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The Economic Impacts of Removing Unauthorized Immigrant Workers

An Industry- and State-Level Analysis

By Ryan Edwards and Francesc Ortega September 2016



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Introduction and summary

In every state and in every industry across the United States, immigrants—authorized and unauthorized—are contributing to the U.S. economy. Immigrant labor and entrepreneurship are believed to be powerful forces of economic revitalization for communities struggling with population decline.¹ Estimates suggest that the total number of unauthorized immigrants currently residing in the United States is approximately 11.3 million, or about 3.5 percent of the total 2015 resident population of 324.4 million.² Of those 11.3 million, we estimate that 7 million are workers. What is the economic contribution of these unauthorized workers? What would the nation stand to lose in terms of production and income if these workers were removed and returned to their home countries?

Mass deportation of 11.3 million unauthorized immigrants would also remove these 7 million workers from the U.S. economy, reducing the total number of U.S. workers by nearly 5 percent. A change in domestic labor supply of the magnitude entailed by such a policy has little historical precedent in the United States. The Great Recession—considered here to take place from 2007 to 2009—raised the unemployment rate by 4.5 percentage points and reduced real gross domestic product, or GDP, by 4.2 percent,³ but its effects were spread across different classes of workers. To estimate how removing unauthorized workers would affect the economy, we proceed by constructing an economic model that builds on the cutting-edge research techniques pioneered by leading economists on all sides of the immigration debate.⁴ In the pages that follow, we use industry-level data and individual data in order to capture the full scale of the diversity within the unauthorized population and to estimate the effects of a mass deportation policy on industries in the United States as a whole, as well as in each state.

The main findings of this report are as follows:

- **A policy of mass deportation would immediately reduce the nation's GDP by 1.4 percent, and ultimately by 2.6 percent, and reduce cumulative GDP over 10 years by \$4.7 trillion.** Because capital will adjust downward to a reduction in labor—for example, farmers will scrap or sell excess equipment per remaining worker—the long-run effects are larger and amount to two-thirds of the decline experienced during the Great Recession. Removing 7 million unauthorized workers would reduce national employment by an amount similar to that experienced during the Great Recession.
- **Mass deportation would cost the federal government nearly \$900 billion in lost revenue over 10 years.** Federal government revenues are roughly proportional to GDP, while federal spending is less responsive. A conservative estimate suggests that annual revenue losses would start at \$50 billion and accumulate to \$860 billion over a 10-year period. With associated increases in interest payments, removal^{*} would thus raise the federal debt by \$982 billion by 2026 and increase the debt-to-GDP ratio, a common measure of fiscal sustainability, by 6 percentage points over the same time period. Unsustainably high levels of the debt-to-GDP ratio may ultimately raise interest rates and choke off economic growth.
- **Hard-hit industries would see double-digit reductions in their workforces.** Unauthorized workers are unevenly spread across industries, with the highest concentrations employed in agriculture, construction, and leisure and hospitality. Those three industries would be hit hardest by a removal policy, experiencing workforce reductions of 10 percent to 18 percent, or more.⁵ Other industries would also experience reductions in output due to a mass deportation policy.
- **The largest declines in GDP would occur in the largest industries, not in immigrant-heavy industries.** Because industries also vary in size, the losses in value added to the national GDP stemming from removal occur across many industries that are not usually associated with unauthorized labor. The three largest U.S. industries in terms of value added are financial activities, manufacturing, and wholesale and retail trade. Annual long-run GDP losses in those industries would reach \$54.3 billion, \$73.8 billion, and \$64.9 billion, respectively, the three largest effects among the 12 private-sector industries.

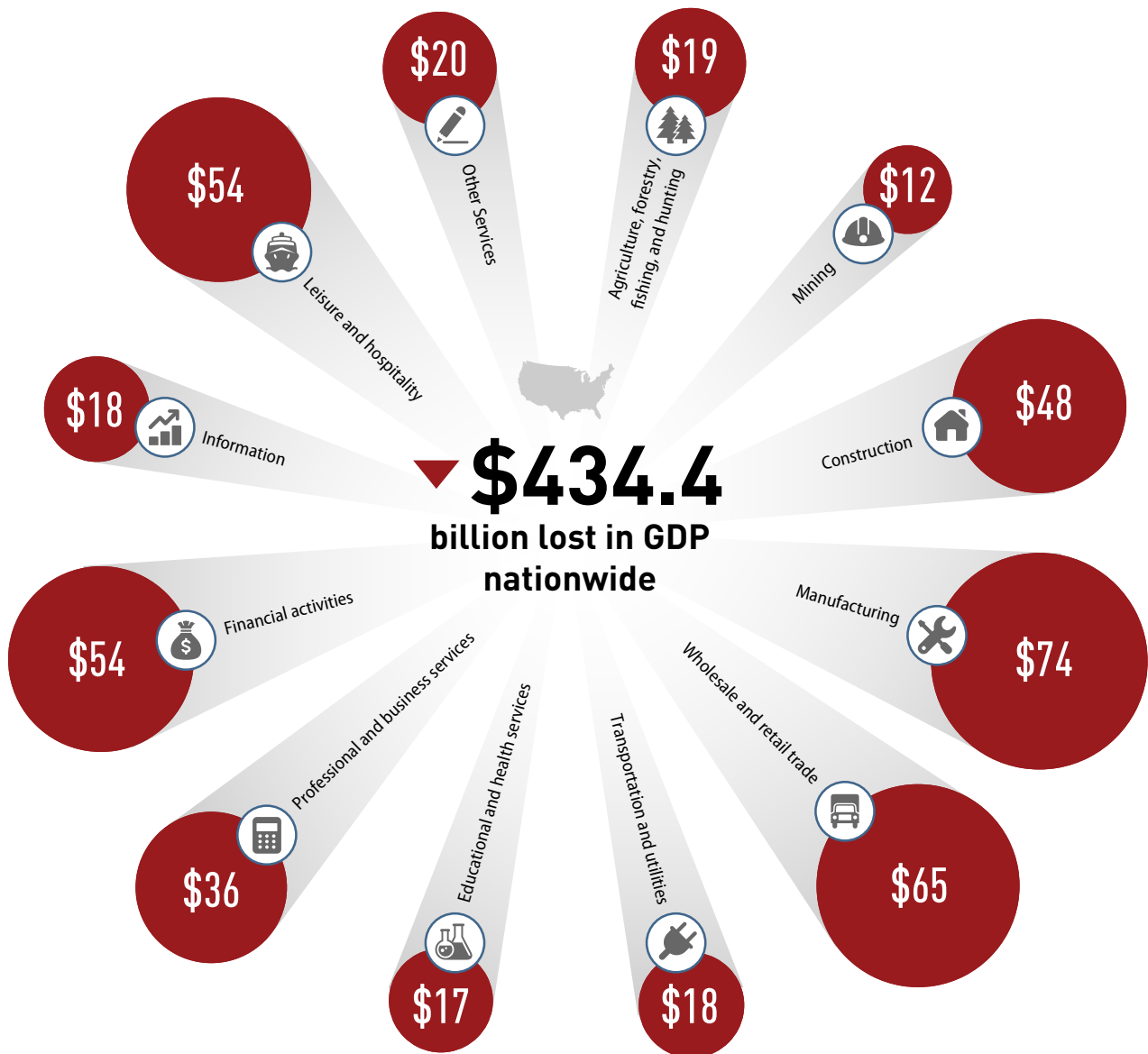
^{*}Throughout this report, the terms “mass deportation,” “deportation,” “removal,” and “removal policy” refer to any policy or practice that results in the 11.3 million unauthorized immigrants in the United States being forced to leave the country.

- **States with the most unauthorized workers will experience the largest declines in state GDP.** We estimate that GDP in California, for example, will ultimately fall by \$103 billion annually—or roughly a 5 percent drop—if mass deportation occurs. Large declines will also occur in other states such as Texas, New York, and New Jersey, with the effects spread across industries.⁶

The economic and fiscal harm from mass deportation is severe. The Center for American Progress previously estimated the direct cost to the government of physically deporting this many unauthorized immigrants at \$114 billion.⁷ This report focuses solely on the economic effects of removal of 7 million unauthorized workers, which are much larger. It is beyond the scope of this report, however, to estimate the economic consequences of removing from the U.S. economy more than 11 million consumers of goods and services. And there are also likely to be harmful noneconomic consequences felt by communities and families that would have to adjust to the removal of millions of people. It is also beyond the scope of this report to estimate response of native employment. But with current unemployment rates low in most industries, the incentives for remaining residents to work more in order to fill in any gaps left by deported workers would most likely be small and temporary. Viewed in this context, our results suggest that a policy of mass deportation faces a high bar in terms of a cost-benefit calculation.

The national economy will suffer losses if unauthorized immigrant workers are removed

Average annual GDP losses from removing unauthorized immigrant workers, by industry (in billions of dollars)



Notes: The annual estimates of GDP lost are the long-run impacts on production (in 2013 dollars) of a policy that removes all unauthorized immigrants. Total GDP lost excludes public-sector, or government, contributions to GDP, which are not shown separately because they do not change with the policy. Estimates are not available, or N/A, for industries within a state where there are too few unauthorized workers observed in the 2011–2013 pooled American Community Survey.

