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Restriction or Legalization?
Measuring the Economic Benefits of Immigration Reform

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Executive Summary

By the latest estimates, 8.3 million workers in the United States are illegal immigrants. Proposed policy responses range from more restrictive border and workplace enforcement to legalization of workers who are already here and the admission of new workers through a temporary visa program. Policy choices made by Congress and the president could have a major economic impact on the welfare of U.S. households.

This study uses the U.S. Applied General Equilibrium model that has been developed for the U.S. International Trade Commission and other U.S. government agencies to estimate the welfare impact of seven different scenarios, which include increased enforcement at the border and in the workplace, and several different legalization options, including a visa program that allows more low-skilled workers to enter the U.S. workforce legally.

For each scenario, the USAGE model weighs the impact on such factors as public revenues and expenditures, the occupational mix and total employment of U.S. workers, the amount of capital owned by U.S. households, and price levels for imports and exports.

This study finds that increased enforcement and reduced low-skilled immigration have a significant negative impact on the income of U.S. households. Modest savings in public expenditures would be more than offset by losses in economic output and job opportunities for more-skilled American workers. A policy that reduces the number of low-skilled immigrant workers by 28.6 percent compared to projected levels would reduce U.S. household welfare by about 0.5 percent, or $80 billion.

In contrast, legalization of low-skilled immigrant workers would yield significant income gains for American workers and households. Legalization would eliminate smugglers' fees and other costs faced by illegal immigrants. It would also allow immigrants to have higher productivity and create more openings for Americans in higher-skilled occupations. The positive impact for U.S. households of legalization under an optimal visa tax would be 1.27 percent of GDP or $180 billion.

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This study explains the implications for the U.S. economy of different policies toward illegal labor, ranging from increased enforcement at the border and in the workplace to a temporary worker program.

Introduction and Methodology

As of March 2008, there were an estimated 8.3 million illegal immigrants working in the United States, accounting for about 5 percent of total employment.[1] Public attitudes on illegal immigrants vary from the negative view that they are impoverishing low-income legal residents by depriving them of jobs to the positive view that they are a vital part of the U.S. economy because they perform tasks that legal residents are unwilling to undertake. Illegal immigration is now a major component of the political debate with policy suggestions ranging from mass deportation to legalization and amnesty.

The aim of this study is to explain and measure the implications for the U.S. economy of different policies toward illegal labor, ranging from increased enforcement at the border and in the workplace to a temporary worker program that would allow additional foreign workers to enter the United States legally. In determining the economic impact, the study will consider the number of illegal immigrants, their skill mix, their wage rates, the taxes they pay, and the public expenditures made on their behalf. We will combine these data with data on the structure of the U.S. economy and the skill mix of U.S. workers. In drawing conclusions from the data, we need to make assumptions about the demands for and supplies of illegal immigrants, and the growth prospects for the U.S. economy. To analyze the interconnected effects of policy changes on the U.S. economy, we employ a 38-industry, 50-occupation version of the U.S. Applied General Equilibrium model.[2]

A computable general equilibrium model such as USAGE allows us to approximate the economywide effects of a policy change on distinct but interconnected markets. It takes into account interrelated changes in labor demand and supply, wages, capital investment, public expenditures and revenues, and exchange rates and trade. Although the model is complex, the intuition behind it is not. The results can be understood and explained by familiar economic mechanisms such as supply and demand curves supplemented by back-of-the-envelope calculations. This allows readers to assess our results in terms of both the plausibility of the underlying theory and the reliability of the data.[3]

The study uses seven USAGE simulations to measure the economic impact of different policy changes toward illegal immigration. In the first two simulations, the policies restrict illegal immigration. In Simulation 1, the restrictive policy is tighter border enforcement; in Simulation 2, it is tighter internal enforcement.

In the other five simulations, we consider policies in which illegal immigration is largely replaced by programs of entry visas. Under such programs, employers in the United States would be able to offer jobs on a temporary basis to people outside the country. Such a policy change would largely eliminate smugglers' fees and other costs of illegal entry, thereby inducing an increase in the supply of what we will now refer to as guest workers.

In Simulation 3, we assume that the workforce characteristics (e.g., productivity) of guest workers are the same as those of the illegal immigrants considered in Simulations 1 and 2. In Simulations 4 and 5, we recognize that it is likely that legalization would move the characteristics of immigrant workers in each occupation toward those of native-born workers. This means that guest workers would be more readily substitutable for U.S. workers in the same occupations and have higher productivity than illegal immigrants. In Simulations 6 and 7, we introduce a visa tax. This would be paid by employers seeking a permit to allow them to hire a foreign worker. The tax can be used to control the number of guest workers and to facilitate the transfer to U.S. households of part of the guest-worker surplus. This surplus is the gap between the value of what guest workers can produce and the wage necessary to induce them to supply their labor.

Via the USAGE model, the effects of changes in immigration policy on the economic welfare of U.S. households can be understood in terms of six factors: (1) the direct effect on the output of illegal or guest workers relative to the cost of employing them; (2) the effect on the occupational mix of U.S. workers; (3) the effect on the amount of capital owned by U.S. house-

holds; (4) the effect on the employment rate of U.S. workers; (5) the effect on public expenditures; and (6) the effect on the macro structure of prices, particularly the prices paid for imports and exports. The six factors will be explained in more detail below.

To simulate the effects of each policy change requires two runs of the model: a business-as-usual run and a policy run. The business-as-usual run is intended to create a plausible baseline forecast out to 2019 that assumes no policy changes are made, while the policy run generates deviations away from the forecast caused by the policy change under consideration. For the most part, we report percentage deviations in variables (such as wage rates and employment) away from their business-as-usual paths caused by the policy.

In our business-as-usual forecast we assume that the present global slowdown will be short-lived. Under this assumption, employment of foreign illegal workers will grow from 7.3 million in 2005 (the base year) to 12.4 million in 2019—an annual rate of growth of 3.8 percent. Rapid growth of illegal employment occurs despite only moderate growth (about 1 percent a year) in the net inflow of illegal immigrants. The reason is that the net inflow in 2005 was large, so that even if there were no growth in net inflow, the stock of illegal workers in the United States would increase rapidly. By contrast with the 3.8 percent annual growth in employment of illegal workers, employment of legal workers grows at an annual rate of only 1 percent.

Throughout the study, we will use the terms "unauthorized" or "illegal" immigrants to describe those workers who are in the country without valid documents. When discussing policies that would authorize them to work in the United States on a limited tenure, it would be confusing and inaccurate to continue to refer to them as illegal. Under such policies, we would expect most illegal immigrants to transform into what we will refer to as "guest workers." When we use the terms "U.S. households" or "U.S. workers," we mean everyone in the United States excluding illegal immigrants and guest workers. This includes U.S. citizens as well as legal permanent residents.

Summary of Results: The Gains from Legalization

A major finding of the study is that the program of tighter border enforcement, Simulation 1, strongly reduces the welfare of U.S. households. A principal effect is that it raises the wage rate of the illegal immigrants who remain in the United States, in effect transferring income from legal residents of the United States to illegal immigrants. Even more importantly, restricting the inflow of illegal immigrants biases the occupational mix of employment for U.S. workers toward low-paying, low-skilled jobs as those jobs become relatively more attractive and available compared with higher-paying occupations. This eventually reduces the overall productivity of U.S. workers and consequently their average real wage rate.

Tighter internal enforcement, Simulation 2, has negative effects similar in magnitude to that of Simulation 1. Rather than the scarcity value of illegal immigrants being realized as an increase in illegal wage rates, it is dissipated in prosecution-mitigating activities by employers, including the hiring of lawyers, accountants, and other professionals. In the language of economics, the scarcity value of illegal immigrants is translated into a dead-weight loss.

In Simulation 1, increased border security moves the supply curve for illegal immigrants sufficiently inwards to reduce their employment in the United States in 2019 by 28.6 percent, from 12.4 million in the business-as-usual run to 8.8 million in the policy run. This reduces the welfare of U.S. households by the equivalent of 0.55 percent of the gross national product, or $80 billion in today's economy.[4] The internal enforcement scenario, Simulation 2, is scaled to have a similar effect on illegal employment as that in Simulation 1. In Simulation 2, the reduction in U.S. household welfare is 0.45 percent.

In Simulations 3 to 7, legalization moves the supply curve for immigrants (now guest workers) outwards. To aid comparability with Simulations 1 and 2, we assume that the percentage increase in supply of guest workers at any given wage (post-tax) is the same as the percentage reduction in Simulation 1.

A major finding of the study is that a program of tighter border enforcement strongly reduces the welfare of U.S. households.

The results in Simulation 3 are close to the opposite of those in Simulations 1 and 2. Legalization produces a strong welfare gain for U.S. households. With legalization, the supply of immigrants (now guest workers) increases and their average wage falls. At the same time, the additional inflow of guest workers has a favorable effect on the occupational mix and average real wage rate of U.S. workers. Allowing low-skilled workers to enter the country legally would boost the welfare of U.S. households by 0.57 percent of GNP. Simulation 4 yields a similar result after assuming U.S. employers can more readily substitute low-skilled immigrant workers for low-skilled U.S. workers.

The welfare gain to U.S. households through legalization is enhanced if, as assumed in Simulations 5 to 7, legalization increases the productivity of immigrant workers. Higher productivity of guest workers opens two avenues for increasing the welfare of U.S. households. First, the productivity gain can be transferred to U.S. households through the Treasury via a visa tax. Second, higher productivity strengthens the favorable occupation-mix effect. With higher productivity, any given number of guest workers replaces more U.S. workers in low-skilled, low-paying jobs.

