IMMIGRATION, PRODUCTIVITY, AND COMPETITIVENESS IN AMERICAN INDUSTRY

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Abstract

In this paper, I examine ongoing research on the economic consequences of immigration to determine its importance for US competitiveness. By competitiveness, I mean the share of global demand that is met by US industries. Immigration may affect the market shares of US firms by making US labor cheaper, by raising the productivity of US factories, or by lowering the cost of trading with or investing in the rest of the world. Empirical evidence suggests that all these mechanisms are operative. Immigration (probably) lowers wages for native workers that compete with immigrants for jobs and also lowers prices of labor-intensive services. At the same time, it bids up housing prices and increases tax burdens on native income earners. Perhaps the most underappreciated evidence about immigration is its link to innovation. Immigrants are far more likely than natives to study science and engineering and more likely to produce innovations in the form of patents. Expanding the supply of immigration visas for high-skilled workers increases patenting activity in science and engineering, particularly in US high-tech firms. Relatively modest changes in US immigration policy could have profound effects on US competitiveness by redirecting a portion of legal immigration visas toward foreign students with the potential to be stars in science and engineering. In comparison to other countries, the United States does well in the global competition for talent. But it could do much better.
1. INTRODUCTION

When Google recently decided where to invest in social media-based computer games, it chose San Francisco, California. The primary attraction of the location was the presence of highly skilled labor, including computer scientists, engineers, web designers, and other technical professionals. A substantial fraction of these workers were not born in the United States. They came to the country to study in US universities or to fulfill temporary employment contracts for US companies under H-1B immigration visas and stayed on to become a permanent part of the US labor force. In California, skilled immigrant labor is vital to the state’s ability to attract and to retain businesses in high-tech industries. In 2008, 37% of California’s supply of engineers and computer scientists was foreign born. If these workers were, for some reason, to leave the state, many of California’s high tech firms would surely follow.

The experience of California raises the broader question of how immigration affects the competitiveness of American industry. Does the presence of immigrant labor enhance the capacity of US companies to compete internationally? By competitiveness, I mean the share of global demand that is met by US industries. Immigration may affect the market shares of US firms by making US labor cheaper, by raising the productivity of US factories, or by lowering the cost of trading with or investing in the rest of the world. Whether and how immigration affects US competitiveness affects both the level and the distribution of national income.

In this paper, I delve into ongoing research by economists on the consequences of immigration to examine its importance for US competitiveness. I begin, in section 2, by outlining a theoretical framework that identifies the mechanisms through which immigration

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2 I calculate labor supply by summing the wage income of workers in engineering and computer science occupations as listed in the 2008 American Communities Survey.
affects production costs, productivity, and trade costs. Then, in section 3, I discuss empirical evidence on the quantitative importance of these mechanisms. I proceed, in section 4, to describe how US immigration policy shapes the level and composition of immigration and how future changes in policy may affect US industries.

For economists, competitiveness is a slippery concept. It mixes productivity – how much one worker is capable of producing in one hour – with production costs – how much that labor hour costs. Changes in competitiveness do not map cleanly into changes in real earnings for capital or labor, which are the proximate determinants of the national standard of living.\(^3\) In the end, competitiveness matters only because it affects US living standards, a point sometimes lost in policy debates. The usefulness of economic theory is that it provides a framework for characterizing the pathways through which immigration affects the market shares of US industries and how, in turn, these changes in market shares affect factor earnings.

Consider two alternative types of immigration shocks, each of which raises global market shares for US industries but which have different effects on the national and international distribution of income. First, suppose that immigration causes aggregate US total factor productivity to increase, as a consequence, say, of foreign engineers creating new production technologies that make US capital and labor more productive. Higher TFP increases US output in all industries, raising the earnings of all factors of production in the process. The share of

\(^3\) To see that competitiveness is not isomorphic to income, consider two alternative shocks to the US commercial aircraft industry. First, imagine that Boeing develops a new aircraft engine, which allows it to capture market share from Airbus. The improvement in US competitiveness and the increase in US incomes (from Boeing’s enhanced profitability) would go hand in hand. Next, suppose that a new US firm enters commercial aircraft production, expanding US market share in the industry but driving down product prices, thereby reducing firm profitability in the sector. In this case, US competitiveness (i.e., market share) rises even as US incomes may fall.

A further caveat is that in evaluating changes in competitiveness one wants to hold constant a country’s trade balance. An increase in global market shares associated with rising net exports (implying the deferral of consumption from today until the future) is obviously much different from an increase in market shares with no change in the trade balance (implying no deferral of consumption). The former merely moves exports from the future to today, whereas the latter implies an increase in the steady state level of exports.
global demand met by US producers rises, with the composition of US output remaining unchanged. Because productivity expands across the board, no one industry grows at the expense of another. Further, the earnings of capital and labor rise proportionately, owing to the fact that their productivity increase is commensurate. The gain in TFP makes the United States wealthier and the rest of the world wealthier, as well. Since the productivity shock causes the market shares of US industries to rise globally, aggregate US TFP growth satisfies my definition of an improvement in US competitiveness. But it is one that is good for everybody.

Next, consider an immigration-induced change in competitiveness that isn’t good for everybody. Suppose that immigration, by increasing the supply of low-skilled labor, causes the wages of these workers in the United States to fall. US industries intensive in the use of low-skilled labor, such as perishable fruits and vegetables, see their profitability rise, allowing them to hire labor, land, and capital away from other sectors, including perhaps capital-intensive crops such as corn or wheat. As production expands in fruits and vegetables, it necessarily declines in some other sectors. The share of global demand met by US labor-intensive industries rises but the share met by some other US industries falls. In this example, the changes in competitiveness are sector specific, which entail differential changes in income by factor type. The owners of land suitable for fruit and vegetable production would likely see their real incomes grow, whereas the owners of land suitable for corn or wheat production may see their real incomes shrink. Further, native-born low-skilled workers in the United States may be hurt, as a consequence of the increase in labor supply lowering their wages.

In the first example, immigration is uniformly good for US industries and factors of production; in the second, it favors some sectors and factors over others. To consider whether either of these stories has relevance for the US economy, we need a model of how immigration
affects productivity, wages, and trade costs. I use the global general equilibrium framework developed by Eaton and Kortum (2002) to show how changes in immigration map into changes in outcomes of interest. Their model isn’t about immigration, per se, but it offers an elegant and intuitive explanation for the determinants of market shares by industry in the global economy, which makes it appealing for our analysis. One can add on to their framework a model of innovation and economic growth (Eaton and Kortum, 2009), which suggests how immigration may affect industry competitiveness dynamically.