Source: Ryan Edwards and Francesc Ortega, "The Economic Impacts of Removing Unauthorized Immigrant Workers: An Industry and State-Level Analysis" (Washington: Center for American Progress, 2016), available at <https://www.americanprogress.org/issues/immigration/report/2016/09/16/144363/>. See Methodology for further detail.

Who are unauthorized U.S. workers?

Unauthorized immigrant workers are a diverse group that is difficult to describe in broad terms. An estimated one-third of all unauthorized workers are employed in agriculture and construction. Perhaps in contrast with popular perception, however, our research shows that unauthorized workers are employed in all U.S. industries, including the information sector—which includes broadcasting, the news media, telecommunications, and internet companies—and in financial fields such as banking and real estate.

Table 1 shows our estimates of U.S. workers by industry, immigration status, and nativity, based on the U.S. Census Bureau’s American Community Surveys of 2011, 2012, and 2013 and legal status imputations by the Center for Migration Studies.⁸ The unauthorized share, shown at the far right, is estimated to be zero only in public administration—which includes occupations such as police and firefighting, in addition to government workers—for whom legal residency is required prior to employment.⁹

The largest employers of unauthorized immigrants are the leisure and hospitality sector and the construction sector; more than 1 million are employed in each, and the unauthorized shares of the sectors’ workforces are 9.5 percent and 12.7 percent, respectively. The unauthorized share is highest in the composite agriculture sector, at 17.7 percent, which includes hired crop workers; owners and employed family members; and workers engaged in forestry, fishing, and hunting. The precise number of unauthorized workers in agriculture, here estimated at 352,000, is often disputed, and we believe this estimate to be conservative. We discuss this topic in greater detail below.

TABLE 1

Unauthorized immigrants are spread out across industries

Employment by industry, nativity, and immigration status, pooled 2011–2013

Industry	Total	U.S. born	Authorized immigrants	Unauthorized immigrants	Unauthorized share of total
All industries	143,369,000	119,169,000	17,130,000	7,070,000	4.9%
Agriculture, forestry, fishing, and hunting	1,987,000	1,393,000	242,000	352,000	17.7%
Mining	854,000	774,000	56,000	25,000	2.9%
Construction	8,838,000	6,738,000	978,000	1,122,000	12.7%
Manufacturing	15,057,000	12,166,000	2,001,000	889,000	5.9%
Wholesale and retail trade	20,539,000	17,479,000	2,207,000	853,000	4.2%
Transportation and utilities	7,040,000	5,923,000	899,000	218,000	3.1%
Information	3,009,000	2,637,000	303,000	70,000	2.3%
Financial activities	9,418,000	8,166,000	1,056,000	196,000	2.1%
Professional and business services	15,658,000	12,605,000	2,068,000	985,000	6.3%
Educational and health services	33,146,000	28,615,000	4,026,000	505,000	1.5%
Leisure and hospitality	13,699,000	10,701,000	1,695,000	1,302,000	9.5%
Other services	7,159,000	5,549,000	1,057,000	553,000	7.7%
Public administration	6,965,000	6,423,000	541,000	0	0.0%

Sources: Data are averages across the 2011, 2012, and 2013 waves of the augmented American Community Survey files supplied by Center for Migration Studies, "Estimates of the Unauthorized Population" (2014). These data are described in Robert Warren, "Democratizing Data about Unauthorized Residents in the United States: Estimates and Public-Use Data, 2010 to 2013," *Journal on Migration and Human Security* 2 (4) (2014): 305–328. See Methodology for further detail.

In our analysis, we find that most groups of unauthorized workers have fewer years of education than natives,[†] except for a few industries where unauthorized workers have fairly high levels of education comparable to natives and authorized immigrants. This appears to be the case for the information, financial services, and education and health services sectors. In each of these industries, unauthorized immigrants reported, on average, at least one year of postsecondary education. Table 2 shows average levels of education by nativity status and immigration status among workers across U.S. industries. Both authorized and unauthorized immigrants in the information sector have more years of education than natives.

[†] In this report, "native" and "native born" are used interchangeably to refer to people who are native citizens of the United States.

TABLE 2

Unauthorized immigrant workers generally have fewer years of education

Average years of education by industry, nativity, and immigration status, pooled 2011–2013

Industry	Total	U.S. born	Authorized immigrants	Unauthorized immigrants
All industries	13.7	13.9	13.3	10.6
Agriculture, forestry, fishing, and hunting	11.2	12.7	8.0	7.7
Mining	13.0	13.1	13.0	11.0
Construction	12.1	12.7	11.0	9.3
Manufacturing	13.1	13.4	12.6	10.5
Wholesale and retail trade	13.1	13.2	12.8	11.3
Transportation and utilities	13.0	13.1	12.7	11.3
Information	14.5	14.4	15.0	14.5
Financial activities	14.4	14.4	14.7	13.6
Professional and business services	14.4	14.6	14.2	11.1
Educational and health services	14.9	14.9	14.8	13.3
Leisure and hospitality	12.5	12.9	11.7	10.2
Other services	13.0	13.4	11.9	10.4
Public administration	14.5	14.5	14.9	N/A

Sources: Statistics are averages across the 2011, 2012, and 2013 waves of the augmented American Community Survey files supplied by Center for Migration Studies, “Estimates of the Unauthorized Population”; Warren, “Democratizing Data about Unauthorized Residents in the United States.” Statistics are drawn from the employment sample described in the text. See Methodology for further detail.

Likewise, we find that unauthorized workers typically have lower average wages than natives and authorized immigrants. Table 3 shows average hourly wages by industry, immigration status, and nativity, which are consistently much lower for unauthorized workers except in the information sector. Consistent with earlier studies, we find evidence that the wages of unauthorized workers are systematically lower than those of authorized immigrants and natives with the same observable characteristics. As others have remarked, these patterns suggest that some combination of a lack of country-specific skills, access to jobs, and discrimination are depressing the wages of unauthorized workers.¹⁰ Due to lack of legal status, these workers also may not have leverage to ask for appropriate wages.

TABLE 3

Average wages are generally lower for unauthorized immigrants

Hourly wages by industry, nativity, and immigration status, pooled 2011–2013

Industry	Total	U.S. born	Authorized immigrants	Unauthorized immigrants
All industries	\$25.36	\$25.88	\$26.39	\$14.79
Agriculture, forestry, fishing, and hunting	\$13.48	\$16.54	\$11.14	\$8.69
Mining	\$28.25	\$28.08	\$33.48	\$22.51
Construction	\$21.21	\$22.91	\$19.80	\$12.85
Manufacturing	\$26.37	\$26.84	\$27.76	\$16.55
Wholesale and retail trade	\$21.49	\$21.96	\$21.08	\$14.23
Transportation and utilities	\$24.28	\$24.83	\$22.37	\$15.63
Information	\$32.37	\$31.79	\$37.27	\$32.01
Financial activities	\$33.80	\$33.58	\$36.62	\$28.08
Professional and business services	\$31.38	\$32.14	\$32.66	\$18.97
Educational and health services	\$25.23	\$24.84	\$29.17	\$16.94
Leisure and hospitality	\$15.27	\$16.16	\$15.23	\$10.62
Other services	\$18.91	\$20.13	\$15.95	\$12.21
Public administration	\$27.88	\$27.65	\$30.76	N/A

Sources: Statistics are averages across the 2011, 2012, and 2013 waves of the augmented American Community Survey files supplied by Center for Migration Studies, "Estimates of the Unauthorized Population"; Warren, "Democratizing Data about Unauthorized Residents in the United States." Dollars are inflated to 2013 levels using the Consumer Price Index. Statistics are drawn from the wage sample described in the text. See Methodology for further detail.

What are the economic impacts of a mass deportation policy?

Unauthorized immigrant workers in the United States are a very diverse group of individuals. Accurately assessing the economic impact of removing them requires a framework that captures this diversity along with complementarities across the different types of workers.

We proceed by adapting a formal production model that has played a central role in recent analyses of the economic effects of immigration.¹¹ After calibrating the parameters of the model, we simulate the effects of removing all unauthorized workers and estimate the short-run and long-run economic impacts when industries adjust their capital to the smaller workforce. We check our results for robustness by considering a broad spectrum of parameter values. (see Appendix for details on the economic model and its calibration)

The strength of our approach is that it is firmly embedded in the economics literature, in which there is both healthy disagreement about the economic impact of immigration and broad agreement about the principles underpinning a realistic model of the U.S. economy. As we discuss in greater detail in the Appendix, our model incorporates the large heterogeneity that we observe in the data in terms of skills and employment sectors of the unauthorized population. It also accounts for the strength of complementarity among different types of workers and for adjustments to capital and equipment in each industry.

Within this framework, we were able to vary key assumptions about the model's parameters to check for robustness. For example, there is disagreement among experts on the extent to which immigrant workers are close substitutes for native workers with the same levels of education and work experience. Some recent empirical studies have directly estimated the degree of worker substitutability, and we base our central scenario on those results. Our results were robust to a very broad range of parameter values.

