Journal of Labour Economics*, 28(3): 473–508.
- LaLonde, Robert, Robert Topel. (1991), Immigrants in the American labour market: quality, assimilation, and distributional effects, *American Economic Review*, 81 (2), 297–302.
- Lewis, Ethan, Giovanni Peri, (2015), Immigration and the economy of cities and regions, *Handbook of Regional and Urban Economics*, 5, 625–685.
- Liu, Xiangbo. (2010), On the macroeconomic and welfare effects of illegal immigration. *Journal of Economic Dynamics and Control*, 34, 2547–2567.
- Liu, Xiangbo, Theodore Palivos, Xiaomeng Zhang. (2017), Immigration skill heterogeneity and qualification mismatch, *Economic Inquiry*, 55(3), 1231–1264.
- Lofstrom, Magnus and Hayes, Joseph. (2011), H-1Bs: how do they stack up to US born workers?, IZA Discussion Papers 6259.
- Moreno-Galbis, Eva, Ahmed Tritah. (2016), *European Economic Review*, 84, 76–98.
- Ottaviano, Gianmarco IP, and Giovanni Peri. "Rethinking the effect of immigration on wages." *Journal of the European Economic Association* 10, no. 1 (2012): 152–197.
- Orrenius, Pia, Madeline Zavodny and Alexander Abraham (2020), The Effect of Immigration on Business Dynamics and Employment. Federal Reserve Bank of Dallas, Working Paper 2004.

- Palivos, Theodore. (2009), Welfare effects of illegal immigration, *Journal of Population Economics*, 22, 131–144.
- Peri, Giovanni, Kevin Shih, and Chad Sparber. (2015). STEM workers, H-1B visas, and productivity in US cities, *Journal of Labour Economics*, 33(S1, Part 2), 225–255.
- Peri, Giovanni. (2016), Immigrants, productivity, and labour markets, *Journal of Economic Perspectives*, vol. 30(4), 3–30.
- Petrongolo, Barbara, and Christopher A. Pissarides. “Looking into the black box: A survey of the matching function.” *Journal of Economic Literature* 39, no. 2 (2001): 390–431.
- Pissarides, Christopher (2000), *Equilibrium unemployment theory*, Second edition. Cambridge, MA: MIT Press.
- Zavodny, Madeline, (2011) *Immigration and American Jobs*, New American Economy. Retrieved from: https://www.newamericaneconomy.org/sites/all/themes/pnae/img/NAE_Im-AmerJobs.pdf