There is intense debate among economists about the consequences of immigration. Today, immigrants account for 15% of the US labor force. Over the last two decades, much of the research on the subject has focused on the US influx of low-skilled labor, mainly from Mexico and Central America (Hanson, 2009). Between 1970 and 2009, immigrants as a share of the US population rose from 5% to 12%, with the newly arriving immigrants concentrated at the extremes of the skill distribution. Currently, 30% of working-age immigrants have less than a high school education, compared to only 8% of native-born adults. It is natural to imagine that large inflows of low-skilled immigrants put downward pressure on the wages of low-skilled native workers. However, the estimated impact of immigration on wages depends very much on the econometric approach that one takes (Borjas, 2003; Card, 2001). Immigration may also affect local prices for housing and non-traded services, which may in turn have indirect consequences for US competitiveness. I discuss evidence on the wage and price impacts of immigration and what it means for US industries.

The policy debate about immigration has also focused on low-skilled labor. One concern is that immigrants with low earnings potential are a net drain on US fiscal accounts, which increases the tax burden on US individuals and corporations (Hanson, 2005). Complicating the
discussion is the fact that a large fraction of low-skilled immigrants are in the United States illegally (Passel and Cohn, 2010). In 2009, unauthorized immigrants were 29% of the US foreign-born population and 5% of the US labor force. On the one hand, illegal immigrants lack access to most federally funded entitlements, mitigating their fiscal impact, at least at the federal level (Hanson, 2007). On the other hand, many illegal immigrants have children who attend public schools and, if they were born in the United States, have access to subsidized health care (Camarota, 2004). The absorption of publicly funded services results in fiscal transfers from native-headed households to immigrant-headed households. Because much of the funding for public education comes from states and localities, the fiscal consequences of immigration vary regionally. Part of immigration’s impact, then, is mediated by tax and spending policies at both the federal and state level. Industries located in states that tax corporate or individual income, have large immigrant populations, and provide benefits that are generous to immigrant families, may face a relatively large tax burden from immigration.

As the political debate about illegal immigration has intensified, high-skilled immigration has been lost in the noise. The omission is unfortunate because, arguably, high-skilled immigration matters much more for US productivity growth than low-skilled immigration. Low-skilled immigration may shift income from low-skilled workers to employers or from taxpayers to immigrant-headed households. But these impacts are largely static in nature and have only indirect effects on growth. For low-skilled immigration to have dynamic effects, it must change savings and investment decisions by firms and households. Such dynamic effects are plausible but likely to be small. Because the US tax system is progressive, more low-skilled immigration could increase tax rates disproportionately for high-income earners, reducing their incentive to work or to invest in human or physical capital. But the elasticity of labor supply with respect to
income appears to be small (Ashenfelter, Doran, and Schaller, 2010), suggesting that such disincentive effects are not large. Further, any such negative consequences may be offset by the fact that low-skilled immigration tends to reduce the price of household services that high-income earners consume (such as child care, house cleaning, and yard care), which enables them to spend more hours at work (Cortes and Tessada, 2009).

In contrast to low-skilled immigration, high-skilled immigration appears to have direct effects on economic growth. High-skilled immigrants are disproportionately represented in technical fields, in which recent US productivity growth has been most rapid. In 2003, foreign-born students accounted for 51% of PhDs in science and engineering fields awarded by US universities, up from 27% in 1973 (Bound, Turner, and Walsh, 2009). In theory, expanding the supply of scientists and engineers increases the US labor force devoted to R&D, which contributes to higher rates of innovation and has positive effects on economic growth (Jones, 1995). Empirically, increases in high-skilled immigration are associated with increases in patenting. While not all new patents find a productive application, a higher level of patenting typically means more innovation and faster productivity growth. Thus, high-skilled immigration affects US competitiveness by raising aggregate TFP and TFP in sectors that are intensive in the use of science and engineering skills.

A further manner through which high-skilled immigration affects competitiveness is through its impact on trade costs (Rauch, 1999). Arriving immigrants bring with them knowledge about market conditions and investment opportunities in foreign countries. Such

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4 For high-skilled immigration to enhance US innovation in this manner, it must be that the gains from innovation are not spread evenly across the globe but captured disproportionately by the US (as would occur if spillovers from innovation are localized or if innovating firms earn profits at the expense of global consumers).

5 In linking immigration and competitiveness, I am assuming implicitly that immigration does not worsen the US trade balance, an assumption that appears reasonable given the absence of obvious reasons for which high-skilled immigration would induce US households to reduce savings.
information flows are likely to lower the cost to US companies of doing business abroad and to foreign companies of doing business in the United States. By hiring immigrant workers, US companies may learn about new foreign inputs they can use in production or new foreign market niches that they can supply. Immigrants that return to their home countries may help US companies invest abroad, as has occurred in China, India, and Taiwan through the return to these countries of individuals who had worked in Silicon Valley (Saxenian, 2002). The international transmission of knowledge engendered by immigration may not help all industries or all regions equally. To the extent that information flows are limited to the sectors or the locations in which immigrants are employed, it will enhance US competitiveness in these locations but, through general equilibrium effects, diminish it in others.

2. IMMIGRATION AND COMPETITIVENESS IN THEORY

I have outlined three mechanisms through which immigration may affect the share of global demand that US industries satisfy. One is by changing production costs. Immigration alters the supply of low-skilled and high-skilled labor in the US economy, which may affect the prices of these factors facing US companies. A second mechanism is by changing productivity. High-skilled immigration adds to the economy workers used intensively in R&D, which may raise the rate of innovation in US industries. And a third mechanism is by changing trade costs. Immigration increases the international transmission of information, which may change the cost of doing business abroad for US firms, as well as the cost to foreign firms of doing business in the United States. In this section, I outline a theoretical framework that incorporates each of these mechanisms into a global general equilibrium setting.
2.1 Productivity, Production Costs, and Market Shares

Before contemplating immigration, we need to characterize the factors that determine the share of global demand in different industries that is satisfied by US firms. The Eaton and Kortum (2002) framework that I employ has three elements: (i) innovation, through which firm TFP is determined, (ii) the hiring of labor and intermediate inputs, through which factor prices are determined, and (iii) international competition, through which firms with the lowest prices (inclusive of the costs of international trade) win the right to serve particular markets.