Our analysis provides a quantitative assessment of the gains from migration based on the comparison between the baseline scenario with the current unauthorized population and a counterfactual scenario without these workers.¹² We focus here on a narrow definition of economic impact: the effects on the value of production in each industry. Admittedly, a full analysis of the economic impact of a mass deportation policy needs to take into consideration a number of additional factors not considered here, such as changes in the labor force participation of natives and the severe disruption to families and communities throughout the country. Regarding the former, we note that unemployment rates are currently low in most industries and that the incentives of the remaining residents to increase work hours would probably be small and short-lived.

Findings

The immediate effect of a policy that removes the 4.9 percent of U.S. workers who are unauthorized immigrants would be a reduction in total gross domestic product by 1.4 percent, or \$236 billion in 2013 dollars. (see Table 4) As revealed in Table 4, the percentage decline in value added within the private sector is slightly larger, at 1.6 percent, because our model assumes that the public sector employs no unauthorized workers. The distribution across industries of this \$236 billion loss is shown by the left panel in Table 5, which indicates that wholesale and retail trade and leisure and hospitality lose the most in the short run, around \$40 billion each annually.¹³ In the long run, once capital has adjusted to the reduced workforce, we project the reduction in GDP to be 2.6 percent, or an average annual loss of \$434 billion in 2013 dollars, almost twice as large as the short-run effect.¹⁴

TABLE 4
GDP lost when unauthorized immigrant workers are removed

Short- and long-run losses from removing unauthorized immigrants, in billions of 2013 dollars

		Short run			Long run		
	2013 GDP baseline	GDP after removal of unauthorized immigrants	Average annual GDP lost	Percentage loss in GDP	GDP after removal of unauthorized immigrants	Average annual GDP lost	Percentage loss in GDP
Private-sector GDP	\$14,439	\$14,202	-\$236	-1.6%	\$14,004	-\$434	-3.0%
Total GDP	\$16,663	\$16,427	-\$236	-1.4%	\$16,229	-\$434	-2.6%

Note: Total GDP includes public administration. Short-run losses are felt immediately and grow to long-run losses over time.
Source: Authors' analysis of 2011–2013 pooled American Community Survey sample. See Methodology for further detail.

Table 5 reveals the long-run effects on GDP to be distributed differently across industries than the short-run effects. This is because labor shares in production vary widely across industries, ranging from values less than 0.25 in agriculture, mining, and finance to around 0.8 in service-based industries such as education and health. (See Appendix) Industries with low labor shares, such as agriculture, rely more on capital equipment to produce output and thus are relatively less affected by a reduction in the workforce in the short run. In contrast, the long-run effects of removal do not depend on an industry's labor share in production, because capital will ultimately adjust downward in every industry. These patterns are evident in Table 5, where we observe a very small short-run effect in agriculture relative to its long-run effect. In contrast, the short- and long-run effects are practically equal in education and health services.

TABLE 5
GDP lost by industry when unauthorized immigrant workers are removed

Average annual short- and long-run losses from removing unauthorized immigrants, in billions of 2013 dollars

	Short-run loss	Long-run loss
Agriculture, forestry, fishing, and hunting	\$4	\$19
Mining	\$3	\$12
Construction	\$30	\$48
Manufacturing	\$35	\$74
Wholesale and retail trade	\$41	\$65
Transportation and utilities	\$9	\$18
Information	\$7	\$18
Financial activities	\$14	\$54
Professional and business services	\$27	\$36
Educational and health services	\$15	\$17
Leisure and hospitality	\$37	\$54
Other services	\$15	\$20
All private industries	\$236	\$434

Note: Short-run losses are felt immediately and grow to long-run losses over time.

Source: Authors' analysis of 2011–2013 pooled American Community Survey sample. See Methodology for further detail.

The total GDP lost by individual industries is important when considering the effect on the national GDP, but measuring the amount of lost GDP within an industry as a share of that industry's total value added informs the disproportionate impact that a policy of mass deportation would have on industries that employ a large percentage of unauthorized workers. Table 6 shows that the agriculture, leisure and hospitality, and construction industries will be highly affected by a mass deportation policy, with industry-specific losses exceeding 7 percent.

TABLE 6

As a percentage of industry GDP, losses in agriculture and leisure and hospitality rank the highest

Average annual short- and long-run losses from removing unauthorized immigrants, by industry

	Short-run loss	Long-run loss
Agriculture, forestry, fishing, and hunting	1.8%	8.6%
Mining	0.6%	2.8%
Construction	4.8%	7.7%
Manufacturing	1.7%	3.6%
Wholesale and retail trade	2.1%	3.3%
Transportation and utilities	1.2%	2.3%
Information	0.8%	2.2%
Financial activities	0.4%	1.6%
Professional and business services	1.4%	1.8%
Educational and health services	1.1%	1.2%
Leisure and hospitality	5.9%	8.6%
Other services	4.2%	5.6%
All private industries	1.6%	3.0%

Note: Short-run losses are felt immediately and grow to long-run losses over time.

Source: Authors' analysis of 2011–2013 pooled American Community Survey sample. See Methodology for further detail.

An alternative scenario for agriculture

The number of unauthorized agricultural workers

Consistent with other studies using similar data, we estimate that the share of workers who are unauthorized is highest in the agriculture industry.¹⁵ Here, agriculture is a composite sector that includes activities in crop production—the largest in terms of employment—as well as animal production, forestry, logging, hunting and fishing, and support activities.¹⁶

Agricultural work is highly seasonal, and workers engaged in seasonal efforts may also be employed in other industries. In our analysis, we adopt a conservative definition of an agricultural worker based on how the Census Bureau asks respondents about their jobs in the American Community Survey, or ACS, which is conducted throughout the year and thus should capture average work activities that are reflective of seasonal variation. Respondents are defined as agricultural workers if they worked the most hours in the previous week in those activities. This categorization method best fits our model of production, but we also believe it results in a conservative estimate of the effect on agricultural production of a removal policy.

Estimating the characteristics and legal status of agricultural

workers is also challenging. An alternative data source that is used to study unauthorized farm workers is the National Agricultural Workers Survey, or NAWS. The NAWS asks about legal status during interviews of hired workers engaged in crop production and support, but it does not provide reliable estimates of their total numbers. The much larger ACS measures characteristics and total numbers but not legal status explicitly. We found large differences between the characteristics of hired crop workers in the NAWS and in the ACS, chief among them being country of origin, ethnicity, and authorization status.¹⁷ Among hired crop workers, the 2011–2012 NAWS reported that 48.2 percent were unauthorized, compared with 32.4 percent reported by the 2012 ACS.

As a result, we constructed an alternative scenario by applying the characteristics of hired crop workers observed in the NAWS to our ACS estimated totals. The resulting figure roughly agreed with estimates issued by the U.S. Department of Labor and cited in the agricultural economics literature.¹⁸ This procedure raised the estimated share of unauthorized workers in the entire agriculture sector from 17.7 percent to 24 percent, as shown in Table 1 and Table 7.

TABLE 7
Employment in agriculture by nativity and immigration status under alternative scenario
Demographic characteristics from the National Agricultural Workers Survey

Industry	Total workers	Hired workers	Unauthorized hired workers	Unauthorized share of hired workers	Unauthorized share of total
Crop production	1,078,000	743,000	358,000	48.2%	33.8%
Animal production and aquaculture	546,000	321,000	71,000	22.1%	13.2%
Forestry, except logging	53,000	52,000	3,000	4.9%	4.8%
Logging	91,000	62,000	2,000	2.9%	2.1%
Fishing, hunting, and trapping	53,000	22,000	1,000	4.0%	2.7%
Support activities	157,000	119,000	31,000	26.4%	20.9%
Total	1,978,000	1,318,000	465,000	35.3%	24.0%

Note: The employment numbers are rounded to the nearest 1,000.
Sources: Statistics are drawn from totals of workers from the augmented 2012 American Community Survey files supplied by Center for Migration Studies, "Estimates of the Unauthorized Population"; Warren, "Democratizing Data about Unauthorized Residents in the United States." Totals are categorized by legal status using the 2011–2012 National Agricultural Workers Survey. See Methodology for further detail.

Re-estimating the economic impact on agriculture

Combining the NAWS and ACS data in this way, we calibrated and simulated the model again and found that the short- and long-run effects on industry GDP are considerably larger in this alternative scenario, reaching 4.1 percent and 20.9 percent, respectively. The results for this alternative scenario for agriculture are shown alongside our baseline results in Table 8.

It is interesting to analyze these results further. Given that the density of unauthorized workers in agriculture is about one-third higher according to the NAWS relative to the ACS, one

would expect the estimates of the long-run economic contribution of unauthorized workers also to be one-third higher than those obtained on the basis of the ACS data. However, Table 8 exhibits effects that are more than twice as large: 20.9 percent vs. 8.6 percent. The reason for the discrepancy lies in the higher wages paid to unauthorized workers, relative to natives with the same skills and experience, observed in the NAWS data. As a result, the calibration of the model based on the NAWS data exhibits substantially higher productivity for unauthorized workers relative to natives, and this accounts for their larger contribution to output.