Under the assumption that legalization increases the productivity of guest workers by 12.5 percent, the welfare gain for U.S. households in Simulation 5 is equivalent to 1.19 percent of the GNP, or $170 billion. Simulations 6 and 7, which introduce a visa tax, yield welfare gains in the same range.

Among other key findings is that additional low-skilled immigration would not increase the unemployment rates of low-skilled U.S. workers. While our modeling suggests that there would be reductions in the number of jobs for U.S. workers in low-skilled occupations, this does not mean that unemployment rates for these U.S. workers would rise. With increases in low-skilled immigration, the U.S. economy would expand, creating more jobs in higher-skilled areas. Over time, some U.S. workers now in low-paying jobs would move up the occupational ladder, actually reducing the wage pressure on low-skilled U.S. workers who remain in low-skilled jobs.

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Our analysis shows that the major ingredient in good policy is legalization. This would eliminate smugglers' fees and other costs faced by illegal immigrants. It would also allow immigrants (now guest workers rather than illegals) to have higher productivity. Both effects create a surplus gain for the economy by raising the value of immigrant labor relative to the wage necessary to attract it. This surplus can then be extracted for the benefit of U.S. households.

Getting the policy right on illegal immigration is important for the welfare of U.S. households. Our simulations show that the difference between the long-run welfare effects for U.S. households of the worst and best policies that we considered—that is, the welfare gap between the tighter-border-enforcement policy in Simulation 1 and the liberalized policy with an optimal visa charge in Simulation 7—is about $260 billion a year.

How Immigration Policies Affect the Economy

The USAGE model considers six main factors that contribute to the long-run effects on the welfare of U.S. households through changes in U.S. immigration policy:

Direct effect. The first factor is the change in U.S. gross domestic product directly attributable to the change in employment of guest workers or illegal immigrants less the change in the cost to the economy of employing them. With the exception of Simulation 2, this cost is measured by their wages less the taxes they pay in the United States. In Simulation 2, the cost also covers lawyers, accountants, and other professionals hired to mitigate against raids, business closures, and prosecutions.

Occupation-mix effect. Illegal immigrants take jobs mainly in low-skilled, low-paying occupations. Restricting illegal immigration opens up employment opportunities for U.S. workers in these occupations. At the same time, it makes the economy smaller, thereby reducing employment opportunities for U.S. workers in the more highly skilled, highly paid occupations. Eventually, under policies that reduce illegal immigration,

the occupational mix of U.S. workers shifts in a way that reduces their overall productivity. Similarly, under policies that increase the number of low-skilled immigrants, the occupational mix of U.S. workers shifts in a way that increases their overall productivity. This will be explained further below.

Capital effect. In the long run, a change in the supply of labor leads to a change in the quantity of capital in the United States and to changes in the shares of this capital that are U.S.- and foreign-owned. In calculating the welfare effects of immigration policies, USAGE takes account of changes in U.S. income resulting from changes in U.S. ownership of capital, and of changes in taxes accruing to the U.S. government from changes in the quantity of foreign-owned capital.

U.S.-employment effect. In our simulations, we assume that changes in policies toward illegal immigrants do not affect the supply of U.S. labor. Nevertheless, these policies can have permanent long-run effects on aggregate employment of U.S. workers. This is because equilibrium unemployment rates are higher for low-skilled occupations than for high-skilled occupations. Consequently, aggregate employment of U.S. workers is reduced (or increased) when the occupational mix of their employment shifts toward low-skilled (or high-skilled) occupations. Changes in aggregate employment of U.S. workers impose changes in their income and welfare beyond those quantified through the occupation-mix effect. Changes in immigration policy also have transitory effects on aggregate employment of U.S. workers: it takes some time for wage rates to adjust to eliminate gaps between the demand for labor and the supply of labor.

Public-expenditure effect. A cut in the number of illegal immigrants working in the United States would reduce public sector expenditures made on their behalf, particularly in elementary education, emergency health care, and correctional services. This would allow an increase in U.S. welfare, either through cuts in taxes or through increased provision of public services to U.S. households. On the other hand, an increase in the number of guest workers would have a negative public expenditure effect on U.S. welfare. It should be noted that the public expenditure effect encompasses only public-sector expenditures and does not take into account taxes paid by immigrants. These taxes are accounted for in the direct effect, where we compute the direct contribution of illegal immigrants or guest workers to GDP net of their post-tax wages.

Macro-price effect. An advantage to the United States of reducing employment of illegal immigrants, and consequently having a smaller economy, is that there would be a favorable movement in global prices for tradable goods and services. Lower demand for imports from a relatively smaller U.S. population would mean lower prices for those imports, while lower production of exportable goods would cause their prices to rise, creating a beneficial move in the "terms of trade," that is, the price of exports relative to the price of imports. This enables U.S. households to transform whatever they produce with their capital and labor into a greater volume of consumption: they need to give up fewer exports to obtain any given volume of imports. More technically, an improvement in the terms of trade increases the real GNP or welfare of U.S. households by increasing the price of U.S. output relative to the price of U.S. consumption. Any policy that expands the size of the U.S. economy will have the opposite effect—increasing the U.S. weight in the global economy, raising the relative prices of imports and reducing the prices of exports—causing an adverse movement in the terms of trade.

How Restricting Immigration Reduces the Welfare of U.S. Households

Our seven simulations can be broken into two sets. The first set, consisting of Simulations 1 and 2, gives the effects of restrictive policies toward illegal immigrants. The second set, Simulations 3 through 7, gives the effects, under various assumptions, of liberalizing policies where illegal immigrants are transformed into legal guest workers. The principal long-run results from the seven simulations are shown in Table 1. The highlighted row reports effects on

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the economic welfare of U.S. households (people apart from the illegal immigrants and guest workers). We measure the effect of a change in immigration policy on the welfare of U.S. households by the deviation in real GNP of U.S. households in the year 2019. We measure the GNP of U.S. households by the total GNP (that is, GDP less net income flowing to foreign investors) minus post-tax income accruing to illegal immigrant or guest workers.[5]

The "Business-as-Usual" Baseline

To measure the change in household income caused by a policy change, we first must establish a baseline scenario. The baseline establishes the benchmarks for employment, household income, wages, and other measurements at a future date if current policies remain unchanged. The most important aspects of the business-as-usual run are those concerning the number of illegal immigrants and their share in the aggregate wagebill (that is, total wages paid in the economy).

In creating the business-as-usual forecast, we recognized that employment of illegal immigrants was growing by about 5.5 percent in 2005, with a net inflow of about 400,000 people, added to an existing population of 7.3 million. In the absence of fresh U.S. policy initiatives, growth in the net inflow of illegal immigrants is likely to be moderate because population growth in the main source country, Mexico, is slowing.[6] We assume an average annual growth in net inflow of only 1 percent through 2019. Under this assumption, growth in employment of illegal immigrants slows but nevertheless averages 3.8 percent for the period. This means that employment of illegal immigrants in the business-as-usual forecast grows from 7.3 million in 2005[7] to 12.4 million in 2019.

Other features of our business-as-usual forecast are that average annual growth rates between 2005 and 2019 will be 3.0 percent for real GDP; 3.2 percent for real private consumption; 4.0 percent for real investment; 2.0 percent for real public consumption; 6.0 percent and 5.6 percent for real exports and imports, respectively; and 1.0 percent for employment of U.S. workers. All of these forecasts are middle-of-the-road and imply that the current global slowdown will be short-lived. Our conclusions about immigration policy are not sensitive to reasonable variations in these macro forecasts.

With employment of U.S. workers growing at only 1.0 percent a year and that of illegal immigrants growing at 3.8 percent a year, the share of illegal immigrants in total employment increases from 4.98 percent in 2005 to 7.17 percent in 2019. Because illegal immigrants have low-paying jobs, their share in the total wagebill is less than their employment share. In the baseline forecast, their wagebill share goes from 2.69 percent in 2005 to 3.64 percent in 2019.

In all simulations, we assume that the policies have been implemented over the period 2006 to 2009. While it might be more natural to look at policies implemented at a future date, we choose 2006 as a starting point because our main data on illegal immigration is for 2005. Although we report some results for the immediate effects of changes in immigration policy, our emphasis is on results for 2019—10 years out from the policy shocks. We interpret these 10-year results as long-run or sustainable effects. These sustainable effects are not sensitive to whether our starting point is 2006 or a more recent date.

Simulation 1: Tighter Border Enforcement

This simulation computes the effects on the U.S. economy of a reduction in the supply of illegal immigrants induced by a policy of tighter border enforcement. We will explain the results of Simulation 1 in more detail than the other simulations because tighter border enforcement is the most popular policy alternative. The details will also help illuminate the effects of the other policy-change simulations.

Simulation 1 can be thought of as an increase in the difficulties faced by potential illegal immigrants in crossing into the United States. This could be expected to increase fees paid to smugglers, as well as financial and other risks faced by people attempting illegal entry. In the simulation, the policy is equivalent to an increase in the costs of an illegal crossing of about $5,000. As can be seen from row nine of Table 1, this reduces the supply of illegal immigrants sufficiently to cut their employment in the long run by 28.6 percent.

An increase in the difficulties faced by potential illegal immigrants in crossing into the United States could increase smugglers' fees, as well as financial and other risks.