One can think of the process of innovation as akin to firms playing a lottery, in which some will have good draws and develop processes that given them high TFP (or, equivalently, high product quality), while others will have bad draws, leaving them with low TFP (or low product quality). Notice that innovation lotteries as described here are about the level of TFP and not its growth. I take up sources of TFP growth in the next section.

A country’s courts, financial markets, education systems, and other institutions play a role in innovation lotteries. In the United States, well-developed markets for venture capital, strong enforcement of intellectual property rights, and high-quality universities make firms in high-tech industries more likely to have good innovation draws than firms in, say, Vietnam, whose legal, financial, and educational institutions are less developed. However, Vietnam has an abundant supply of low-skilled labor and rich tropical farmland, which may give firms in the country an advantage vis-à-vis rivals in the United States in coming up with cost effective ways of producing clothing or cultivating rice. Within each US industry, there will be some firms that succeed in innovating and others than do not, with the share of firms that succeed varying across industries according to US potential productivity in the sector, where potential productivity captures the set of factors that the determine the likelihood of successful innovation. One easily
recognizes this framework as a souped up version of Ricardian comparative advantage. Potential productivity is roughly the equivalent of absolute advantage in an introductory textbook model.

To produce output, firms hire labor and other factors and purchase intermediate inputs. The cost of labor is determined by its supply and demand, such that wages are higher where high productivity causes labor demand to be strong and lower where population growth, educational upgrading, or inflows of foreign workers expand labor supply. Strong potential productivity in one industry pushes up the price of labor for other industries, such that firms in industries with weak potential productivity will only survive if they have been particularly lucky in the innovation lottery. The price of intermediate inputs in a country depends on the country’s industrial capacity in upstream industries and the proximity of the country to upstream suppliers in other countries. Immigration has direct effects on input prices through its impact on labor supply. All else equal, US firms will have a cost advantage in industries that rely more heavily on the types of skills that US workers have in abundance (where the astute observer will detect a bit of Heckscher-Ohlin reasoning sneaking into the framework). If immigration increases the supply of these skills, it will enhance existing US cost advantages.

The price that a US firm charges in foreign markets will depend in part on its TFP (higher TFP means a firm can get away with charging a lower price) and economy-wide wages (where lower wages are passed through to lower prices) and in part on international trade costs (which represent an ad valorem markup on the foreign price of US goods). Trade costs are determined by importing country tariffs and non-tariff barriers, international freight and insurance costs, and foreign marketing and distribution costs. Let’s imagine that competition in industries is Bertrand, such that the lowest price firm wins the market for a specific product in a particular industry. Each industry consists of a large number of individual product varieties. US firms will
capture a larger market share – i.e., they will produce a larger share of product varieties – in industries in which US potential productivity is greater (such that a higher fraction of US firms have good innovation draws) or US input costs are lower (due either to a low share of low-skilled labor in production costs or a high share for high-skilled labor in production costs), and in countries in which trade costs vis-à-vis the United States are lower.

US export supply capacity in an industry is, then, the product of factors related to US potential productivity, US input costs, and international trade costs. The share of a specific market – e.g., semiconductors – that US firms will capture in a particular country – e.g., France – will depend on US export supply capacity for semiconductors in France relative to the export supply capacity for semiconductors in France of other countries that also serve the French market. Since I equate competitiveness with market share, US competitiveness rises in semiconductors when US export supply capacity in semiconductors rises relative to other countries. Such an outcome obtains when US potential productivity rises (meaning more firms innovate successfully), US input costs fall (meaning that US cost advantages rise), or trade costs specific to US firms decline (meaning that US firms gain market access relative to foreign rivals). Immigration affects export supply capacity by affecting productivity, production costs, or trade costs, completing the intuition developed in the introduction. I have not yet said anything about how changes in export supply capacity affect the level or the distribution of national income in the United States. I will address these outcomes in section 3, in which I consider how changes in the US economy brought by immigration may have affected US earnings for low-skilled labor, high-skilled labor, and capital.

2.2 Innovation and Economic Growth
The framework I’ve outlined so far is static in nature. Innovation lotteries determine the level of TFP among firms in an industry. For there to be economic growth, TFP must rise over time, which requires that potential productivity expand. To understand sources of productivity change, I follow Eaton and Kortum (2009) and draw on models of endogenous economic growth.

Imagine that instead of drawing their productivity from a lottery, firms invest in innovation by hiring R&D labor. The more firms invest, the more new ideas they generate and the more likely they are to generate market winning innovations. The firm with the best innovation captures the market for a specific product, at least until another firm comes up with something better. In this way, production in an industry follows a “quality ladder” or “productivity ladder,” in which new innovations steadily raise quality or TFP relative to the past state of the art (Grossman and Helpman, 1991). The rate of innovation and therefore the rate of economic growth depends positively on the supply of R&D labor, the productivity of R&D labor (which may vary across countries in a manner similar to variation in potential productivity), and the average magnitude of new innovations (in terms of their impact on raising quality or TFP), and negatively on the rate at which firms discount future profits.

How does immigration affect growth in such a framework? If immigration expands the supply of R&D labor in the United States, it raises investment in innovation, which increases the rate at which successful new innovations occur. To the extent that the global supply of R&D labor is constrained – as would be the case if there were only a small number of superstar scientists that were capable of generating significant innovations – the US attracting a star scientist would necessarily mean that another country loses her. The international competition for talent, then, may affect which countries generate most new innovations. Country immigration policies may constrain companies in their global talent search. With global trade,
innovations developed in the United States would ultimately diffuse to other countries (and vice-versa), either through imitation or through foreign direct investment, raising global growth. At least in theory, high-skilled immigration has the potential to affect US growth rates directly by raising industry innovation rates and thereby the rate of growth of industry export supply capacities.

2.3 Immigration and Trade Costs

International trade costs impede trade flows, and thereby diminish US industrial competitiveness, by acting as a tax on cross-border commerce. The commerce-inhibiting effects of trade barriers are obvious when one thinks of import tariffs, import quotas, or the costs of international shipping. However, incomplete information between countries about demand and supply may also inhibit trade. Information barriers may account for why countries with a common language, common colonial history, or common religious traditions tend to trade more, as among these countries cultural barriers to commerce may be small.