TABLE 8
Economic impacts of unauthorized workers in an alternative agricultural scenario
GDP in billions of 2013 dollars

			Short run			Long run		
	2013 GDP	Unauthorized workers as a share of total workers	GDP after removal of unauthorized immigrants	Average annual GDP lost	Percentage loss in GDP	GDP after removal of unauthorized immigrants	Average annual GDP lost	Percentage loss in GDP
Original scenario	\$225	17.7%	\$221	-\$4	-1.8%	\$206	-\$19	-8.6%
Alternative scenario	\$225	24.0%	\$216	-\$9	-4.1%	\$178	-\$47	-20.9%

Note: Short-run losses are immediate, and long-run losses are annual.
Source: Authors’ analysis using data from 2011–2013 pooled American Community Survey sample and 2011–2012 National Agricultural Workers Survey. See Methodology for further detail.

10-year forecasts of economic and fiscal impacts of mass deportation

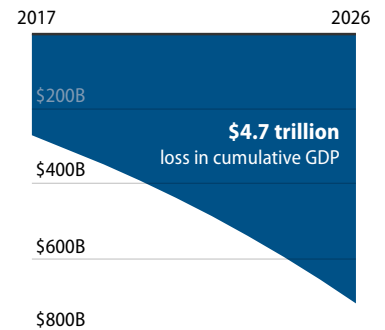
Our framework distinguishes between short- and long-run effects, where the latter incorporate the adjustments of the capital stock in each industry. Following a reduction in the workforce, industry capital-labor ratios will adjust downward. This adjustment is likely to be gradual but can take place fairly rapidly if equipment can be reallocated easily to other industries or countries. We provide a calculation that assumes that industry capital stocks fully adjust in 10 years.¹⁹

We modeled this adjustment during the 10-year budget window adopted by the Congressional Budget Office, or CBO, and often referenced in policy debates, and we updated the launch point of the forecast from 2013 to fiscal year 2017 by applying our estimates of the annual percentage reductions in GDP to the CBO forecasts.²⁰ Table 9 depicts the projected 10-year effects of a removal policy on GDP, which begin at a 1.4 percent loss in terms of GDP but rise over time as capital gradually adjusts, culminating in the full 2.6 percent loss in 2026 relative to the baseline. Cumulatively, over the 10-year period, the lost income in terms of GDP will amount to \$4.7 trillion.

TABLE 9
Losses from a mass deportation policy grow over time

Cumulative GDP lost in billions of nominal dollars over 10 years, 2017–2026

Year	Baseline GDP	GDP after removing unauthorized immigrants	Lost GDP	Percentage GDP lost
2017	\$19,297	\$19,026	\$270	1.4%
2018	\$20,127	\$19,818	\$309	1.5%
2019	\$20,906	\$20,558	\$348	1.7%
2020	\$21,710	\$21,319	\$391	1.8%
2021	\$22,593	\$22,156	\$437	1.9%
2022	\$23,528	\$23,041	\$486	2.1%
2023	\$24,497	\$23,958	\$539	2.2%
2024	\$25,506	\$24,910	\$595	2.3%
2025	\$26,559	\$25,904	\$655	2.5%
2026	\$27,660	\$26,941	\$719	2.6%
Cumulative GDP, 2017–2026	\$232,382	\$227,633	\$4,749	2.0%



Note: We assume that the short-run percentage reduction in GDP associated with the removal policy applies in 2017 and that it takes 10 years to reach the long-run percentage reduction. We apply this estimated path of percentage losses under the removal policy to the baseline GDP forecast.

Source: Baseline GDP statistics are from the Congressional Budget Office, "Updated Budget Projections: 2016 to 2026" (Washington: Congressional Budget Office, 2016), available at <https://www.cbo.gov/publication/51384>.

What are the likely fiscal impacts of a removal policy for government budgets and for U.S. taxpayers? The most immediate costs to government would no doubt stem from executing and enforcing a policy that removes 11.3 million individuals. As outlined earlier, CAP previously estimated the direct cost of physically deporting this many unauthorized immigrants at \$114 billion.²¹ The American Action Forum estimated costs of \$100 billion to \$300 billion for removal and enforcement and an additional \$315 billion in prevention costs over 20 years, for a total approaching \$420 billion to \$620 billion over 20 years.²²

In addition to increasing government spending, the removal of unauthorized workers will also reduce government revenues by decreasing national income. Income and payroll taxes are the primary source of tax financing for the federal government. When GDP falls, as we project it will if unauthorized workers are removed, so will tax revenues because of the nature of the U.S. tax system, which primarily taxes income.²³

By contrast, federal expenditures are unlikely to fall significantly with the removal of unauthorized immigrants. Those who are unauthorized are prohibited by law from receiving many types of government benefits, such as Social Security and Medicare, which account for the majority of federal government spending. Although a stereotype exists that unauthorized immigrants absorb government benefits because they have low socio-economic status, modern federal government spending on income support mostly operates through the tax code, which requires a valid Social Security number. If anything, removal is likely to increase federal spending significantly, at least in the short run, due to the costs of executing and monitoring such a policy.

Assuming that revenues remain a constant share of GDP while expenditures remain tied to the unchanged native-born and authorized foreign-born populations, we project that removing unauthorized immigrants is likely to reduce federal revenues by 1.4 percent in the short run and 2.6 percent in the long run, the same percentage reductions that we project in GDP.²⁴ With federal revenues forecast to be \$3.5 trillion in the baseline in 2017, removal would raise the annual deficit by \$50 billion immediately. Over a 10-year window, such a removal policy would raise combined federal deficits—including extra interest payments and thus debt held by the public—by roughly \$1 trillion.²⁵ The debt-to-GDP ratio in 2026 would be 6 percentage points higher. Table 10 shows annual effects on federal government revenues stemming from reductions in GDP triggered by a removal policy under our baseline assumptions regarding the speed of capital adjustment.²⁶

The effects that removing unauthorized immigrants would have on state and local budgets are less clear. State and local tax revenues would also likely fall because many states tax income as well. But states also tax property holdings and sales, which may be affected by a removal policy in ways that are less evident. Removal of 11.3 million people also means devastating effects on housing, businesses, and local economic activity, which we do not consider here. On the other hand, states bear the fiscal costs of providing public education, which is disproportionately tied to the number of families with young children, and many unauthorized immigrants fall into this category.²⁷

TABLE 10

The effects on the federal budget of reductions in GDP caused by a mass deportation policy over the 10-year budget window

In billions of nominal dollars

Year	Federal revenues in baseline	Federal revenues after removal	Difference equals revenues lost	Increase in unified deficit	Debt held by the public baseline	Debt held by the public after removal	Debt as a percentage of GDP	
							Baseline	Removal
2017	\$3,508	\$3,459	\$49	\$49	\$14,572	\$14,621	76%	77%
2018	\$3,645	\$3,589	\$56	\$57	\$15,177	\$15,284	75%	77%
2019	\$3,772	\$3,709	\$63	\$66	\$15,934	\$16,106	76%	78%
2020	\$3,931	\$3,860	\$71	\$76	\$16,771	\$17,019	77%	80%
2021	\$4,082	\$4,003	\$79	\$87	\$17,692	\$18,028	78%	81%
2022	\$4,247	\$4,159	\$88	\$99	\$18,766	\$19,200	80%	83%
2023	\$4,423	\$4,326	\$97	\$113	\$19,880	\$20,428	81%	85%
2024	\$4,615	\$4,507	\$108	\$128	\$21,012	\$21,687	82%	87%
2025	\$4,825	\$4,706	\$119	\$144	\$22,280	\$23,100	84%	89%
2026	\$5,042	\$4,910	\$131	\$162	\$23,672	\$24,654	86%	92%
Cumulative, 2017–2026	\$42,089	\$41,229	\$860	\$982				

Note: We assume that federal revenues remain a fixed share of GDP and that federal expenditures other than net interest payments remain unaffected by the removal policy. The unified deficit equals the excess of expenditures, including net interest, and revenues and represents the change in debt held by the public. The increase in the unified deficit here equals lost revenue plus associated increase in net interest payments, and the cumulative sum of increases in unified deficits equals the total increase in debt held by the public.

Source: Baseline GDP and budget statistics are provided by the Congressional Budget Office, "Updated Budget Projections: 2016 to 2026." For details on the GDP forecast, see the Notes in Graphic 9. We assume that federal revenues remain a fixed share of GDP and that federal expenditures other than net interest payments remain unaffected by the removal policy. The unified deficit equals the excess of expenditures, including net interest over revenues, and represents the change in debt held by the public. The increase in the unified deficit here equals lost revenue plus associated increase in net interest payments, and the cumulative sum of increases in unified deficits equals the total increase in debt held by the public.

State-level results

We also explored the effects of a removal policy on GDP for individual states. Although such a policy would reduce GDP in every state, we find that the largest effects naturally are found in the states with the largest shares of unauthorized workers. In our data, these states are California, where 10.2 percent of workers are unauthorized; Texas, at 8.7 percent; New Jersey, at 7.4 percent; and New York, at 6.2 percent.