Table 1
Long-run (2019) Percentage Effects on Welfare of U.S. Households (excludes guest workers and illegal immigrants)

Economic Effect	Reduced entry via:		Liberalized entry with:				
	Tighter border security	Tighter internal enforcement	No change in characteristics of immigrants	Increased substitutability	Increased substitutability and productivity	Increased substitutability and productivity plus employment-neutralizing visa charge	Increased substitutability and productivity plus optimal visa charge
Simulation:	1	2	3	4	5	6	7
1. Direct effect	-0.29	-0.35	0.31	0.27	0.57	0.80	0.75
2. Occupation-mix effect	-0.31	-0.22	0.32	0.41	0.73	0.15	0.48
3. Capital effect	-0.24	-0.26	0.26	0.28	0.49	0.24	0.39
4. U.S.-employment effect	-0.11	-0.08	0.11	0.11	0.26	0.02	0.16
5. Public-expenditure effect	0.17	0.17	-0.19	-0.23	-0.32	0.00	-0.17
6. Macro-price effect	0.23	0.29	-0.24	-0.28	-0.55	-0.06	-0.34
Welfare (real GNP of U.S. households)	-0.55	-0.45	0.57	0.56	1.19	1.15	1.27
Employment and wage rates of guest workers or illegal immigrants							
7. Real cost to employers, per person	9.2	9.1	-7.7	-4.8	1.3	13.0	6.0
8. Real post-tax wage rate, people	9.2	-17.3	-7.7	-4.8	1.3	-21.6	-8.7
9. Employment, people	-28.6	-28.4	32.0	38.7	53.2	0.0	29.3
10. Real cost to employers, effective units	9.2	9.1	-7.7	-4.8	-11.4	-1.1	-7.3
11. Employment, effective units	-28.6	-28.4	32.0	38.7	75.1	14.3	47.8
12. Real post-tax wage, effective units	9.2	17.3	-7.7	-4.8	-11.4	-31.4	-20.1

Source: Authors' calculations.

Reducing the number of illegal workers by 28.6 percent sends ripples through the economy in a number of important ways. It leads to a long-run reduction in the U.S. capital stock (equipment, buildings, roads, and other structures) by 1.7 percent; a reduction in labor input of 1.6 percent; and an overall reduction of the output of goods and services (that is, GDP) of 1.6 percent. Employment of U.S. workers falls slightly as more of them shift to lower-skilled occupations with higher structural unemployment rates. Certain industries contract and others expand, although the changes are not dramatic and do not necessarily reflect an industry's use of illegal labor. (More details of the industry, occupation, and wage effects of Simulation 1 can be found in Appendix A.)

Examining the six major effects of Simulation 1 more closely, we find:

1. Direct effect. This effect measures the change in economic output *directly* attributable to the change in employment of illegal immigrants less the change in the cost to the economy of employing them. Restricting the number of such workers by 28.6 percent relative to the baseline causes the wages of the remaining ille-

Restricting the supply of illegal immigrants changes the occupational mix of employment of U.S. workers, reducing their average hourly wage rate by 0.46 percent.

gal workers to rise by 9.2 percent. This is the main reason that Simulation 1 shows a strong negative direct effect. When we factor in the direct and indirect taxes the immigrants pay, the direct effect in Simulation 1 is equivalent to a sustained 0.29 percent annual reduction of the business-as-usual GNP of U.S. households. (A more technical explanation of the direct effect of Simulation 1 can be found in Appendix B.)

2. Occupation-mix effect. Restricting the supply of illegal immigrants changes the occupational mix of employment of U.S. workers, reducing their average hourly wage rate by 0.46 percent. This occurs because the reduction in illegal workers creates more job openings in lower-skilled occupations. At the same time, the reduction in illegal labor causes the overall economy to be smaller than it would be in the baseline, reducing the number of jobs available in the higher-paying, higher-skilled categories. Over time, the changing occupation mix draws Americans into less productive, lower-paying jobs than they would have occupied otherwise. In 2019, this costs legal residents about $45 billion (in 2009 dollars), calculated as the wage effect times the business-as-usual wagebill of U.S. workers. Translating this cost into an effect on welfare means a reduction of 0.31 percent in the income of U.S. households.

The long-run shift in occupational mix caused by tighter border enforcement does not imply that existing U.S. workers change their occupations. For each occupation, restricting the supply of illegal workers presents U.S. workers with opportunities to replace illegal workers. On the other hand, the economy is smaller, generating a negative effect on employment opportunities for U.S. workers seeking opportunities in higher-skilled occupations. The positive replacement effect dominates in the low-paying occupations that currently employ large numbers of illegal immigrants. The negative effect of a smaller economy dominates in high-paying occupations that currently employ few illegal immigrants. Thus, there is an increase in vacancies in low-paying occupations relative to high-paying occupations, allowing the low-paying occupations to absorb an increased proportion of new entrants to the workforce and unemployed workers.

Another way of understanding the change in the occupation mix of U.S. workers is to recognize that the labor market involves job shortages. At any time, not everyone looking for a job in a given occupation can find a job in that occupation. So people settle for second best. The college graduate who wants to be an economist settles for a job as an administrative officer. The high-school graduate who wants to be a police officer settles for a job in private enforcement. The unemployed person who wants to be a chef settles for a job as a short-order cook, and so on. It is this shuffling process that explains how a reduction in supply of illegal immigrants reduces the skill composition of employment of U.S. workers, thus reducing their long-term productivity and income.

3. Capital effect. Simulation 1 shows a -1.7 percent long-run deviation in capital. With returns to capital being 26 percent of GDP, the 1.7 percent reduction in capital causes a reduction in GDP of 0.44 percent (1.7 times 0.26). Not all of this loss in GDP is a loss in welfare for U.S. households. The welfare effect for U.S. households is the U.S.-owned part of the lost capital income plus just the tax component of the foreign-owned part. In Simulation 1, the U.S.-owned share of the reduction in capital is about 40 percent. Taking this into account and allowing for tax effects on foreign-owned capital, we find that the reduction in GDP of 0.44 percent translates into a long-run welfare loss for U.S. households of 0.24 percent.

4. U.S.-employment effect. The tighter-border-enforcement policy reduces U.S. employment in 2019 by 0.16 percent. The direct wage loss to U.S. workers from this reduction in employment is about $15 billion (2009 dollars). The cost to U.S. households is slightly greater than this because, with a reduction in U.S. employment, there is a reduction in the collection of indirect taxes. Taking this into account expands the loss in U.S. income to $16 billion. Expressed as a percentage of GNP for U.S. households in 2019, this gives a welfare loss of 0.11 percent.

5. Public-expenditure effect. For public consumption, we assume that expenditure per capita on both legal residents and illegal immigrants is proportional to private consumption per capita by

legal residents. The factor of proportionality for illegal immigrants is set at 0.49 times the value applying to legal residents. (Because of their lower incomes, illegal residents consume only about half as much per capita of public goods as legal residents.)[8] Thus we make three assumptions: (1) that as legal residents become richer they demand more services from the public sector; (2) that illegal immigrants cannot be prevented from enjoying improvements in public amenities made available for legal residents; and (3) that not all government services available to legal residents are available to illegal immigrants. In the business-as-usual forecast for 2019, the share of illegal immigrants in the workforce is 7.17 percent. We assume that this is also their share in the population and that the 0.49 ratio for public expenditure is maintained. Thus, in the business-as-usual forecast for 2019, the share of illegal immigrants in public expenditure is 3.65 percent.[9] With a 28.6 percent reduction in illegal immigrants, the public sector reduces its expenditure in 2019 by 1.04 percent (calculated as 28.6 percent of 3.65 percent). With no need to devote this 1.04 percent of public expenditure to illegal immigrants, resources are freed to generate a welfare gain for U.S. households that is worth about $24 billion, or about 0.17 percent of the GNP of U.S. households.

6. Macro-price effects. The cut in illegal immigration in Simulation 1 reduces the size of the U.S. economy, which causes global prices to shift in a way that is favorable to U.S. households. A smaller economy compared to the baseline improves the U.S. terms of trade: U.S. households pay lower prices for the imports they buy and U.S. producers receive higher prices for the exports they sell. Lower import prices and higher export prices reduce the price index for private and public consumption, relative to that for GDP, in 2019 by 0.23 percent.[10] This increases the consuming power of the GNP of U.S. households, or their welfare, by 0.23 percent.

Net welfare effect. When we combine the six effects, the net impact on U.S. households from tighter border enforcement is unambiguously negative. Restricting illegal immigration would benefit U.S. households through reduced public expenditures and a favorable change in the terms of trade with the rest of the world. But those gains are more than cancelled out by the loss of output from reduced immigrant labor, the less-well-paying mix of jobs occupied by Americans, reduced earnings and taxes from capital, and reduced employment of U.S. workers.

The net effect of Simulation 1 is that the real GNP of U.S. households (and their private and public consumption) is 0.55 percent lower in 2019 than it would be without the policy change. We take this to mean that the policy in Simulation 1 generates a sustained, permanent reduction in the economic welfare of U.S. households of 0.55 percent. For readers who prefer to think in terms of current (2009) dollars, this is equivalent to a permanent annual loss in economic welfare of about $80 billion.

Simulation 2: Tighter Internal Enforcement

This simulation computes the effects of reduced demand for illegal immigrants induced by a policy of raids, business closures, and rigorous prosecution of employers. We assume that employers respond by hiring lawyers, accountants, and other professionals to mitigate damages. To aid comparability between Simulation 1 (supply restriction) and Simulation 2 (demand restriction), we scale the cost increases imposed on businesses in Simulation 2 so that the long-run effect on employment of illegal immigrants is approximately the same as in Simulation 1.

The policy in Simulation 2 reduces demand for illegal immigrants by imposing costs on employers. Rather than reducing the supply of illegal workers, as in Simulation 1, the policy in Simulation 2 reduces demand by imposing regulatory costs on hiring illegal workers.

As can be seen from Table 1, the six contributions to U.S. welfare in Simulation 2 are broadly similar to those in Simulation 1. However, there are interesting differences.