International migration creates linkages between a country and the rest of the world, which may help reduce information barriers and therefore lower international transaction costs. Casella and Rauch (2002) develop a model in which membership in a group – such as common ancestry or ethnicity – helps individuals in different countries reduce barriers to international trade associated with incomplete information. Relative to purely anonymous trade, the presence of group ties increases the volume of trade and GDP in the trading countries, though individuals lacking group ties are worse off (because they lose access to their more productive potential trading partners). Migration is an obvious mechanism through which cross-national group ties may be established and maintained over time.
In empirical analysis of bilateral trade flows using the gravity model, there is a robust positive correlation between bilateral trade and bilateral migration, indicating that a pair of countries trades more today when there has been high levels of migration flows between them in the past. This finding has been interpreted as evidence of a “diaspora externality,” in which previous waves of migration create cross-national networks that facilitate commercial exchange. Gould (1994) finds that bilateral trade involving the United States is larger with countries that have larger US immigrant populations. Head, Reis, and Swenson (1998) find that a 10% increase in Canada’s immigrant population from a particular country is associated with a 1% increase in bilateral Canadian exports and a 3% increase in bilateral Canadian imports.

Pushing the analysis a step further, Rauch and Trindade (2002) focus specifically on networks associated with overseas Chinese populations. Successive waves of emigration from southeastern China have created communities of ethnic Chinese throughout Southeast Asia, as well as in South Asia and on the east coast of Africa. Rauch and Trindade find that bilateral trade is positively correlated with the interaction between the two countries’ Chinese populations (expressed as shares of the national population), similar to the findings in Gould and Head, Ries, and Swenson. More interestingly, the correlation between Chinese populations and trade is stronger for differentiated manufacturing products than it is for homogenous goods. To the extent differentiated products are more subject to informational problems (Rauch, 1999), these are the goods one would expect to be most sensitive to the presence of business networks. Rauch and Trindade focus on Chinese business networks owing to their expanse, which makes empirically identifying their impact on trade feasible. Presumably, international business networks are common to many migrant communities. In the United States, large concentrations of immigrants from Latin America, Asia, and Europe, among other regions, may contribute to
decreasing US trade relations with these regions.

One issue about the relationship between trade and migration is that it is unclear whether greater trade is the outcome of increased migration or a reflection of the types of individuals who select into migration. If more skilled and more able individuals are more likely to migrate abroad and more likely to exploit business opportunities, then the correlation between trade and migration may be a byproduct of migrant self-selection. US policies to liberalize immigration may not necessarily increase trade with sending countries, unless they allowed for the admission of individuals with a higher propensity to engage in trade. Consistent with this reasoning, Head, Ries, and Swenson (1998) find that immigrants admitted as refugees or on the basis of family ties with Canadian residents have a smaller effect on trade than immigrants admitted under a point system that values labor-market skills.

Other evidence suggests international migration may increase the flow of investment between countries. In China, India, and Taiwan, the migration of skilled labor to Silicon Valley – where Indian and Chinese immigrants account for one third of the engineering labor force – has been followed by increased trade with and investment from the United States (Saxenian, 2002). By virtue of understanding business conditions in their home countries, these immigrants may be particularly well-positioned to exploit investment opportunities abroad. Immigrants attracted by the lure of engineering jobs in Silicon Valley, today, may contribute to investment by Silicon Valley firms in their home countries, tomorrow, which may then lead to expanded trade flows between the United States and these countries, in the future.

3. EMPIRICAL EVIDENCE ON IMMIGRATION AND COMPETITIVENESS

The theoretical framework developed in the last section identifies the mechanisms
through which immigration may impact the market shares of US industries in the global economy. In this section, I review evidence on how immigration may have affected production costs and industrial productivity in the United States. In considering these mechanisms, I emphasize what research has to say about the effects of immigration on factor earnings. In the end what matters is not just whether immigration causes US global market shares to rise but whether individuals in the United States are made better off.

3.1 Immigration and Production Costs

Over the last two decades, the US labor market has shifted in favor of utilizing more-skilled labor. Using www.ipums.org data from US population censuses and American Community Surveys, Figures 1a and 1b show the fraction of hours worked and the total wage bill accounted for by workers at different education levels. Between 1990 and 2008, the share in total employment of workers with a high-school education or less fell sharply, whereas the share with a college education or more (BA degree, master’s or professional degree, or PhD) rose sharply. Immigration, as we will see next, has attenuated the declining employment share of low-skilled workers and accelerated the rising employment share of high-skilled workers, leading the US supply of labor to be more concentrated at the extremes of the skill distribution than it otherwise would have been.

Figures 2a and 2b examine how the presence of immigrants in the US labor force has evolved over time. Each graph shows the share of hours worked accounted for by immigrants among individuals with a given level of education, where I plot these shares by year and labor-market experience groups (1 = 0-5 years of experience, 2 = 6-10 years of experience, 3 = 11-15 years of experience, 4 = 16-20 years of experience, 5 = 21-25 years of experience, 6 = 26-30
years of experience, 7=31-35 years of experience, and 8=36-40 years of experience). In all of
the graphs, the lines rise over time, with immigrant employment shares being higher in 1980 than
1970, higher in 1990 than 1980, and so on. Clearly, immigrants have become a more important
part of the US labor force across all education and experience levels, for both men and women.
However, the size of the increase in the immigrant employment share differs sharply across
education groups. The graphs for workers with less than a high school education show that
between 1970 and 2008 the share of immigrants in hours worked rose from under 10 percent to
over 40 percent for most experience groups and to over 50 percent for groups with 11 to 30 years
of experience. Among college graduates, there has also been a notable increase in the immigrant
share of hours worked, rising from around 5 percent in 1970 to over 15 percent 2008.

The importance of immigrants for changes in labor supply among high-skilled workers is
seen more clearly in Figures 3a and 3b, which breaks the college educated into four schooling
groups. In 2008, among younger workers (with less than 20 years of labor-market experience)
immigrants accounted for around 20 percent of hours worked among men with a professional
degree, 20-30 percent of hours worked among men with a master’s degree, and over 40 percent
of hours worked among men a PhD. Figures for women are similar. Clearly, foreign-born
workers are now a significant part of US labor supply among the very highly educated.

How does rising immigration change the wages of workers at different skill levels?
According to a simple model of labor demand and labor supply, the wages for the most affected
groups – the very low-skilled and the very high-skilled – should have been adversely affected by
immigration. A decline in wages would lower production costs, aiding firms that employ
immigrant labor relatively intensively. However, the labor-market consequences of international
migration have inspired intense debate among scholars and there is not yet a consensus about the
wage impacts of immigration in the United States.