Our findings for these four states are summarized in Table 11, which lists baseline GDP in 2013 by industry for each state alongside our estimate of the long-term reduction in each industry associated with a removal policy.²⁸ Across these four states, the total long-run reduction in state GDP ranges between \$26 billion and \$103 billion—between 3 percent and 5 percent. The expected effect on California’s agricultural output, \$8 billion, is a large part of the \$19 billion total effect on that sector nationally, shown in Table 5. But reductions in manufacturing and wholesale and retail trade industries—especially in California—are also large, reaching as high as \$20 billion. In New York and New Jersey, the largest effects of a removal policy are reductions in value added from financial activities, which are those states’ largest contributions to national GDP. These declines reach \$7 billion in New Jersey and \$10 billion in New York. We estimate that GDP in Texas would decline by \$10 billion due to reduced manufacturing activity, another \$9 billion each in construction and in wholesale and retail trade, and \$8 billion in mining. Expressed as shares of industry output within that state, these losses range between 4 percent and 13 percent.

TABLE 11

State economies will shrink when unauthorized immigrant workers are removed

Average annual long-run state GDP impacts, in billions of 2013 dollars

	California		Texas		New Jersey		New York	
Industry	2013 GDP	Long-run GDP loss	2013 GDP	Long-run GDP loss	2013 GDP	Long-run GDP loss	2013 GDP	Long-run GDP loss
Agriculture, forestry, fishing, hunting	\$39	\$8	\$11	\$1	\$1	\$0	\$3	\$0
Mining	\$26	\$1	\$214	\$8	\$0	NA	\$1	NA
Construction	\$72	\$8	\$74	\$9	\$19	\$2	\$41	\$4
Manufacturing	\$245	\$20	\$230	\$10	\$44	\$4	\$69	\$3
Wholesale and retail trade	\$258	\$17	\$197	\$9	\$76	\$4	\$132	\$7
Transportation and utilities	\$78	\$5	\$87	\$3	\$26	\$1	\$43	\$2
Information	\$181	\$7	\$55	\$2	\$24	\$1	\$103	\$1
Financial activities	\$465	\$9	\$208	\$4	\$130	\$7	\$416	\$10
Professional and business services	\$282	\$9	\$153	\$4	\$81	\$3	\$167	\$3
Educational and health services	\$160	\$3	\$89	\$2	\$46	\$1	\$117	\$2
Leisure and hospitality	\$86	\$12	\$49	\$6	\$17	\$2	\$50	\$5
Other services	\$47	\$5	\$31	\$3	\$11	\$1	\$26	\$2
All private industries	\$1,938	\$103	\$1,398	\$60	\$475	\$26	\$1,168	\$40
Total GDP	\$2,216	\$103	\$1,555	\$60	\$534	\$26	\$1,325	\$40

Source: Authors' analysis of 2011–2013 pooled American Community Survey sample. Total GDP includes public administration. See Methodology for further detail.

Conclusion

A policy of removing all unauthorized workers would have important—and overwhelmingly negative—effects on the nation’s economic and fiscal well-being. Nearly 5 percent of the U.S. workforce is unauthorized, and the labor services provided by these workers are valuable in every state and in every private industry. We estimate the economic costs of removing unauthorized workers to be 1.4 percent of gross domestic product in the short run, ultimately rising to 2.6 percent once industries resize their stocks of capital.²⁹

Our findings are consistent with other recent studies that have explored the economic contributions of unauthorized immigrants.³⁰ One analysis associated each H-2A agricultural worker³¹ in North Carolina with about \$42,000 in additional state GDP in 2012.³² Our model finds a roughly \$54,000 impact of each unauthorized agricultural worker on national GDP in 2013. Another study assumed constant worker productivity within industries, which our data suggest overstates the productivity of unauthorized workers. That report estimated a long-run economic cost of \$623 billion in lost private-sector GDP in 2012, compared to our estimate of \$434 billion in 2013.³³

The unauthorized immigrant population is far from monolithic. There is great variation in terms of skills, productivity, industry of employment, and geographic location. As a result, the economic contributions of unauthorized workers are large and widespread across the economy. Removal of unauthorized workers would entail large economic losses in many states and in many industries. If such a removal were to occur, the U.S. economy would experience a significant reduction in GDP and tax revenue, which would likely lead to an increase in federal budget deficits and indebtedness.

Appendix: Methodology

Measuring unauthorized workers

Our study requires us to know the detailed characteristics of unauthorized immigrants. One might expect it to be difficult to measure the characteristics of a group that may not want to be measured.

The legal implications of being unauthorized are complicated and depend on location and circumstance.³⁴ The decennial census and related surveys such as the American Community Survey and Current Population Survey are conducted by the U.S. Bureau of the Census using postal addresses supplemented by telephone and in-person interview or enumeration. Noncompliance or refusal is a perennial and growing challenge for survey-based efforts, but there is no a priori reason to expect that unauthorized groups would systematically fail to respond. Most Census Bureau surveys do not ask respondents to reveal their legal residency status. If the objective is to blend in, one might expect unauthorized immigrants to respond to these surveys at the same or higher rate than equivalent legal residents.

Since the late 1990s, a variety of researchers in government, think tanks, and academia have combined Census Bureau products—which measure characteristics of the resident population, including place of birth—with official immigration statistics on naturalizations and other events in order to impute legal status via a residual estimation method.³⁵ Although not without its critics, these efforts using multiple data sources generally agree with one another and illustrate the general contours of the unauthorized population in the United States. A concern is whether the imputation process that identifies likely unauthorized immigrants accounts for the correlation of important characteristics with unauthorized status.³⁶

For our study, we used augmented versions of the 2011, 2012, and 2013 American Community Surveys distributed by the Integrated Public Use Microdata Series—known as IPUMS—project at the University of Minnesota. These files include imputations of legal status created by researchers at the Center for Migration

Studies, or CMS, which distributes these data sets on a restricted basis to external researchers.³⁷ Comparisons to the work of other researchers using similar data indicate the face validity of these data.³⁸ We believe the CMS data accurately capture the true covariance structure between authorized status and the characteristics that are important for this study: industry; education; and basic demographics. We also note that other imputation methods deliver slightly different results that can occasionally lead to discrepancies.³⁹

Because our analysis requires fine disaggregation of workers into subgroups defined by industry, nativity and immigration status, education, and years of work experience, in our central analysis, we pool the 2011, 2012, and 2013 waves of the ACS. In our state-level estimates, which are based on our national estimates, we also use pooled averages from these waves of the ACS.

To check the robustness of our findings, we also supplement our analysis of unauthorized agricultural workers with data from an alternative survey that directly asks about legal status, the National Agricultural Workers Survey, conducted by the U.S. Department of Labor. The NAWS is a small annual survey conducted through face-to-face interviews, in contrast to the mail and telephone modes used by the ACS. Like other researchers facing similar challenges, we cannot easily assess which data source provides more accurate measurement. Instead, we construct an alternative scenario for agriculture in which we inflate NAWS data so that the estimated subpopulation size is consistent with ACS and Department of Labor data while retaining the average characteristics of the subpopulation as they are measured in the NAWS. To do this, we use the 2012 ACS data combined with the 2011–2012 waves of the NAWS. As we describe in the text, we find large and unexplained differences in the prevalence and characteristics of unauthorized hired crop workers as measured in the ACS vs. the NAWS that seem likely to be related to differences in the mode of interview between the two surveys. A thorough understanding of these divergent findings awaits further study.

Industry classification

We adopt a standard approach to categorizing workers and output by industry using the North American Industry Classification System. This approach, which combines industries into 14 supersectors, has previously been applied in the literature on unauthorized workers.⁴⁰

Workers are classified as belonging to one of the following 14 industries:

1. Agriculture, forestry, fishing, and hunting
2. Mining, quarrying, and oil and gas extraction
3. Construction
4. Manufacturing
5. Wholesale and retail trade
6. Transportation and utilities
7. Information
8. Financial activities
9. Professional and business services
10. Education and health services
11. Leisure and hospitality
12. Other services
13. Public administration
14. Active-duty military

We observe workers in these industries in the ACS extracts provided by the CMS, and we observe GDP by industry and by state in 2013 using publicly available online statistics provided by the U.S. Bureau of Economic Analysis.

As shown in Table 1 in the report, estimates of unauthorized workers in public administration and on active duty in the military are assumed to be zero. These industries require documentation for employment that is believed to exclude unauthorized workers, although there is anecdotal evidence that a likely negligible number of unauthorized immigrants have worked in each of these industries.

Measuring and categorizing workers

As we describe below, we adopt the analysis framework of George Borjas and, more specifically, the extension by Gianmarco Ottaviano and Giovanni Peri, who in 2012 re-examined the effect of immigration on U.S. wages by collapsing workers into parsimonious but detailed categories based on their observed characteristics in Census Bureau data.⁴¹ Following their lead, we characterized workers within each industry observed in the 2011–2013 ACS as belonging to one of 96 possible groups, defined in the following way:

- Three categories of nativity and immigration status: natives; authorized immigrants; and unauthorized immigrants
- Four categories of educational attainment: less than high school degree; high school degree; more than high school; and college graduate
- Eight categories of potential work experience: 1–5 years; 6–10 years; 11–15 years; 16–20 years; 21–25 years; 26–29 years; 30–35 years; and 36–40 years.