The assumption in the Simulation 2 policy run that employment of illegal immigrants requires complementary employment of domestic professionals (to enforce the new workplace restrictions) means that Simulation 2 generates relatively favorable employment deviations for highly paid domestic workers. This explains the less unfavorable occupation-mix effect in Sim-

When we combine the six major effects of tighter border enforcement, the net impact on U.S. households is unambiguously negative.

ulation 2 compared with Simulation 1, as the negative occupation-mix effect of reducing illegal immigration is partially offset by the creation of better-paying jobs for lawyers and accountants needed to enforce the workplace restrictions.

The more favorable macro-price effect in Simulation 2 relative to Simulation 1 is explained by a lower level of exports in Simulation 2. Fewer exports allows higher foreign-currency export prices. But why are there fewer exports in Simulation 2 than in Simulation 1? The need to employ domestic professionals as a complement to illegal workers is equivalent to a technological deterioration: more inputs are required to produce a given amount of output. A technological deterioration reduces GDP directly, and also indirectly, by making the capital stock smaller than it otherwise would have been. With a smaller GDP in Simulation 2 than in Simulation 1, the United States has fewer imports, and consequently, fewer exports.

The greater negativity of the direct effect in Simulation 2 compared with Simulation 1 is due to a tax effect. To understand this, we need first to look at the wage results. In Simulation 2 the post-tax wage rate for illegal immigrants (Table 1, row 8) falls by 17.3 percent, while in Simulation 1 it rises by 9.2 percent. By contrast, the two simulations give almost identical results for the increase in the real cost to employers per illegal immigrant (9.2 percent compared with 9.1 percent; row 7). In Simulation 2, the gap between the post-tax wage rate and the cost rate is explained by payments to lawyers, as well as other prosecution-mitigating expenses. What happens as we go from Simulation 1 to Simulation 2 is that the scarcity bonus associated with the restriction of illegal immigrants is transformed from being an increase in the incomes of these people to being dissipated as a dead-weight loss in the use of professional services. Either way, it is income that is forfeited by U.S. households. But there is a difference in tax implications. When, as in Simulation 1, the scarcity bonus is higher wages for the illegal immigrants, the Treasury claws some of it back through taxes, which can be used to enhance the welfare of U.S. households. When, as in Simulation 2, the scarcity bonus is dissipated as a dead-weight loss, none of it is transferred through the tax system to U.S. households. This tax difference explains why the direct effect in Simulation 2 is more negative than in Simulation 1.

When combined, the effects of tighter internal enforcement in Simulation 2 reduce the welfare of U.S. households in 2019 by 0.45 percent.

Our model shows that reductions in the number of illegal workers beyond those assumed in Simulations 1 and 2 would only increase the welfare loss to U.S. households. In fact, up to a practical limit, the loss of income for U.S. households would be roughly proportional to the reduction of illegal workers. Doubling the cut in illegal workers from the baseline projection would double the welfare loss for U.S. households.

The loss of income for U.S. households would be roughly proportional to the reduction of illegal workers.

How Legalization of Low-Skilled Labor Enhances U.S. Household Incomes

In contrast to the two enforcement-only simulations, all the legalization scenarios raise the incomes of U.S. households. Under the enforcement scenarios, the direct, occupation mix, capital, and U.S.-employment effects were all negative, reducing the welfare of U.S. households. But under the five legalization simulations, those effects are positive, boosting the welfare of U.S. households. Under legalization, the public expenditure and macro-price effects turn negative, but they are more than compensated for by the income gains from the other effects.

Simulation 3: Liberalized Entry with No Change in Characteristics

This simulation is the opposite of Simulation 1. We consider a policy in which illegal immigration is largely replaced by a program of entry permits. Under such a program, employers in the United States would be able to offer jobs on a temporary basis to people outside the United States. Such a policy change would largely eliminate smugglers' fees and other entry costs to the United States, thereby inducing an increase in the supply of what we will now refer to as guest

workers. In Simulation 3 the shift that we impose on the immigration supply function to the United States is the same as that in Simulation 1, but with opposite sign. An important assumption in Simulation 3 is that the workforce characteristics (e.g., productivity) of guest workers are the same as those of the illegal immigrants considered in Simulations 1 and 2. The reduction of entry costs in Simulation 3 means that more immigrants (now as guest workers rather than as illegals) are willing to come to the United States at a lower wage.

The results in Simulation 3 are close to an exact reversal of those in Simulation 1.[11] With regard to the direct effect, legalization transforms what were formerly smugglers' fees and other entry costs into a benefit for U.S. households via lower costs of using immigrant labor. Another important benefit comes through the occupation-mix effect. The presence of more guest workers in lower-skilled, lower-paying occupations encourages Americans to seek employment in occupations where they can be more productive. This positive occupation-mix effect will be familiar to students of the history of U.S. immigration. The influx of low-skilled immigrants during the "Great Migration" of the early 20th century induced native-born U.S. residents by the millions to complete their education and enhance their skills. The greater competition to fill low-skilled jobs helped to spur a sharp increase in high-school graduation rates from 1910 to 1930, a phenomenon known to educational historians as the "High School Movement." In this way, low-skilled immigrants chased native-born workers up the occupational ladder.[12] A greater inflow of legalized workers today would have the same beneficial, long-term effect on U.S. households.

Together, the six effects of Simulation 3 increase the welfare of U.S. households by 0.57 percent.

Simulation 4: Liberalized Entry with Increased Substitutability

Our view is that for employers, legality is an important characteristic of employees. Many employers who do not currently use illegal immigrants may require considerable reductions in illegal/legal wage ratios to tempt them to switch to illegal workers. This suggests that illegal immigrants in a given occupational category (e.g., janitors) are currently only moderately substitutable for U.S. workers. We assume a substitution elasticity of 5, which means that a 1 percent *decrease* in the wage rate of illegal workers in a particular occupation relative to that of legal workers in the same occupation causes a 5 percent *increase* in employment of illegal workers in that occupation relative to that of legal workers.

With a legalization program, we would expect substitutability to increase. In Simulation 4 we investigate the implications of this possibility. We assume that the liberalization program introduced in Simulation 3 is accompanied by a sharp increase in substitutability: rather than an elasticity of substitution of 5, we assume that the elasticity of substitution between guest workers and U.S workers increases up to 10. That means that a 1 percent decrease in the cost of hiring an immigrant worker relative to a U.S. worker causes a 10 percent increase in the use of immigrant labor relative to U.S. labor.

In the policy run of Simulation 4 the demand curve for guest workers is flatter than in Simulation 3, meaning that demand for guest workers is more responsive to changes in their wages. The outward shift in the supply curve for guest workers is the same in Simulation 4 as in Simulation 3. But now with a flatter demand curve, the effect in Simulation 4 is a smaller wage reduction and a larger employment increase for guest workers. In Simulation 4, the guest-worker wage falls by 4.8 percent, compared with a fall of 7.7 percent in Simulation 3, while employment of guest workers rises by 38.7 percent in Simulation 4, compared with only 32.0 percent in Simulation 3. As we go from Simulation 3 to 4, the wage and employment movements shift the direct effect in opposite directions. However, the wage movement dominates, leaving the direct effect in Simulation 4 slightly less positive than that in Simulation 3 (0.27 percent compared with 0.31 percent).

While the direct effect in Simulation 4 is smaller than that in Simulation 3, the other five contributing factors to welfare are larger in absolute size in Simulation 4 than in Simulation

The presence of more guest workers in lower-skilled, lower-paying occupations encourages Americans to seek employment in occupations where they can be more productive.

3, reflecting the increased number of guest workers. Overall, the total for the six factors in Simulation 4 is about the same as that in Simulation 3 (a positive 0.56 percent compared with 0.57 percent), indicating that the substitution assumption is not a major determinant of the welfare result.

Simulation 5: Liberalized Entry with Increased Productivity

Rates of pay for illegal immigrants in a given occupation are below those for U.S. workers. We interpret this as meaning that illegal immigrants have relatively low productivity. This could reflect lack of reliability (the possibility that they will suddenly become unavailable). It could also reflect lack of skill, with employers being unwilling to provide training for transient workers of uncertain tenure. With legalization giving more reliability and permanency to their employment, we would expect the productivity of guest workers to gradually move toward that of legal immigrants in similar occupations. We impose this in Simulation 5 by assuming that the transition of an illegal immigrant to a guest worker is accompanied by a 14.3 percent increase in productivity. This is about half the gap that we think currently exists between the productivity of illegal and native workers in the same occupation.

Simulation 5 shows that the productivity of guest workers is a major determinant of their welfare effect on U.S. households.

For understanding the implications of a productivity increase it is useful to think in terms of effective units of labor input. In Simulation 4, the number of effective units of guest-worker input and the wage per effective unit were simply the number of guest workers and their wage per person. Now, in Simulation 5, the number of effective units is the number of guest workers inflated by 14.3 percent: each guest worker encapsulates 14.3 percent more effective labor power. The wage per effective unit is the wage per guest worker deflated by 14.3 percent. The productivity increase in Simulation 5 does not move the demand curve for effective units; that is, it does not alter the number of effective units of guest-worker labor demanded at any given wage per effective unit. However, it moves the supply curve to the right; that is, it increases the supply of effective units available at any given wage per effective unit.