Borjas (2003) defines labor markets at the national level according to a worker’s education and labor-market experience, using the same groups as in Figure 2. Over the period 1960 to 2000, education-experience cells in which immigrant labor supply growth has been larger – such as for young male high school dropouts – had slower wage growth, even after controlling for education or experience specific wage shocks (i.e., including education-by-year and experience-by-year fixed effects in the estimation). Borjas’ evidence is consistent with immigration having depressed wages for low-skilled US workers. A 10% increase in the population due to immigration leads to a 3% to 4% reduction in US wages. The concern about this approach is that it might confound immigration with other labor-market shocks that have hurt low-skilled workers, such as skill-biased technological change. Absent controls for these other shocks, one cannot be sure that the attributed wage changes are really due to immigration.

Applying a similar approach to Canada, Aydemir and Borjas (2007) find comparable evidence of the wage effects of immigration. In Canada, where immigration has been dominated by workers toward to the top end of the skill distribution – owing to Canada’s use of skill-based point system to regulate immigration – immigration is negatively correlated with wages across education-experience cells, with more-educated workers being the ones who have suffered the largest negative wage effects from foreign labor inflows. Since Canada is presumably subject to many of the same technology shocks as the United States, it would not appear that unobserved technology shocks could explain away the wage effects of immigration in both countries.

An older and larger literature has searched for immigration’s impact by correlating the change in wages for low-skilled US natives with the change in the immigrant presence in local labor markets, typically at the level of US cities. These area studies tend to find that immigration
has little if any impact on US wages. Card (2005) argues that if immigration has affected the US wage structure one should see larger declines in the wages of native high school dropouts, relative to native high school graduates, in US cities where the relative supply of high school dropouts has expanded by more. In fact, the correlation between the relative wage and the relative supply of US high school dropouts across US cities is close to zero.

The area study approach also has its problems. Immigrants may tend to settle in US regions in which job growth is stronger, causing one to underestimate the wage impact of immigration when using city or state-level data. As a correction, many studies instrument for growth in local immigrant labor supply using lagged immigrant settlement patterns. But this strategy requires strong identifying assumptions. It would be invalid, for instance, if the labor-demand shocks that influence immigrant settlement patterns are persistent over time (Borjas, Freeman, and Katz, 1997).

One explanation for why low-skilled immigration may not have had larger impacts on US wages is that immigration induces firms to change their investment decisions in a manner that offsets the wage effects. Lewis (2010) finds that in US states experiencing more immigration firms invested less heavily in automation machinery. Automation machinery replaces low-skilled labor, reducing the demand for their services. Thus, immigration may have induced firms to be less capital intensive in production than they otherwise would have been. Less investment in physical capital that replaces low-skilled labor may have helped mitigate the negative effect of immigration on wages. Lewis’ results apply to US manufacturing over the 1998 to 1993 period. It is unclear how much they matter for other industries or time periods.

Despite the conflicting evidence on wages, there are other results suggesting that immigration has had significant economic impacts on prices in US cities that have experienced
larger influxes of immigrants. Cortes (2008) finds that in the 1980s and 1990s US cities with larger inflows of low-skilled immigrants saw larger reductions in prices for housekeeping, gardening, child care, dry cleaning and other labor-intensive services. She finds that a 10% increase in the local population due to immigration is associated with decreases in prices for labor-intensive services of 1.3% percent. As prices for these services fall, highly educated women are likely to increase the number of hours they spend working. Cortes and Tessada (2009) find that as a consequence of US low-skilled immigration over the period 1980-2000 highly educated women increased their weekly labor supply by approximately 45 minutes, with women working the longest hours having the largest increases.

A second impact of immigration is on the price of land. As immigrants are attracted to a location, the demand for housing rises, which may lead to increases in the price of housing, unless housing supply is relatively elastic. Saiz (2007) examines the correlation between immigration and housing prices and finds that an increase in immigration equivalent to 1% of the population of a US city is associated with a 1% increase in local housing values.

A third impact of immigration is on local or national taxes. Immigration may affect production costs by altering tax rates faced by workers or businesses. Where immigrants pay more in taxes than they receive in government benefits, as is likely the case with high-skilled immigrants, immigration reduces the net tax burden on native taxpayers. Where immigrants pay less in taxes than they receive in government benefits, as is likely the case with low-skilled immigrants, immigration increases the net tax burden on natives.

In the United States, immigrant households have historically made greater use of subsidized health care, income support to poor families, food stamps and other types of public assistance (Borjas and Hinton, 1996). immigrant households tend to be larger than native
households, have more children, and have very low incomes, making them eligible for means-tested benefits. In the last decade and a half, however, the difference between immigrant and native use of welfare programs in the US has fallen or even reversed, largely because of welfare reform in 1996, which restricted non-citizens from having access to many federally funded benefit programs. While immigrant households still make greater use of public healthcare than native households (largely through their US born children), they make comparable or less use of other types of public assistance (Borjas, 2003; Capps et al., 2005).

Because immigrant-headed households tend to have more children of school age than native-headed households, increasing immigrant presence in a locality is likely to increase demand for public education. Thus, even if immigrant use of social services does not differ from that of natives, growth in the immigrant population increases school enrollments, placing a strain on state or local government finances. In 2004, the fraction of school age children who had foreign-born mothers was 47% in California, 30% in Nevada, 29% in New York, 27% in Arizona and Florida, and 26% in New Jersey and Texas.

Calculating the fiscal consequences of immigration precisely is difficult. One needs to know many details about the income, spending, and employment of immigrants. There are few comprehensive analyses of the fiscal impact of immigration. In one of the few such studies, Smith and Edmonston (1996) estimate that in 1996 immigration imposed a short-run fiscal burden on the average US native household of $200, equivalent to 0.2% of US GDP. In the United States, the fiscal consequences of immigration appear to matter for individual preferences over immigration policy. Hanson, Scheve, and Slaughter (2007) find that US natives who are more exposed to immigrant fiscal pressures – those living in states that have large immigrant

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6 This estimate is based on short run considerations. Allowing for dynamics could change the results.
populations and that provide immigrants access to generous public benefits – are more in favor of reducing immigration. This public-finance cleavage on immigration policy is strongest among natives with high earnings potential, who tend to be in high tax brackets. Thus, growth in the local immigrant population may contribute to political conflict over immigration policy, working through immigration’s impact on local public accounts.