Following Ottaviano and Peri, work experience is defined as a worker's current age minus either 1) 17 if the worker has less than a high school degree; 2) 19 if the worker has exactly a high school degree; 3) 21 if the worker has some college but no degree; or 4) 23 if the worker has a college degree or more education.

When we measure wages in order to estimate worker productivity, we follow Ottaviano and Peri and restrict the sample to workers who 1) are not living in group quarters; 2) are ages 18 and older; 3) reported some work in the previous year; 4) had between 1 and 40 years of potential work experience; 5) reported some wage or salary income; and 6) were not self-employed.

When we measure total employment, however, we drop these restrictions. In addition, we top-code measure potential work experience at 40 for workers with more than 40 years, and we bottom-code measure it for workers with less than 1 year. This changes the number of workers in these extreme categories but does not appreciably affect the results.

Modeling industry output and capital accumulation

Following the standard neoclassical tradition, we assume that within each industry, labor combines with physical capital goods and with technical knowledge in a production function that exhibits constant returns to scale:

$$Y_j = A_j K_j^{\alpha_j} L_j^{1-\alpha_j}, \quad (1)$$

where Y_j is real GDP in industry j , the stock of technical knowledge is A_j , the capital stock is K_j , and the industry labor aggregate is L_j . Key to our analysis is the nature of the labor aggregate, which as we describe in the next section is constructed as a multinedsted constant elasticity of substitution, or CES, aggregator.

Each nest contains multiple types of labor that can differ in productivity and is characterized by a nest-specific elasticity of substitution.

The parameter α_j is a number between 0 and 1 that economists call the “capital share.” Accordingly, $1 - \alpha_j$ is the labor share in production, defined as the share of income paid out to workers in industry j . For the economy as a whole, the capital share α is about one-third, but it also varies widely across industries.⁴² Taking this into account is important in order to quantify the time patterns of adjustment for each industry, which we discuss below.

Consider the implications of Equation 1 for the effects of output due to a change in the amount of labor in the industry. When changes in labor do not affect the stock of capital or the level of technical knowledge, we posit that the short-run change in output is given by:

$$d \ln Y_j^{SR} = (1 - \alpha_j) d \ln L_j, \quad (2)$$

where “ln” is the natural logarithm. That is, a 1 percent increase in labor leads to a short-run percentage change in output that is approximately equal to the labor share in the industry. Over the long run, changes in the labor input trigger adjustments in investment decisions that eventually leave the capital-labor ratio unchanged. As a result, there is a one-to-one long-run relationship between changes in labor and in output:

$$d \ln Y_j^{LR} = d \ln L_j. \quad (3)$$

Correspondingly, if all workers were the same in terms of their skills and all industries had the same labor share of 0.67, this model implies that the short-run effect of removing 1 percent of the employed population would be a short-run reduction in gross domestic product of approximately two-thirds of 1 percent. Under standard assumptions regarding investment, the capital stock would respond by eventually also falling by 1 percent, and the long-run effect of the removal of labor would be a reduction in GDP of a full 1 percent.

We measure labor shares in production using standard techniques described by Andrew Figura and David Ratner.⁴³ Table A1 shows these statistics for 2011 to 2013 and the average across those years, which we use in our calibrated model. The line for public administration is not used in our analysis and is included as a reference only.

TABLE A1
Labor shares across industries, 2011–2013

	2011	2012	2013	Average
Private industries (1–12)	0.532	0.535	0.533	0.533
All nondefense industries (1–13)	0.572	0.571	0.569	0.571
1. Agriculture, forestry, fishing, and hunting	0.208	0.258	0.217	0.228
2. Mining	0.224	0.244	0.234	0.234
3. Construction	0.647	0.636	0.634	0.639
4. Manufacturing	0.484	0.483	0.479	0.482
5. Wholesale and retail trade	0.653	0.641	0.636	0.643
6. Transportation and utilities	0.521	0.533	0.533	0.529
7. Information	0.381	0.392	0.382	0.385
8. Financial activities	0.257	0.252	0.252	0.254
9. Professional and business services	0.728	0.738	0.752	0.739
10. Educational and health services	0.855	0.863	0.867	0.862
11. Leisure and hospitality	0.705	0.709	0.702	0.706
12. Other services	0.751	0.748	0.755	0.751
13. Public administration	0.792	0.785	0.783	0.787

Note: We construct labor shares as compensation of employees divided by value added less taxes on production and imports less subsidies, per Andrew Figura and David Ratner, “The Labor Share of Income and Equilibrium Unemployment,” FEDS Notes, June 8, 2015, available at <https://www.federalreserve.gov/econresdata/notes/feds-notes/2015/labor-share-of-income-and-equilibrium-unemployment-20150608.html>.

Substitution between worker types in production

We model total labor in an industry as an aggregation between different types of labor across multiple levels of characteristics. As described earlier, we categorize workers as belonging to one of 96 possible combinations of educational attainment, years of work experience, and nativity and immigration status. We model four hierarchical levels of aggregation between these groups with four different elasticities of substitution, and we weight the contributions of workers within these aggregations by their relative productivities, which we calibrate on the basis of measured relative earnings.

Formally, this procedure works in the following way. Our four levels of aggregation, from highest to lowest, are: 1) educational groups; 2) experience groups, given education; 3) native born vs. foreign born, given education and experience; and 4) documented[‡] vs. undocumented foreign born, given education, experience, and foreign nativity. Starting at the fourth level, for example, we construct a CES function between documented foreign-born workers, *DFB*, and undocumented foreign-born workers, *UFB*, within each cell that is defined by education, *e*, experience, *x*, and nativity:

$$L_{e,x}^{FB} = \left(\theta_{e,x}^{DFB} \times [DFB_{e,x}]^{\sigma_d/(\sigma_d-1)} + \theta_{e,x}^{UFB} \times [UFB_{e,x}]^{\sigma_d/(\sigma_d-1)} \right)^{(\sigma_d-1)/\sigma_d}, \quad (4)$$

where σ_d is the elasticity of substitution between documented and undocumented workers with the given level of education and experience, and the θ 's are their relative productivities. Once we evaluated this CES function, we move up to the next level. The procedure continues until we reach the top level, and the result is a labor aggregate that weights the different groups of workers by their relative productivities, taking into account the elasticities of substitution among labor types at each nest.

The elasticities of substitution between different classes of workers are an important set of inputs. These elasticities govern how easily one type of worker can be replaced by other types within the same nest. In Cobb-Douglas functions, this elasticity is exactly 1, but in our more general framework, it is governed by a parameter that can take any positive value.

We calibrate our model using a central set of conservative assumptions about these substitution elasticities based on recent empirical estimates, which we assume to be the same for all industries.⁴⁴ We check our results for robustness by varying these elasticities to extreme values in alternative scenarios. We also check robustness by flattening the productivity gradient across workers, even though we observe a fairly steep gradient in the data. Because as we move up across CES nests workers are more similar in terms of their characteristics, it makes sense to require that elasticities of substitution be increasing—weakly—as we move to higher-level nests. Table A2 summarizes assumptions across our estimation scenarios.

[‡] In this section, “documented” and “undocumented” are used interchangeably with “authorized” and “unauthorized,” respectively.

TABLE A2
Scenarios: Elasticity of substitution

	Education	Experience	Native born vs. foreign born	Documented foreign born vs. undocumented foreign born
Scenario	σ_e	σ_x	σ_n	σ_d
Baseline	3	6	20	1,000
Low substitution between documented foreign born and undocumented foreign born	3	6	20	20
High substitution between native born and foreign born	3	6	1,000	1,000

For our baseline scenario, we adopt one of the preferred sets of estimates used by Ottaviano and Peri. Their study did not distinguish between documented and undocumented foreign-born workers.⁴⁵ Thus, it is implicitly assumed that the elasticity of substitution between those two types of workers is effectively infinite. Accordingly, we adopt a large—though finite—value. The second scenario explores the role of the latter parameter by considering the lowest possible value consistent with the nested structure of the production function. The third scenario adopts a very large elasticity of substitution between native and immigrant workers with the same education and potential experience, as in Borjas, and an equally large substitution between documented and undocumented immigrant workers.⁴⁶

Worker productivities are calibrated as follows. Under the assumption that marginal products determine equilibrium wages, the ratio of wages between two groups in a nest should be equal to the ratio of their productivities, adjusted for their relative supplies. In the case of the productivities between undocumented and documented workers in Equation 3, this relationship is given by:

$$\frac{w_{e,x}^{DFB}}{w_{e,x}^{UFB}} = \frac{\theta_{e,x}^{DFB}}{\theta_{e,x}^{UFB}} \left(\frac{DFB_{e,x}}{UFB_{e,x}} \right)^{-1/\sigma_d}. \quad (5)$$

Given the relative wage and the relative employment as observed in the data, and an estimate of the elasticity of substitution, we are able to solve for the relative productivity. In practice, we normalize $\theta_{e,x}^{UFB}$ —and, in general, one of the productivities within each nest—to unity. The same procedure is applied for each nest.

The speed of capital adjustment

As discussed earlier, in the long run, capital will adjust to the reduction in labor within each industry so as to return to the original path of the capital-labor ratio. Exactly how long this adjustment will take in practice is unclear, but the literature offers some guidance.