The supply curve moves for two reasons. First, at any given wage for effective units the wage for people in Simulation 5 is 14.3 percent higher than it was in Simulation 4, generating supply from more people. Second, each person supplies more effective units. With a much stronger outward shift in the supply curve, Simulation 5 generates an increase in the quantity of effective units that is almost twice that in Simulation 4 (75.1 percent compared with 38.7 percent). The 75.1 percent increase in effective units in Simulation 5 is made up of a 53.2 percent increase in the number of guest workers and the 14.3 percent increase in the productivity of each guest worker.[13]

Simulation 5 shows that the productivity of guest workers is a major determinant of their welfare effect on U.S. households. In the move from Simulation 4, most of the welfare effects expand broadly in line with the expansion in the quantity of effective units of guest workers. With approximately twice the increase in effective labor input from guest workers, Simulation 5 gives results for the first four effects and the macro-price effect that are approximately twice as large as in Simulation 4. However, the negative contribution from the public expenditure effect is muted because it depends on the number of guest workers, which has increased by a smaller percentage than the number of effective labor units.

The effects all combine to explain the more than doubling of the welfare benefit for U.S. households as we go from Simulation 4 to 5 (1.19 percent compared with 0.56 percent).

Simulation 6: Liberalized Entry with an Employment-Neutralizing Visa Charge

With legalization, it would be possible for the government to raise revenue and to influence the number of guest workers through the use of a visa tax or a charge for entry permits. In Simulation 6 we add this feature to Simulation 5. The rate of the visa tax is chosen to be employment neutralizing: in the long run it leaves the employment of guest workers in 2019 at 12.4 million, the same level as that of illegal immigrants in the baseline forecast.

The appropriate tax turns out to be 31 percent of the cost (including the visa tax) of employing a guest worker. Why is the U.S. government able to impose such a tax without driving the supply and demand for guest workers below the baseline forecast? The answer is that the tax absorbs what were formerly the costs of illegal entry as well as the productivity increase generated by legalization. Together, these two factors represent about 31 percent of what legalized guest workers can produce.

Capturing the guest workers' productivity increase and illegal entry costs via the U.S. Treasury is strongly positive for U.S. households: it increases the direct effect from 0.57 in Simulation 5 to 0.80 in Simulation 6. However, this gain is offset by the movements in the other factors, which are sharply reduced by the cut in the number of guest workers (no increase rather than an increase in 53.2 percent).

As a result of all those factors, the net welfare effect on U.S. households with an employment-neutralizing visa tax is slightly less positive than the effect of liberalized entry without a visa tax. Imposition of the visa tax reduces the welfare gain for U.S. households from 1.19 percent in Simulation 5 to 1.15 percent in Simulation 6.

Simulation 7: Liberalized Entry with an Optimal Visa Charge

This simulation is the same as Simulation 6 except that the visa tax is set at the level that maximizes the long-run welfare benefit to U.S. households. In Simulation 7, we set the visa tax at 14 percent of the cost of employing a guest worker. We found, after a little experimenting, that this rate generated the maximum welfare gain for U.S. households (1.27 percent) by striking the optimal balance between the positive effect of capturing part of the productivity increase of guest workers and the negative effect of limiting the number of guest workers.

Imposition of the optimal visa tax gives a slightly smaller direct effect than imposition of the employment-neutral visa tax (0.75 percent in Simulation 7 compared with 0.80 percent in Simulation 6). As well as the direct effect, the public-expenditure and macro-price effects are more unfavorable in Simulation 7 than in Simulation 6. The public-expenditure effect in Simulation 6 is zero because the liberalization policy in that simulation leaves the number of guest workers unchanged from the number of illegal workers in the baseline forecast. In Simulation 7, the number of guest workers is 29.3 percent greater than the number of illegal workers at the baseline, generating a public-expenditure effect of -0.17 percent. In Simulation 6, the policy has relatively little effect on the size of the economy and consequently on the level of exports and the terms of trade. This leaves the macro-price effect considerably less negative in Simulation 6 than in Simulation 7.

The negative effects, as we go from Simulation 6 to Simulation 7, are outweighed by the improvements in the occupation-mix, capital, and U.S.-employment effects, each of which is positively influenced by the increase in the number of effective units of guest-worker labor. The increase in the occupation-mix effect is particularly pronounced (0.48 percent compared with 0.15 percent). This effect is close to proportional to the increase in the number of effective units of guest workers.

Under an optimal visa tax, U.S. households in 2019 would realize a welfare gain of 1.27 percent compared to no change in policy. That translates into a gain of $180 billion in 2009 dollars.

Conclusions and Policy Implications

Getting the policy right on illegal immigration is important for the welfare of U.S. households. Our simulations show that the difference between the long-run welfare effects for U.S. households of the worst and best policies that we considered is about $260 billion a year in current dollars. This is the welfare gap between the tighter-border-enforcement policy in Simulation 1 (a welfare loss of 0.55 percent) and the liberalized policy with an optimal visa charge in Simulation 7 (a welfare gain of 1.27 percent).[14]

The major ingredient in good policy is legalization. This would eliminate smugglers' fees and other costs associated with illegal entry and

The difference between the long-run welfare effects for U.S. households of the worst and best immigration reform policies is about $260 billion a year in current dollars.

The positive effects on the broader economy from legalization overwhelm the public-expenditure effects. The gains to U.S. households from higher wages, investment income, employment, and government revenue swamp any increases in government spending.

allow immigrants (now guest workers rather than illegals) to have higher productivity. Elimination of illegal entry costs would lower the wage required to attract immigrants, while increases in their productivity would raise the value of immigrant labor relative to this wage. Both these effects of legalization raise the value of immigrant labor relative to the cost of employing it. Our simulations show that this creates a considerable surplus that can be enjoyed by U.S. households.

Would legalization lead to an unmanageable influx of guest workers? We don't think so.[15] In any case, under a program of legal guest workers, numbers could be controlled via the imposition of visa taxes. Our simulations suggest that a visa tax levied on employers at about 31 percent of the cost of employing a guest worker would keep the number of guest workers on about the same path as illegal immigrants in the business-as-usual forecast. Why 31 percent? This is approximately the value of costs of illegal entry plus the value of the productivity increase that we think would follow from legalization.

The simulations show that the optimal visa tax is about 14 percent. This would allow the number of guest workers to grow beyond the number of illegals in the business-as-usual forecast. A visa tax of 14 percent strikes the optimal balance between the advantage of capturing surplus value from guest workers and the disadvantage of limiting their numbers. By using a 31 percent visa tax to hold back the number of guest workers, U.S. households forgo too much of the potentially available movement up the occupational ladder; that is, they lose too much potential gain from the occupation-mix effect.

While 14 percent is the optimal rate for the visa tax, the simulations indicate that the welfare penalty for adopting different rates is not very high. The welfare gain moves within a narrow range of 1.19 percent in Simulation 5 with (no visa tax) to 1.27 percent in Simulation 7 (with the optimal visa tax of 14 percent) and back to 1.15 percent with the employment-neutral visa tax of 31 percent. The major benefit to U.S. households in these three simulations is from legalization and associated productivity increase. The visa tax is a useful instrument for fine-tuning the number of guest workers, but it is not a major determinant of welfare.

Another implication of our study is that focusing exclusively on the fiscal impacts of immigration reform can be misleading. Our model does confirm that an increase in low-skilled guest workers raises the cost of public expenditures to U.S. taxpayers, as many critics of legalization have pointed out. But it also confirms that the positive effects on the broader economy from legalization overwhelm the public-expenditure effects. The gains to U.S. households from higher wages, investment income, employment, and government revenue swamp any increases in government spending.

When Congress and the president consider competing proposals to either restrict or legalize low-skilled immigration, they should consider that the economic stakes are high. Compared to either border or interior enforcement, a policy of legalization would, over time, raise the incomes of U.S. workers and their families.

Appendix A: Economywide Effects of Reducing the Supply of Illegal Immigrants

In this appendix, we describe in greater detail the economywide impact of tightened border restrictions. Focusing on Simulation 1 is especially useful because enhanced enforcement is the principal alternative to any policy of legalization. Examining the more detailed macro and sectoral impact of one policy also helps us understand in greater depth the impacts of the other policy alternatives.

The changes in Simulation 1 reduce illegal employment in 2019 by 3.55 from the 12.4 million that is projected in the baseline. The focus of our analysis is the effects of this 3.55 million cut in illegal employment, not the exact nature of the supply-reducing shocks that cause it. As we noted before, the change can be thought of as an increase of about $5,000 in the costs of an illegal border crossing. This figure is helpful but not critical for our analysis. The important point is that we are imposing a supply-reducing policy that cuts illegal employ-

ment in the long run by 28.6 percent compared to the baseline.

Restricting the inflow of low-skilled labor causes a long-run reduction (2019) in total jobs of 2.2 percent. This mainly reflects the reduction of 3.55 million in the number of illegal jobs: 3.55 million is 2.1 percent of the total jobs in 2019 in the baseline forecast. There is also a small loss of legal jobs.

Loss of jobs is not necessarily a good measure of loss of labor input. This is because different jobs have different levels of productivity, broadly reflected by different wage rates. Thus, if the economy loses a low-paying job, then the reduction in labor input is less than when the economy loses a high-paying job. Because the lost jobs in Simulation 1 are mainly for low-paid workers, the reduction in labor input in 2019 is less than 2.2 percent. We might expect the percentage loss in labor input to be about 1.04 percent: 28.6 percent (the reduction in illegal employment) of 3.64 percent (the illegal share in the business-as-usual forecast of the total wagebill for 2019). However, restriction of illegal employment shifts the occupational mix of remaining employment toward low-paying occupations, expanding the loss in labor input in 2019 to about 1.6 percent.

Reduced Immigration Causes Drops in Investment, Output, and Consumption

The long-run percentage reduction (1.7 percent) in U.S. capital stock (equipment, buildings, roads, and other structures) approximately matches that of labor input. Consistent with economic theory, our simulations imply that changes in immigration policy do not have a noticeable long-run effect on the amount of capital used per unit of labor input.[16] With 1.6 percent less input of labor and 1.7 percent less input of capital, the economy produces around 1.6 percent less goods and services; that is, GDP is reduced by about 1.6 percent.