In sum, there is evidence that in the United States immigration has put downward pressure on the wages of low-skilled labor, high-skilled labor, and the prices of labor-intensive services, and upward pressure on housing prices and the net tax burden facing native-headed households. Such changes help industries intensive in the use of very low-skilled or very high-skilled labor but hurt industries located in regions in which immigrants have caused state or local spending on education or social services to increase. Many US regions are seeing both types of changes occur simultaneously – increases in low-skilled and high-skilled immigrant labor supply and increasing net fiscal burdens on local taxpayers – implying that which industries gain and which lose from immigration depend on specific details regarding industry skill intensity in employment and exposure to tax increases.

3.2 Immigration and Innovation

Clearly, immigration matters for the supply of human capital in the United States. Absent the arrival of foreign students and highly skilled foreign labor, the country would have far fewer engineers, scientists, and other technical professionals. The theoretical framework developed in section 2 suggests that the presence of such labor affects innovation positively. I turn next to evaluate evidence on whether immigration has altered the scale and composition of innovative activities in the United States.
Highly skilled foreign individuals enter the US labor force primarily through three channels: F-1 immigration visas, which permit them to study in the United States and work in US universities; H-1B temporary immigration visas, which permit them to work for a specific US employer for a period of three years (renewable once); or an employer-sponsored permanent immigrant visa, or green card. Other temporary immigration options for high-skilled labor exist but are small by comparison. Figure 4 shows the number of new F visas issued by the US Department of State between 1966 and 2010. Until 2001, the number of foreign students shows a strong upward trend. Between 1990 and 2000, the number of visas increased by 31%. After the events of 9/11, the US government put new restrictions in place that required individuals applying for F visas to undergo an interview at a US consulate and those wishing to study science or engineering to undergo an FBI background check (Alden, 2009). The practical impact of these restrictions was sharp reduction in visas issued, which fell from 284,000 in 2001 to 216,000 in 2003. The number of F visas has since recovered but in the interim many foreign students likely have decided instead to study in their home countries, or in Australia, Canada, France, Germany, or the United Kingdom, which are among the countries that compete with the United States in university education. One consequence of the visa restrictions was, not surprisingly, a reduction in the number of foreign students enrolled in US universities. Figure 5 shows US enrollments for foreign graduate students from the Institute for International Education (www.opendoors.iienetwork.org). After increasing by 78% between 1990 and 2003, enrollment of foreign graduate students declined from 280,000 in 2003 to 266,000 in 2007, before recovering slightly. Given F visas affect the flow of new students into the stock of enrollees, one would expect the 9/11 visa restrictions to reduce enrollments with a lag, as Figure 5 suggests occurred.
The 9/11 shock to F visas contributed to a downward trend in the US share of global university education. Between 1970 and 2006, the US share of enrollments in worldwide higher education fell from 29% to 12% (Freeman, 2009). There are many reasons why a decline in US market share for higher education is occurring. As other countries catch up to the United States in terms of income, they are likely to expand local university offerings. Perhaps more of a concern is that the United States is also losing market share in graduate training in science and engineering, fields which are directly related to the country’s capacity for innovation. Freeman shows that in 1975 the United States produced over four times as many PhDs in science and engineering as did China, Japan, India, and Korea combined; by 2006 these countries produced 23% more science and engineering PhDs than the United States.

Do foreign students affect US productivity? Stuen, Mobarak, and Maskus (2010) examine the changing number of foreign science and engineering graduate students in US universities over the period 1973 to 1998, focusing on the top 100 US schools. Graduate students are key inputs into university research, providing both grunt work as research assistants and substantive contributions as collaborators. Stuen, Mobarak, and Maskus report that in a recent survey of Science, a premier scientific journal, 87% of papers published had a student or post-doctoral fellow as a co-author, with 60% of these co-authors being foreign born. In their analysis, they exploit the fact that shocks in foreign countries, associated with macroeconomic crises, military conflicts, or changes in political regime, affect the ability of students from these countries to travel to the United States for graduate study. These shocks provide a source of exogenous variation in the supply of foreign graduate students in the United States. The authors find that a 10% reduction in a university’s share of science and engineering graduate students that are foreign born leads to a 5% to 6% reduction in research output, measured as publications.
in peer-reviewed journals or citations of published research. One interpretation of their result is that losing access to foreign students restricts US university access to scientific talent, which reduces the productivity of US researchers. For this interpretation to hold, it must be true that the domestic students that replace foreign students lost to turmoil in their home countries are less able, not as hard working, or less diverse in their intellectual perspectives.

The emphasis on science and engineering is warranted by the fact that occupations related to these fields are at the heart of US innovation. Hunt and Gauthier-Loiselle (2008) use the 2003 National Survey of College Graduates to examine patenting activity by native and foreign-born university degree holders. US immigrants patent at twice the rate that natives do, a difference that is explained entirely by the much higher propensity of the foreign born to hold degrees in science and engineering. They find further that for every 1% increase in the population made up by immigrant university graduates, patents per capita increase by 6%. They offer suggestive evidence that patenting by immigrants does not crowd out patenting by domestic workers (as would occur if immigrants simply captured jobs from native-born workers in which workers are more likely to generate new patents). Instead, there may be positive spillovers from immigrants to natives in innovation. The link of immigrants to university education in the United States turns out to be important for innovative outcomes. Immigrants who did not study in the United States and who arrived in the country at an older age do not exhibit the same positive patenting differential vis-à-vis natives (Hunt, 2009).

Of course, only a small fraction of foreign students in the United States turn out to be superstars in their chosen fields. But attracting these superstars appears related to regional economic performance. Zucker and Darby (2008) follow 5,400 highly cited scientists from the 1980s to the 2000s. Of this group, 62% reside in the United States, the large majority of them
having graduated from US universities. Attracting a star scientist to a US region (say, when she is hired by a local university) is associated with a higher likelihood of firm entry in fields related to the scientist’s area of study. It is difficult to make causal inferences from this association but it appears that innovation in universities may be related to innovation in local industries.

After completing university training, foreign students must change their visa status in order to stay and work in the United States. The H-1B immigration visa is a common channel through which foreign students with US university degrees enter the US labor market. (Indeed, Kato and Spulber (2010) suggest that reductions in the supply of H-1B visas lower the academic quality of foreign applicants to US universities.) Workers abroad recruited by employers with US operations are another group that utilizes these visas. An H-1B visa gives an individual the right to work in the United States for three years. Applications for visas are filed by a US employer. Renewal for a second three-year period is generally automatic for those complying with visa guidelines. Figure 6 shows the number of new H-1B visas made available each year by the US government. The program, which came into existence in 1990, initially made 65,000 visas available each year. The quota was raised to 115,000 in 1999 and to 195,000 in 2001, at the behest of employers in high-tech industries who demanded an increase in visa supplies during the late 1990s US technology boom. In 2003, Congress allowed the quota to return to its original 65,000 level where it remains.