Many studies in economics have attempted to measure the speed of capital adjustment when economies or industries react to a shortage of capital. Generally, these studies have found that capital accumulation at the aggregate level is a gradual process. Ottaviano and Peri reported that empirical evidence supports a rate of upward adjustment in the capital stock of around 10 percent per year, but slower rates have also been considered in the literature.⁴⁷

In our particular application, we are concerned with downward adjustment, which may potentially be faster than adjustments that require accumulating capital. Furthermore, we provide estimates at the industry and state levels. The rates of adjustment of the capital stock at these lower levels may be faster due to interindustry, interstate, or international flows of capital.

In order to provide cumulative effects in a transparent manner, we assume that full adjustment of the capital stock is accomplished in a 10-year period. This is somewhat faster than the rate implied by a 10 percent annual rate of movement toward the steady state due to the mathematical nature of exponential growth or decay, but it is still a reasonable speed of adjustment in the context of our application. Additionally, the data that we report in this report can be used to experiment with patterns of adjustment that are faster or slower than the one that we consider here. Specifically, we assume that the percentage reduction in GDP in the first year is 1.4 percent—the short-run estimate—and the subsequent percentage reductions in annual GDP increase additively until reaching the long-run estimate of 2.6 percent in the 10th year.

Robustness

We conducted a number of robustness tests on our findings: We first explored the impacts on our estimates of altering assumptions about the elasticities of substitution between workers of different types and about workers' relative productivities, as described in the scenarios in Table A2. Even unrealistically large changes in

these parameter values did not change our results in a qualitative sense. The largest change was associated with equalizing workers' productivities so that, against the evidence, unauthorized workers are assumed to be just as productive as native and authorized foreign-born workers. In that case, long-term GDP effects came closest to the 4.9 percent reduction one might expect to find if all workers were equal in terms of skills. When we experiment with unrealistically high or low values for the elasticities of substitution between native and immigrant labor and across documentation status, the results are practically unaffected, providing an important robustness check for our baseline results.

State-level estimates

In order to assess what our estimates and the data imply about how different states would likely be affected by a mass deportation policy, we conducted a simple imputation that takes as inputs our national, industry-level estimates of changes in GDP and supplemental statistics drawn from our pooled ACS samples that indicate the degree of state-specific effect. Specifically, we measured the total pooled average annual earnings reported by unauthorized immigrant workers within each industry, across all education and experience categories. For each state and each industry, we then constructed the state shares of the earnings by unauthorized workers for each industry and used them to apportion the national estimates.

We found that our imputation procedure produced state-level estimates that were broadly similar to the limited state-by-state structural analysis that we could conduct given the data. We also found that our imputed estimates of state-industry percentage were closely predicted by state-industry unauthorized shares of the workforce, as one would expect.

In supplementary material, we report estimates of long-run GDP losses by state and industry whenever the state-industry cell included more than 20 observations over the three ACS years. These data consist of 386, or 63 percent, of the 612 possible state-industry cells. We also computed state-level totals across industries for all 50 states plus the District of Columbia.

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- 2 Anna Brown and Renee Stepler, "Statistical Portrait of the Foreign-Born Population in the United States," Pew Research Center, April 19, 2016, available at <http://www.pewhispanic.org/2016/04/19/statistical-portrait-of-the-foreign-born-population-in-the-united-states-key-charts>. Estimates of the number of unauthorized immigrants residing in the United States have been relatively flat since 2009, having peaked at 12.2 million in 2007.
- 3 We use the peak and trough dates of business cycles published by the Business Cycle Dating Committee of the National Bureau of Economic Research. According to the National Bureau of Economic Research, the Great Recession began in December 2007 and ended in June 2009. Based on the Current Population Survey, the unemployment rate rose from 5 percent in December 2007 to 9.5 percent in June 2009. Real gross domestic product fell 4.2 percent from the second quarter of 2008 to the trough in the second quarter of 2009, according to data from the Bureau of Economic Analysis. Relative to the level of potential, or full employment, GDP, as calculated by the Congressional Budget Office, actual GDP had fallen by around 8 percent below trend at the peak of the Great Recession.
- 4 George Borjas, "The Labor Demand Curve Is Downward Sloping: Reexamining the Impact of Immigration on the Labor Market," *Quarterly Journal of Economics* 118 (4) (2003): 1335–1375; Gianmarco I. P. Ottaviano and Giovanni Peri, "Rethinking the Effect of Immigration on Wages," *Journal of the European Economic Association* 10 (1) (2012): 152–197.
- 5 Because of the importance of seasonal work, agriculture is a special industry, and the American Community Survey may undercount workers in this industry. We have also conducted an analysis measuring agricultural workers using a different data set, the National Agricultural Workers Survey. The results show that the share of unauthorized workers in agriculture could be as high as 24 percent and greater than 48 percent among hired crop workers.
- 6 Florida's agricultural industry would see an annual GDP loss of \$1.3 billion. Illinois' manufacturing industry would lose \$5.6 billion annually.
- 7 Philip E. Wolgin, "What Would It Cost to Deport 11.3 Million Unauthorized Immigrants?," Center for American Progress, August 18, 2015, available at <https://www.americanprogress.org/issues/immigration/news/2015/08/18/119474/what-would-it-cost-to-deport-11-3-million-unauthorized-immigrants>.
- 8 Center for Migration Studies, "Estimates of the Unauthorized Population" (2014). Data set is based on the augmented 2010–2013 ACS data files hosted by the Integrated Public Use Microdata Series. See also Robert Warren, "Democratizing Data about Unauthorized Residents in the United States: Estimates and Public-Use Data, 2010 to 2013," *Journal on Migration and Human Security* 2 (4) (2014): 305–328.
- 9 Although some unauthorized immigrants may have served in the military and performed other government jobs, we follow the generally accepted contours of the residual methodology used to assign unauthorized status, which assumes that unauthorized immigrants do not work in public-sector jobs because these types of occupations generally and more stringently require proof of legal status.
- 10 Robert Lynch and Patrick Oakford, "The Economic Effects of Granting Legal Status and Citizenship to Undocumented Immigrants" (Washington: Center for American Progress, 2013), available at <https://www.americanprogress.org/issues/immigration/report/2013/03/20/57351/the-economic-effects-of-granting-legal-status-and-citizenship-to-undocumented-immigrants/>; Adriana Kugler and Patrick Oakford, "Comprehensive Immigration Reform Will Benefit American Workers" (Washington: Center for American Progress, 2013), available at <https://www.americanprogress.org/issues/immigration/report/2013/09/12/74014/comprehensive-immigration-reform-will-benefit-american-workers/>. See also Manual Pastor and Justin Scoggins, "Citizen Gain: The Economic Benefits of Naturalization for Immigrants and the Economy" (Los Angeles: Center for the Study of Immigrant Integration, 2012), available at <http://dornsife.usc.edu/csii/citizen-gain/>.
- 11 Borjas, "The Labor Demand Curve Is Downward Sloping"; Ottaviano and Peri, "Rethinking the Effect of Immigration on Wages," *Journal of the European Economic Association*.
- 12 This approach is identical to the one used to quantify the gains or costs from international trade or globalization more generally. The reduction in the size of the labor force associated with the removal of unauthorized workers will create a temporary excess of capital, reflected in a lower marginal product of capital and higher average wages. Employers will respond by adjusting downward their capital stock, and eventually average wages will return to their original path. Presumably, the labor supply of U.S.-born and legal residents would then be back to the current levels.
- 13 For more information on the subsectors, see Bureau of Labor Statistics, "Industries by Supersector and NAICS Code," available at http://www.bls.gov/iag/tgs/iag_index_naics.htm (last accessed August 2016).
- 14 These percentage reductions in GDP are smaller than the reduction in the workforce largely because of the lower productivity of unauthorized workers relative to natives and authorized immigrant workers. The elasticities of substitution between labor types play a relatively minor role in these results. Later, we discuss implications of altering these assumptions.
- 15 Jeffrey S. Passel and D'Vera Cohn, "Share of Unauthorized Immigrant Workers in Production, Construction Jobs Falls Since 2007" (Washington: Pew Research Center, 2015), available at <http://www.pewhispanic.org/2015/03/26/share-of-unauthorized-immigrant-workers-in-production-construction-jobs-falls-since-2007>.
- 16 Often the term "agriculture" more specifically refers to crop production activities, which alone employed 1.1 million of the 2 million workers shown in Table 7, not including those in support activities. Of this total, hired crop workers numbered 743,000.