Figure 1 shows how the reduction in GDP is distributed between its components: GDP is private consumption (C), plus investment (I), plus public consumption (G), plus exports (X), minus imports (M). As can be seen from the chart, the long-run percentage effects on these components are all negative and range around the value for GDP. Public consumption falls relative to private consumption because consumption of public goods by illegal immigrants is high relative to their consumption of private goods. In the business-as-usual forecast for 2019, illegal immigrants account for 3.7 percent of public consumption but only 2.4 percent of private consumption. Thus, reduction in the number of illegal immigrants reduces public consumption relative to private consumption.

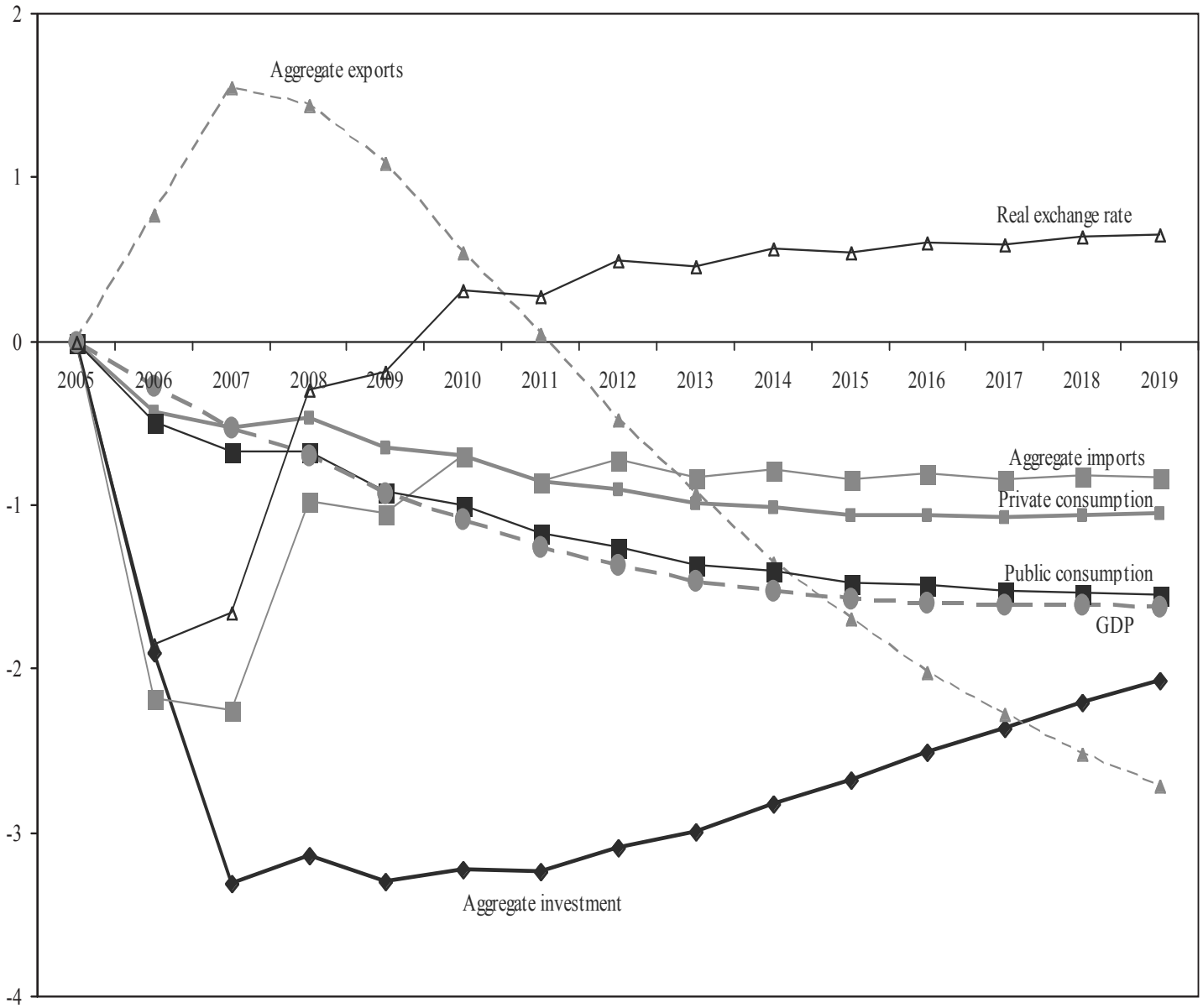
Both private and public consumption rise relative to GDP in the long run. In other words, the policy in Simulation 1 allows the United States to increase its consumption (C+G) relative to its production (GDP). This is because the policy increases the prices of the goods and services produced by the United States relative to prices of the goods and services consumed by the United States. It does this by increasing the terms of trade: the price of exports divided by the price of imports. This is a benefit from having a 1.6 percent smaller economy that demands less imports (thereby lowering their price) and supplies less exports (thereby raising their price).

Another implication of the improvement in the terms of trade is a long-run real appreciation of the U.S. currency in global exchange markets. This means that the U.S. exchange rate increases by a greater percentage than can be accounted for by differences between the U.S. rate of inflation and the rates of inflation of its trading partners. In other words, the terms-of-trade improvement reduces U.S. international competitiveness. As can be seen in Figure 1, this leaves the long-run deviation in imports above that of GDP and the long-run deviation in exports below that of GDP. Nevertheless, there is no deterioration in the trade balance: the improvement in the terms of trade means that the United States can pay for any volume of imports with fewer exports.

The 2019 deviation in investment is below that of GDP. Investment provides the change in capital stock each year. In the very long run, a change in immigration policy will have little identifiable effect on the growth rate of capital

Restricting the inflow of low-skilled labor causes a long-run reduction of 2.2 percent in the total number of jobs by 2019.

Figure 1
Expenditure Aggregates with Tighter Border Security, Simulation 1 (percentage deviations from business-as-usual)



Source: Authors' calculations according to USAGE model.

relative to that of GDP and therefore on the ratio of investment to GDP. The deviation line for capital is still falling slightly in 2019, indicating that the capital stock has not fully adjusted to the 1.6 percent reduction in labor input. With capital still adjusting downwards in 2019, the investment-to-GDP ratio is still below its eventual long-run level.

The short-run results in Figure 1 are dominated by the need for the economy to adjust in the policy run to a lower capital stock than it had in the business-as-usual forecast. In the short run, the policy causes a relatively sharp reduction in investment. With U.S. investment at the margin being financed mainly by foreigners, a reduction in investment weakens demand for the U.S. dollar, thus weakening the U.S. exchange rate. This temporarily stimulates

Table 2
Selected Industries:* Data for 2005 and Deviation Results for 2019 in Simulation 1 (tighter border security)

	Percentage shares in industry costs, 2005		Simulation 1: percent deviations in 2019		
	Legal	Illegal	Output	Labor input	Jobs
Industry	1	2	3	4	5
1. Agriculture	14.18	0.59	-2.10	-2.17	-3.26
2. Ground maintenance	50.44	4.08	-1.71	-2.19	-3.70
4. Construction	45.99	4.51	-2.14	-2.12	-3.30
8. Apparel	14.12	1.34	-1.95	-2.00	-3.32
9. Textiles	21.90	1.50	-2.38	-2.69	-3.67
11. Paper & publishing	32.07	0.76	-2.10	-2.11	-2.58
16. Machinery	31.61	0.76	-2.97	-3.01	-3.43
17. Computers	7.33	0.07	-1.69	-1.62	-1.84
19. Motor vehicles	16.59	0.71	-2.60	-2.61	-3.25
22. Communication	17.77	0.15	-1.52	-1.50	-1.63
23. Utilities	9.87	0.27	-1.19	-0.94	-1.38
24. Wholesale & retail	45.76	1.17	-1.54	-1.51	-2.01
27. Medical services	60.52	0.45	-1.05	-0.90	-1.15
34. Foreign vacations**	0	0	1.68	-	
35. Export tourism**	0	0	-2.64	-	-
Average, All Industries	37.31	1.00		-1.66	-2.19

* The full set of industry results are given in P. B. Dixon, M. Johnson and M. T. Rimmer, "Reducing Illegal Immigrants in the U.S.: A Dynamic CGE Analysis," CoPS/Impact Working Paper G-183, 2009, http://www.monash.edu.au/policy/ftp/workpapr/g-183.pdf.

** In USAGE, "Foreign vacations" is a collection of inputs, such as airline travel and shopping in foreign countries, which are used by U.S. residents when they take a vacation outside the United States. Export tourism is a collection of inputs used by foreign tourists when they take a vacation in the United States. These artificial industries do not employ people directly.

demand for the U.S. dollar, thus weakening the U.S. exchange rate. This temporarily stimulates exports and inhibits imports. As the downward adjustment in the capital stock is completed, investment recovers, causing the real exchange rate to rise, exports to fall, and imports to rise. As indicated in the previous paragraph, this process is not quite completed by 2019.

Industry Effects of Reducing the Supply of Illegal Immigrants

In popular discussions, it is often asserted that some U.S. industries rely on illegal labor to such an extent that they would not be able to survive without it. This position is not supported by Simulation 1. Table 2 shows that the long-run effects on industry outputs of tighter border enforcement are not very pronounced. The percentage deviations in industry outputs from a policy that restricts the supply of illegal employment by 28.6 percent lie in the range -2.97 to 1.68. The variations within this narrow range are explained mainly by macroeconomic effects.