Visas are awarded to applicants on a first-come, first-served basis. When the number of applications exceeds the quota, as occurred on the first day applications were accepted in both 2007 and 2008, the US Department of Homeland Security awards visas by lottery. High-tech companies are the largest users of H-1B visas. Kerr and Lincoln (2010) report that between 1995 and 2008, science, engineering, and computer related occupations accounted for 60% of H-
To hire a worker on an H-1B visa, an employer must apply for and receive a foreign labor certification from the US Department of Labor, verifying that the foreign worker will not displace a US worker. DOL records show the number of foreign labor certifications sought by US companies. In 2008, Cisco Systems applied for 4,747 certifications (for both new and renewing H-1B visas), Hewlett-Packard applied for 4,358, IBM applied for 2,601, Microsoft applied for 3,442, and Sun Microsystems applied for 1,834.\textsuperscript{7}

To examine how H-1B visas affect US innovation, Kerr and Lincoln (2010) exploit the fact that the supply of visas has varied over time according to Congressional changes in the visa quota. They examine patenting activity by individuals with identifiably Chinese or Indian names (given that patent applications do not list an individual’s immigration status). Over the period 2000 to 2005, 50\% of H-1B visas went to individuals from India or China. Since the H-1B program was established in 1990, the share of patents awarded to individuals with Indian names increased from 3\% to 5\% and the share going to individuals with Chinese names increased from 4\% to 9\% (trend growth in these shares was more modest before 1990). The patent shares going to these two groups are substantially higher in fields related to computers, electronics, chemicals, or pharmaceuticals. Kerr and Lincoln allocate H-1B visas across US cities according to where the employers that apply for the visas are located. The cities that attract most H-1B visa holders are San Francisco, Miami, Washington, DC, Raleigh-Durham, Boston, Austin, and New York. A 10\% increase in the population of H-1B visa holders is associated with a 1\% to 4\% increase in city patenting activity (for every standard deviation increase in a city’s share of H-1B visas). They also allocate H-1B visas across large employers according to their historic use of the visas.

\textsuperscript{7} Business services companies are the largest users of H-1B visas. These entities in effect subcontract H-1B workers out to US companies that need their services; they appear to attract relatively low level software programmers. They include multinationals from India (e.g., Wipro, Infosys Technologies, McPhasiS, and Satyam Computer Systems) and US-based companies (e.g., Xceltech, Enterprise Business Solutions, Business Intelligence Systems).
A 10% increase in population of H-1B visa holders is associated with 4% to 5% increase in company patenting activity (for every standard deviation increase in a firm’s share of H-1B visas). It thus appears that expanding the number of H-1B visas may increase patenting in companies that specialize in high-tech activities and in US cities where high-tech companies are based.

To remain in the United States after the H-1B visa expires, an individual must obtain a US green card. This requires being sponsored either by a US family member or US employer (or seeking one of the small number of green cards made available through lottery). Though US-educated immigrants who have US work experience under an H-1B visa would seem to be natural candidates for an employer-sponsored green card, the limited supply of these visas means that workers often seek other paths to residency. The Immigration Act of 1990 set an overall annual cap on the number of green cards at 675,000, with specific quotas assigned to immigrants who are family-sponsored (480,000), employment-based (140,000), or entering under the diversity program (55,000) (US Department of Homeland Security, 2009). Immediate relatives of US citizens may obtain visas not subject to a cap. Figure 7 shows the allocation of permanent resident visas by category over the period 1998-2008. Two-thirds of visas went to family members of US citizens or legal residents, with 44% going to immediate family members and 21% going to other family members. Only 15% of visas went to individuals sponsored by their employers. Given the relative ease of obtaining visas through family connections, it is perhaps not surprising that among individuals obtaining a green card in 2003 who had first entered the United States on a student visa, 56% obtained the green card through marrying a US citizen, whereas only 20% were sponsored by a US employer (Rosenzweig, 2006). It thus appears that obtaining permanent residence in the United States is enhanced not just by being a good student.
or managing to land a US job but by succeeding in the dating market, as well.

4. US IMMIGRATION POLICY AND AMERICAN COMPETITIVENESS

The lessons from section 2 are that US industries capture larger global market shares when their export supply capacity expands. Export supply capacity, in turn, depends on US productivity levels, production costs, and international trade costs. Immigration may lower wages, and therefore production costs, for employers that use intensively the skills that immigrants bring with them. It may also accelerate productivity growth, if the arrival of foreign workers expands the supply of R&D labor that is used intensively in innovation. Further, immigration may lower the costs of international trade by reducing informational barriers.

Empirical evidence, discussed in sections 2 and 3, suggests that all these mechanisms are operative. Immigration (probably) lowers wages for native workers than compete with immigrants for jobs and also lowers prices of labor-intensive services. At the same time, immigration tends to bid up housing prices and to increase tax burdens on native taxpayers, at least in regions that have a large population of low-skilled immigrants and that provide relatively generous services to them. Perhaps the most striking and underappreciated evidence about immigration is its link to innovation. Immigrants are far more likely than natives to study science and engineering and as a consequence are more likely to produce innovations in the form of patents. Expanding the supply of high skilled immigrant workers expands patenting activity in science and engineering fields, particularly in high-tech firms and in US regions that house these firms.

There is both a strong theoretical and empirical case to be made that immigration improves US competitiveness in high-tech industries (in the sense that it would expand the share
of global demand for high-tech products met by US firms). To what extent does US policy incorporate the effects of immigration on competitiveness into decisions about how many visas to allot to whom to allot them? The short answer is not much.

As we see in Figure 7, the United States places much more weight on family reunification than it does on employability in allocating permanent residence visas. Figure 8 shows the allocation of visas by legal status. Fully 30% of US immigrants are unauthorized, with the vast majority of these individuals being low skilled. The United States thus appears to favor relatively high levels of low-skilled illegal immigration and immigration of US family members. Further, levels of high-skilled immigration are only weakly responsive to economic conditions. It is clear in Figure 6 that Congress did not expand H-1B visas until the 1990s technology boom was nearly over, then kept visas high during the 2001-2002 recession (when demand for visas was low), and finally reduced visa supply in 2003 just as the US economy (and visa demand) was beginning to expand once again, yielding binding visa quotas shortly thereafter.