- 17 The differences between ACS and NAWS samples are likely related to mode of interview. The ACS collects data via mail and telephone follow-up, while the NAWS is conducted face to face.
- 18 Philip L. Martin, "Agricultural Labor: Supply of Labor." In Neal Van Alfen, ed., *Encyclopedia of Agriculture and Food Systems*, vol. 1 (San Diego: Elsevier, 2014).
- 19 A discussion of the speed of adjustment to changes in the workforce is offered in Gianmarco I. P. Ottaviano and Giovanni Peri, "Rethinking the Effect of Immigration on Wages." Working Paper 12497 (National Bureau of Economic Research, 2006), available at <http://www.nber.org/papers/w12497>.
- 20 Congressional Budget Office, "Updated Budget Projections: 2016 to 2026" (2016), available at <https://www.cbo.gov/publication/51384>.
- 21 Wolgin, "What Would It Cost to Deport 11.3 Million Unauthorized Immigrants?"
- 22 Ben Gitis and Laura Collins, "The Budgetary and Economic Costs of Addressing Unauthorized Immigration: Alternative Strategies" (Washington: American Action Forum, 2015), available at <https://www.americanactionforum.org/research/the-budgetary-and-economic-costs-of-addressing-unauthorized-immigration-alt>.
- 23 Precisely for this reason, the nonpartisan CBO projects tax revenue to remain roughly constant as a share of GDP. See Congressional Budget Office, "Updated Budget Projections: 2016 to 2026"
- 24 We believe this simple approach is highly stylized but reasonable. Revenues may not fall as fast as GDP if the reductions in GDP that we estimate on the production side translate into reductions on the income side, where there are lower effective tax rates. The precise extent to which unauthorized immigrants pay income and payroll taxes is not well understood, but one estimate is that more than half are working jobs where their income is reported to the Internal Revenue Service. See Council of Economic Advisers, *Economic Report of the President* (Executive Office of the President, 2005), available at <https://www.gpo.gov/fdsys/pkg/ERP-2005/pdf/ERP-2005.pdf>. Although some unauthorized workers are highly educated and earn high wages, the average unauthorized immigrant is likely to face a lower tax rate on earnings than the average native or authorized immigrant because of being in a lower tax bracket. However, part of the GDP produced by unauthorized workers also represents income earned by owners of domestic capital. In capital-intensive industries such as agriculture, which employs the least educated and least well-paid unauthorized immigrants, the share of GDP earned by capital is very high. Because wealth is concentrated, owners of capital may be in substantially higher tax brackets. And as we stated earlier, if capital adjustment occurs more rapidly than in our baseline scenario, the fiscal impacts will be larger. We view the precise revenue consequences of a mass deportation policy as a subject worthy of its own study, and we view our treatment of this question as providing a simple but reasonable estimate of potential impacts.
- 25 We assume that the effective interest rate paid on debt is unaffected by the policy. When increases in the debt-to-GDP ratio are large, economists believe interest rates rise because government borrowing crowds out domestic investment.
- 26 We also estimate fiscal impacts assuming that capital adjustment concludes after five years. Because GDP falls faster in this scenario, tax revenues also fall faster and debt grow faster. By 2026, debt held by the public rises by \$1.1 trillion compared with the baseline.
- 27 James P. Smith and Barry Edmonston, eds., *The New Americans: Economic, Demographic, and Fiscal Effects of Immigration* (Washington: The National Academies Press, 1997).
- 28 We discuss our method of deriving industry-specific GDP impacts for states in the Appendix. The method disaggregates our estimates of nationwide impacts by industry into state impacts on the basis of the shares of earnings of unauthorized workers within industries by state in the ACS data.
- 29 The reason that the reduction in GDP would be smaller than the reduction in employment is that the microdata imply that, on average, unauthorized workers are less productive than authorized immigrants and natives with the same measured levels of education and experience. A more naïve calculation that did not make use of the microdata on workers' skills and wages would have overestimated the economic contribution of unauthorized workers.
- 30 Michael Clemens, "The Effect of Foreign Labor on Native Employment: A Job-Specific Approach and Application to North Carolina Farms." Working Paper 326 (Center for Global Development, 2013), available at <http://www.cgdev.org/publication/effect-foreign-labor-native-employment-job-specific-approach-and-application-north>; Michael Clemens, "International Harvest: A Case Study of How Foreign Workers Help American Farms Grow Crops—and the Economy" (Washington: Partnership for a New American Economy and Center for Global Development, 2013), available at <http://www.renewoureconomy.org/wp-content/uploads/2013/07/nc-agr-report-05-20131.pdf>; Ben Gitis and Jacqueline Varas, "The Labor and Output Declines From Removing All Undocumented Immigrants" (Washington: American Action Forum, 2016), available at <https://www.americanactionforum.org/research/labor-output-declines-removing-undocumented-immigrants>.
- 31 These are workers who are foreign and are brought to the United States to fill temporary jobs in the agricultural sector. For more information, see U.S. Citizenship and Immigration Services, "H-2A Temporary Agricultural Workers," available at <https://www.uscis.gov/working-united-states/temporary-workers/h-2a-temporary-agricultural-workers> (last accessed September 2016).
- 32 Clemens, "The Effect of Foreign Labor on Native Employment."
- 33 Gitis and Varas, "The Labor and Output Declines From Removing All Undocumented Immigrants." These authors also produced a smaller estimate of \$382 billion by assuming that some unemployed natives and authorized immigrants become employed as a result of a removal policy. In that scenario, they assumed that the unemployment rate in each industry declined to 5.1 percent, which the CBO currently assumes is the long-run national rate. According to the July 2016 unemployment report of the Bureau of Labor Statistics, the industries in which not seasonally adjusted unemployment exceeds 5.1 percent are mining, at 9.3 percent; leisure and hospitality, at 6 percent; information, at 5.7 percent; agriculture, at 5.5 percent; and wholesale and retail trade, at 5.2 percent. See Bureau of Labor Statistics, "The Employment Situation—July 2016," Press release, August 5, 2016, available at http://www.bls.gov/news.release/archives/emp-sit_08052016.pdf.

- 34 Smith and Edmonston, *The New Americans*. As explained in this source, "It is a civil matter to overstay a visa, a misdemeanor to illegally enter the country, and a felony to re-enter the country after having been previously caught here illegally and deported."
- 35 Jeffrey S. Passel and Rebecca L. Clark, "Immigrants in New York: Their Legal Status, Incomes and Taxes" (Washington: Urban Institute, 1998), available at <http://webarchive.urban.org/publications/407432.html>; Bryan Baker and Nancy Rytina, "Estimates of the Unauthorized Immigrant Population Residing in the United States: January 2012" (Washington: Office of Immigration Statistics, 2013), available at https://www.dhs.gov/sites/default/files/publications/ois_ill_pe_2012_2.pdf; Robert Warren and John Robert Warren, "Unauthorized Immigration to the United States: Annual Estimates and Components of Change, by State, 1990 to 2010," *International Migration Review* 47 (2) (2013): 296–329; Jeffrey S. Passel and D'Vera Cohn, "Unauthorized Immigrant Totals Rise in 7 States, Fall in 14: Decline in Those From Mexico Fuels Most State Decreases" (Washington: Pew Research Center, 2014), available at <http://www.pewhispanic.org/2014/11/18/unauthorized-immigrant-totals-rise-in-7-states-fall-in-14>; Passel and Cohn, "Share of Unauthorized Immigrant Workers in Production, Construction Jobs Falls Since 2007"; Warren, "Democratizing Data about Unauthorized Residents in the United States."
- 36 In the case of health insurance coverage, for which many unauthorized immigrants are ineligible, one study showed that imputation procedures produce estimates that are too high, ostensibly because the procedure either omitted information in the survey on health insurance or could not leverage it. See Jennifer Van Hook and others, "Can We Spin Straw Into Gold? An Evaluation of Immigrant Legal Status Imputation Approaches," *Demography* 52 (1) (2015): 329–354.
- 37 Center for Migration Studies, "Estimates of the Unauthorized Population." Data set is based on the augmented 2010–2013 ACS data files hosted by IPUMS. See also Warren, "Democratizing Data about Unauthorized Residents in the United States."
- 38 Passel and Cohn, "Share of Unauthorized Immigrant Workers in Production, Construction Jobs Falls Since 2007."
- 39 An insightful discussion can be found in Pastor and Scoggins, "Citizen Gain."
- 40 Passel and Cohn, "Share of Unauthorized Immigrant Workers in Production, Construction Jobs Falls Since 2007."
- 41 Borjas, "The Labor Demand Curve Is Downward Sloping"; Ottaviano and Peri, "Rethinking the Effect of Immigration on Wages," *Journal of the European Economic Association*.
- 42 Andrew Figura and David Ratner, "The Labor Share of Income and Equilibrium Unemployment," FEDS Notes, June 8, 2015, available at <https://www.federalreserve.gov/econresdata/notes/feds-notes/2015/labor-share-of-income-and-equilibrium-unemployment-20150608.html>.
- 43 Ibid.
- 44 Borjas, "The Labor Demand Curve Is Downward Sloping"; Ottaviano and Peri, "Rethinking the Effect of Immigration on Wages," *Journal of the European Economic Association*; Marco Manacorda, Alan Manning, and Jonathan Wadsworth, "The Impact of Immigration on the Structure of Wages: Theory and Evidence From Britain," *Journal of the European Economic Association* 10 (1) (2012): 120–151.
- 45 Ottaviano and Peri, "Rethinking the Effect of Immigration on Wages," *Journal of the European Economic Association*.
- 46 Borjas, "The Labor Demand Curve Is Downward Sloping."
- 47 Ottaviano and Peri, "Rethinking the Effect of Immigration on Wages." Working Paper.

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