Simulation 1 produces a long-run appreciation in the real exchange rate (see Figure 1). Consequently, in Table 2, trade-exposed industries (e.g., agriculture, apparel, textiles, and export tourism) show output deviations in 2019

The long-run effects on industry outputs of tighter border enforcement are not very pronounced.

The results for an industry's output and labor input are not closely linked to the industry's use of illegal labor.

that are more negative than for GDP. The long-run output deviation in construction is also slightly more negative than that of GDP, in line with the long-run investment deviation (Figure 1). Non-trade-exposed, consumption-oriented industries (mainly services), have output deviations that are less negative than that for GDP. This is explained by the long-run increase in the ratio of private and public consumption to GDP (Figure 1). The foreign vacations category is an outlier in Table 2. Its strongly positive output result reflects long-run exchange-rate-induced substitution of foreign vacations for domestic vacations.

The results for an industry's output and labor input in Table 2 are not closely linked to the industry's use of illegal labor. Column 2 shows the illegal labor share of industry costs in 2005. The correlation coefficient between the output results in column 3 and the share data in column 2 is -0.20 (which means a mildly negative correlation), while that between the labor input results in column 4 and the data in column 2 is -0.25.[17] It is true that industries relying relatively heavily on illegal immigrants incur cost increases when the supply of this type of labor is restricted. Consequently, these industries suffer adverse substitution effects as the prices of their

Table 3
Selected Occupations:* Data for 2005 and Deviation Results for 2019 in Simulation 1 (tighter border security)

		Illegal immigrants:	% deviation in 2019	
		% of labor costs in 2005	Legal jobs	Legal real wage
		1	2	3
1	Cooks	15.6	4.20	1.89
2	Grounds maintenance	24.8	7.45	3.19
3	House keeping & cleaning	22.0	6.56	2.82
4	Janitor & building cleaner	10.4	2.31	1.19
5	Misc. agriculture worker	34.3	10.70	4.55
6	Construction laborer	23.9	7.10	3.16
8	Carpenter	15.1	3.90	1.92
10	Cashier	4.7	0.31	0.43
13	Waiter	5.7	0.64	0.53
16	Painter	24.9	7.46	3.31
17	Dishwasher	22.7	6.83	2.86
24	Child care	5.2	0.56	0.51
26	Dry wall installer	35.8	11.43	4.87
30	Automotive repairs	6.3	0.88	0.64
31	Sew. Machine oper.	18.8	4.95	2.39
32	Concrete mason	22.6	6.61	3.00
33	Roofers	28.2	8.64	3.78
34	Plumbers	7.1	1.07	0.80
43	Welder	6.2	0.31	0.41
50	Services, other	0.4	-1.27	-0.13
Average, All Occupations		2.6	-0.16	-0.46

*The full set of occupation results are given in P. B. Dixon, M. Johnson and M. T. Rimmer, "Reducing Illegal Immigrants in the U.S.: A Dynamic CGE Analysis," CoPS/Impact Working Paper G-183, 2009, http://www.monash.edu.au/policy/ftp/workpapr/g-183.pdf.

products rise relative to those of other industries. These effects are included in USAGE simulations, but are weak. Illegal-labor cost shares are small, with the largest being 4.51 percent for construction. As we saw in Table 1, real wage rates for illegal workers in Simulation 1 increase on average by 9.2 percent. Those of competing legal workers increase by considerably less (Table 3, column 3). These wage increases are not sufficient to generate significant substitution effects because they do not induce significant changes in relative prices.

The correlation coefficient between the jobs results in column 5 of Table 2 and the share data in column 2 is -0.52. The larger absolute size of this coefficient reflects replacement of illegal labor with legal labor in industries that currently rely relatively heavily on illegal labor. As mentioned above, illegal workers in any occupation receive lower wages than legal workers in the same occupation, and we interpret this as meaning that they are less productive.[18] Consequently, when we simulate the effects of restricting the supply of illegal workers, we find that job numbers fall relatively sharply in those industries in which there is a significant replacement of low-productivity illegal workers with higher-productivity legal workers.

Occupation and Wage Effects

Column 1 of Table 3 shows the share of illegal immigrants in the wagebill of each occupation. The 50-order occupational classification was chosen to give maximum detail on employment of illegal immigrants. About 90 percent of their employment is in the first 49 occupations. The last occupation, "Services, other," accounts for about 60 percent of employment in the United States, but only 10 percent of illegal employment. Columns 2 and 3 show the long-run effects of the supply-restriction policy on employment and real wage rates of U.S. workers by occupation.

In broad terms, the employment results in Table 3 show a long-run transfer of U.S. workers from "Services, other," which is an amalgam of predominantly high-skilled, high-paying jobs, to the occupations that currently employ large numbers of illegal immigrants. These latter occupations are mainly low-skilled, low-paying jobs. The correlation coefficient between the deviations in jobs for U.S. workers (column 2) and illegal shares (column 1) is close to one, which means a strong one-to-one positive correlation. In occupations vacated by illegal immigrants, U.S. workers not only gain jobs but also benefit from significant wage increases. The correlation coefficient between the employment and wage results in columns 2 and 3 is also close to one.

While restriction of illegal immigration would increase employment and wages for U.S. workers in many occupations, the overall effect would be negative. The last entries in columns 2 and 3 show reductions in aggregate employment and average real wage rates of 0.16 and 0.46 percent.

It is not surprising that the aggregate employment effect is small (-0.16 percent): in the absence of supply shocks to the U.S. workforce, restricting illegal immigration can have no more than a minor effect on aggregate long-run employment of U.S. workers. But why is the effect negative? The decrease in employment of U.S. workers arises from the occupational shift in the composition of their employment toward low-skilled occupations. These occupations have relatively high equilibrium rates of unemployment, which we have assumed are unaffected by immigration policy.

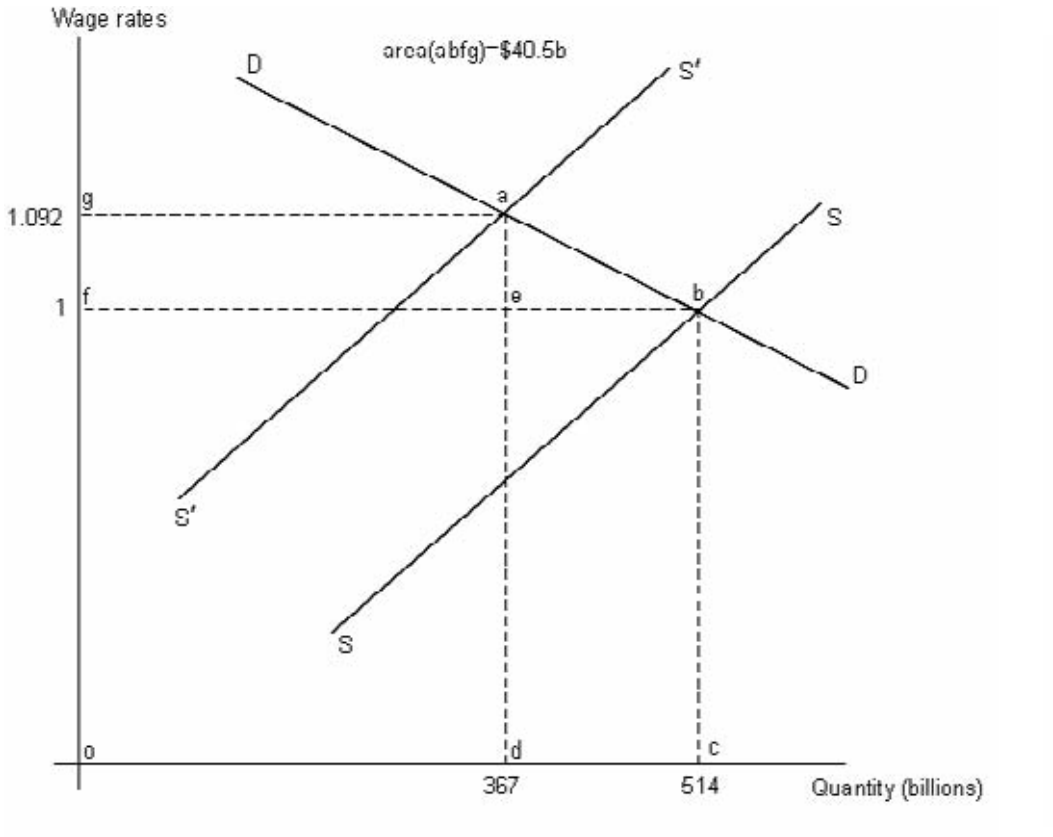
Column 3 of Table 3 shows that restriction of illegal immigration increases wage rates for U.S. workers in all occupations except "Services, other," in which the wage rate is reduced by only 0.13 percent. However, the average hourly wage rate of U.S. workers is reduced by 0.46 percent, reflecting the shift in the occupational composition of their employment to low-paying jobs.

While restriction of illegal immigration would increase employment and wages for U.S. workers in many occupations, the overall effect would be negative.

Appendix B: The Direct Effects of Reducing the Supply of Illegal Immigrants: A Demand-Supply Diagram Approach

In Simulation 1, tighter border enforcement increases the costs of illegal entry, reducing the

Figure 2
Demand for and Supply of Illegal Immigrants in 2019, Simulation 1



Source: Authors' calculations according to USAGE model.

inflow of illegal workers. In Figure 2, DD is the demand curve for illegal immigrants in 2019, drawn as a function of their pre-income-tax wage rate. In this simulation, the pre-income-tax wage rate is the cost to employers of illegal immigrants. The DD curve has a negative slope because higher costs mean lower demand by employers. SS and S′S′ are the supply curves for illegal immigrants in the business-as-usual and policy runs, respectively. Both relate supply to pre-income-tax wage rates and are drawn on the assumption that the income-tax rate applying to illegal immigrants is held constant. Supply curves slope up: with higher wages more people come to the United States as illegal immigrants.