It thus appears that the United States tries hard to divert opportunities for immigration away from high-skilled workers. However, things are not as bad as they seem, especially when compared to other high-income countries. In luring high-skilled immigrants, it is the attractiveness of the US relative to other countries that matters. Relative attractiveness depends, in part, on US wages and the malleability of US admission policies. Compared to other countries, the US does well on both counts. Figure 9 shows immigrants as a share of the population in the United States, Europe, and Australia, Canada, and New Zealand. Immigration is on the rise across the board, showing the strongest increases in Ireland and Spain, which are the European countries that until 2008 had both relatively fast income growth and booming construction sectors. Despite US policies, the United States compares favorably in the skill
profile of the immigrants it attracts. Figure 10 shows the share of the immigrant population with 13 or more years of schooling in high-income countries. The tertiary educated are nearly 60 percent of the foreign-born population in Canada, as a consequence of the country’s point system which gives preference to more skilled individuals in granting immigration visas. The United States has the second most educated immigrant population, with 42% of US immigrants having 13 or more years of schooling. In Europe, education levels among immigrants are far lower, with less than 30 percent of immigrants having tertiary education in all countries.

What accounts for the skill profile of US immigrants relative to other nations? Grogger and Hanson (2008) examine the factors that affect the skill composition of bilateral migration flows into OECD economies. They find that countries in which the reward to being a skilled worker is relatively large attract a disproportionate share of more-educated emigrants. In the United States and Canada, the difference in earnings between high-skilled and low-skilled workers is much greater than in continental Europe, with this difference being even larger once we account for Europe’s more progressive tax system and generous welfare benefits. Compared to Europe, the United States has relatively high inequality in pre-tax earnings, with Europe’s tax and welfare policies making the United States appear even more unequal when earnings are evaluated post-tax. The United States and Canada are home to 51% of the OECD’s immigrants, but 66% of its immigrants with tertiary schooling. Europe, in contrast, receives 38% of the OECD’s immigrants, but only 24% of those who are tertiary-educated. Skilled immigrants find their way into the United States – in spite of the country’s immigration policies – because the reward to skill in the country is so large. Canada attracts skilled immigrants by making its policies as favorable toward them as any high-income country. Making US immigration policy more like Canada’s would further enhance the attractiveness of the US as a destination, given the
already large advantage afforded by the US wage structure.

Another dimension in which the United States performs relatively well in its immigration policy is in addressing changes in the demographic structure of the labor force. Throughout the rich world, fertility rates have been dropping sharply over the last several decades, such that Korea, Japan, Singapore and most countries in Europe have population growth rates that are well below replacement. As a consequence, the size of the native-born labor force is beginning to decline. One possible role for immigration policy is to ease adjustment to a future with smaller populations, given a near term in which the population of retired workers will be large the population of active workers will be small (with corresponding pressures on government budget deficits to grow to cover public pension liabilities). In the United States, past high levels of immigration have helped keep birth rates relatively high, allowing the US population to continue to expand. Figure 11 shows the change in the working age population that will result in countries between 2005 and 2020 if they allow no further immigration. Japan’s working-age population will fall by over 10 percent and Italy’s and Germany’s by over five percent. In the United States, in contrast, the working age population will expand by over five percent, even with no additional inflows of foreign workers. The United States faces comparatively minor challenges in adjusting to changes in the age structure of its population.

Comparisons to other countries suggest that whatever the United States getting wrong in its immigration policy, other countries may be doing much worse. Still, were the country to expand the objectives of immigration policy to include promoting US competitiveness, the changes would be profound. Shifting immigration visas toward high-skilled workers would have the potential to expand the US science and engineering labor force, to increase the rate at which US companies create new patents, and to increase the rate of productivity growth in the US

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economy. In the process, the United States would likely shift resources toward production activities that are intensive in the use of science and engineering talent and away from other activities. Simply reducing visas to family members of US residents by one quarter (roughly 150,000 visas a year) would allow the number of employer-sponsored green cards to double. Reducing family-based visas by one half would allow employer-sponsored visas to triple. Relatively modest changes in immigration policy could then have profound effects on US competitiveness, if the redirected (or expanded) immigration visas were targeted toward foreign students with the potential to be stars in science and engineering. The United States does reasonably well in the global competition for talent but it could do much better.
REFERENCES


Passel, Jeffrey, and D’Vera Cohn. 2010. “US Unauthorized Inflows are Down Sharply Since Mid Decade.” Pew Center for Hispanic Studies.


FIGURE 1: SHARE OF US EMPLOYMENT BY EDUCATION GROUP

(a) Hours Worked

(b) Wagebill
Figure 2: Immigrant share of US employment by education and experience
(a) Males

(b) Females
Figure 3: Immigrant share of employment for highly educated workers
(a) Males

(b) Females
FIGURE 6: ANNUAL CAP ON NEW H-1B VISAS FOR SKILLED LABOR
FIGURE 7: DISTRIBUTION OF LEGAL PERMANENT RESIDENCE VISAS, 1999-2008

Immediate relatives of US citizens: 428,000 (44%)
Employer sponsored: 149,000 (15%)
Family sponsored: 210,000 (21%)
Refugees/asylees: 12,000 (11%)
Diversity: 45,000 (4%)
Other: 37,000 (4%)
FIGURE 8: COMPOSITION OF THE US FOREIGN BORN POPULATION BY LEGAL STATUS, 2007

- **Naturalized Citizens**: 14.2 million (36%)
- **Legal Permanent Resident Aliens**: 12.3 million (31%)
- **Unauthorized Aliens**: 11.9 million (30%)
- **Temporary Legal Residents**: 1.4 million (4%)

*Note: The percentages do not sum up to 100% due to rounding.*
FIGURE 9:

PERCENT OF FOREIGN BORN IN THE NATIONAL POPULATION

Source: OECD.
FIGURE 10: PERCENT OF IMMIGRANT POPULATION WITH 13+ YEARS OF EDUCATION, 2000

Source: OECD.
FIGURE 11: CHANGE IN WORKING AGE POPULATION 2005-2020 WITH ZERO IMMIGRATION

(AS % OF 2005 POPULATION)

Source: OECD.