The numbers in Figure 2 refer to simulation results for 2019. In the business-as-usual run for 2019, the pre-tax wage rate for one unit of illegal labor is $1 (2009 prices) per unit, rising to $1.092 in the policy run as the supply of illegal labor is reduced through increased border enforcement. The aggregate wagebill in the business-as-usual forecast for 2019 is $14,127 billion (in 2009 dollars). As mentioned in the main text, the share of illegal immigrants in the total wagebill is 3.64 percent. Thus, with the wage rate at $1, business-as-usual employment of illegal immigrants in 2019 is 514 billion units (0.0364 times $14,127 billion). In the policy run, the quantity of illegal immigrant employment is 28.6 percent lower, 367 billion units.

To a first approximation, the loss in output (represented by GDP) from reducing employment is the change in the area under the demand curve.

As former students of economics 101 may recall, to a first approximation, the loss in output (represented by GDP) from reducing employment is the change in the area under the demand curve. In Figure 2, this is area *abcd*: assuming that the last employed unit of illegal immigrant labor received a wage reflecting its marginal product,

elimination of this unit reduces GDP by $1; elimination of the next unit reduces GDP by slightly more than $1; and so on until the elimination of the final unit in the 28.6 percent cut in illegal employment reduces GDP by $1.092.

The change in the total cost to employers of illegal immigrants is area *gado*, the cost with the policy in place, minus area *fbco*, the cost in the business-as-usual forecast. This can be represented as area *gaef*, the increase in costs associated with the increase in the illegal immigrant wage rate, minus area *ebcd*, the reduction in costs associated with employment of fewer illegal immigrants. Ignoring taxes, the analysis so far suggests that the direct effect of cutting illegal employment (the change in GDP less the change in the costs of employing illegal workers) is a loss represented by area *abfg*. As indicated in Figure 2, this area is worth $40.5 billion.

Taxes complicate the situation in two ways. First, the change in the area under the demand curve is an underestimate of the loss in GDP because indirect taxes mean that pre-tax wage rates are less than the marginal product of workers. Second, illegal immigrants pay income taxes. Consequently, area *ebcd* overstates the savings to the U.S. economy associated with paying wages to 28.6 percent fewer illegal immigrants and area *gaef* overstates the cost to the U.S. economy of paying higher wage rates to illegal immigrants who remain in employment. Adjusting for taxes takes our final estimate of the direct effect to a loss of $61.0 billion in 2019, which is 0.29 percent of business-as-usual GNP of U.S. households (Table 1, row 1, column 1). Applied to the 2009 economy, a 0.29 percent loss in GNP of U.S. households is equivalent to a loss of $41.7 billion.

Notes

The work reported in this paper is part of a broader project concerned with the creation and application of USAGE, a detailed policy-relevant model of the U.S. economy. Contributions to the USAGE Project have been made by the U.S. International Trade Commission; the U.S. Departments of Agriculture, Commerce, and Homeland Security; and the Centre of Policy Studies at Monash University in Australia. Since its inception in 2001, the USAGE project has been guided and inspired by Bob Koopman, director of the Office of Economics at the U.S. International Trade Commission. Without his support, the USAGE model would not exist.

The present study was suggested to us by Daniel Griswold of the Cato Institute, and is an extension of earlier work undertaken for the U.S. Departments of Commerce and Homeland Security. Bryan Roberts of Homeland Security has been the driving force behind the application of USAGE to immigration issues. In adapting USAGE for the study of immigration, we have received valuable advice and encouragement not only from him, but also from Marvin Fell, Michael Ferrantino, Gordon Hanson, Martin Johnson, Jan Mares, and James Whitaker. We thank them all. None of them is responsible for views expressed or for shortcomings in this study.

1. Jeffrey S. Passel and D'Vera Cohn, "A Portrait of Unauthorized Immigrants in the United States," Pew Hispanic Center, April 14, 2009, p. i.

2. This is a dynamic economywide model of the United States created at the Centre of Policy Studies, Monash University, in collaboration with the U.S. International Trade Commission. The theoretical structure of USAGE is similar to that of the MONASH model of Australia; see P. B. Dixon and M. T. Rimmer, *Dynamic General Equilibrium Modelling for Forecasting and Policy: A Practical Guide and Documentation of MONASH* (Amsterdam: North-Holland Publishing Company, 2002). USAGE has been used in applications for the U.S. International Trade Commission and the U.S. Departments of Agriculture, Commerce, and Homeland Security. See, for example, U.S. International Trade Commission, *The Economic Effects of Significant U.S. Import Res-traints: Fourth Update*, June 2004, and *Fifth Update*, February 2007.

3. Creation and application of models such as USAGE require detailed theoretical specifications; many pages of computer code; and years of work on industry, trade, and occupational data. It is not practical for consumers of analyses from large-scale models to be familiar with all their aspects. A common reaction in these circumstances is to demand numerical sensitivity analysis. Such analysis is provided in P. B. Dixon, M. Johnson and M. T. Rimmer, "Reducing Illegal Immigrants in the U.S.: A Dynamic CGE Analysis," CoPS/Impact Working Paper G-183, 2009, http://www.monash.edu.au/policy/ftp/workpapr/g-183.pdf. However, in our view, numerical sensitivity analysis is a rather inferior substitute for understanding results. In this paper, we provide explanations that we hope will give readers a framework for understanding how the results would be affected by variations in assumptions and data input.

4. This, and all other dollar amounts mentioned in the paper, refer to 2009 dollars.

5. To convert to real GNP for U.S. households, we deflate by a weighted average of the price indexes for private and public consumption. In our simulations we assume that percentage deviations in private consumption by U.S. households and public consumption on their behalf are the same as the percentage deviations in real GNP for U.S. households. Consequently, deviations in consumption by U.S. households also indicate deviations in welfare.

6. G. H. Hanson and C. McIntosh, "The Great Mexican Emigration," University of Southern California, San Diego, July 2007, p. 48.

7. This estimate is based on J. Van Hook, F. D. Bean, and J. Passel, "Unauthorized Migrants Living in the United States: A Mid-Decade Portrait," Pew Hispanic Center, September 2005, p. 43, www.migrationinformation.org/feature/display.cfm?ID=329. The more recent estimate for the number of unauthorized immigrants in March 2008 (cited above) is almost exactly in line with the growth rate assumed in our model from the 2005 baseline.

8. The main sources for this estimate are R. Rector and C. Kim, "The Fiscal Cost of Low-Skill Immigrants to the U.S. Taxpayer," Heritage Special Report SR-14, Heritage Foundation, May 2007, p. 70, http://www.heritage.org/Research/Immigration/sr14.cfm; and Carole Keeton Strayhorn, "Undocumented Immigrants in Texas: A Financial Analysis of the Impact to the State Budget and Economy," Special Report, Office of the Comptroller of Texas, December 2006, p. 22.

9. We calculate the 3.65 percent as 100 times 0.49 times 0.0717, divided by (0.49 times 0.0717, plus 1-0.0717).

10. A terms-of-trade improvement generally reduces the price index for gross national expenditure (private and public consumption plus investment) relative to that for GDP, because GNE includes imports but not exports, while GDP includes exports but not imports. In Simulation 1, the reduction in the price of consumption relative to the price of GDP is accentuated by movements in the component prices in GNE. The price of consumption falls relative to the price of GNE because the price of the other component of GNE, investment, is elevated, reflecting the heavy representation of illegal immigrants in the construction industry.

11. Because the wage reduction in Simulation 3 applies to more workers than the wage increase in Simulation 1, we expected that the direct effect would be noticeably larger in absolute size in Simulation 3 than in Simulation 1. However, the demand curve for illegal immigrants or guest workers is not exactly a straight line: it is concave from above. This means that the wage reduction in Simulation 3 is smaller in absolute size than the wage increase in Simulation 1 (7.7 percent decrease compared with 9.2 percent increase). This leaves the direct effect in Simulation 3 only slightly larger in absolute size than that in Simulation 1 (0.31 percent compared with -0.29 percent) despite the difference in the numbers of foreign workers involved.

12. Daniel T. Griswold, "Willing Workers: Fixing the Problem of Illegal Mexican Migration to the United States," Trade Policy Analysis no. 19, Cato Institute, October 15, 2002, p. 13.

13. That is, 1.532 times 1.143 equals 1.751.

14. One factor that is omitted from our modeling is the implementation costs of different policies. Legalization would not eliminate the need for border enforcement. However, we doubt that it would significantly increase the costs of border enforcement, and it could plausibly reduce costs by reducing the number of workers crossing the border illegally. Internally, the tradeoff would be administration of a visa-tax program against a program of internal enforcement. Remembering that the welfare difference between policies can be as high as $260 billion a year, it seems unlikely that explicit recognition of implementation costs would challenge our conclusion in favor of liberalization.

15. For a description of the effects of the 1965 liberalization of U.S. immigration policy, see Griswold, p. 4.

16. We assume that immigration policy does not change either technologies or long-run rates of return, implying that it has little effect on the capital-to-labor (K/L) ratio.

17. We compute the Pearson product-moment correlation coefficient. This measures the strength of the linear dependence between two variables. This correlation coefficient lies between -1 and 1 and is close to +1 (or -1) if the variables have a strong positive (or negative) linear dependence.

18. In the database for the initial year, 2005, we set wage rates for legal and illegal migrants in any occupation at 0.9 and 0.8 times those of native workers. Support for the 0.9 is provided in Table 2, page 11 of R. Rector and C. Kim. The 0.8 is an assumption.

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