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A general equilibrium analysis of effects of undocumented workers in the United States

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Abstract

We examine some of the economic impacts of the 7.2 million undocumented workers in the United States. We use the USAGE-ITC model, an applied general equilibrium model of the United States. Our simulation suggests that the immigration surplus due to undocumented workers is about $20 billion, which is about 0.19 percent of GDP. Additional calculations with the GTAP model of global trade suggest that ignoring the international implications of immigration and remittances might underestimate the immigration surplus due to undocumented workers.

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Introduction

In 2005 the number of undocumented workers in the United States was about 7.2 million, which is equal to about 5 percent of the U.S. workforce (Passel, 2006). About 3 million of the 7.2 million workers were in occupations in which undocumented workers account for at least 15 percent of total employment in that occupation. These included construction labor (25 percent), cooks (20 percent), maids and housecleaners (22 percent), and grounds maintenance (25 percent). Among roofers, 29 percent of the total workforce was estimated to be undocumented workers.

Economic theory predicts that, when the supply of productive factor increases, its rental rate will fall. So will the rental rates of factors that are close substitutes. On the other hand, there will be an increase in the rental rate of factors that are used in combination with it, i.e., complements. So for example, if the supply of fruit pickers in the United States increases through immigration, theory predicts that the wages of fruit pickers in the United States will fall. So will the wages of workers with similar skills. But there will be an increase in the earnings of fruit growers, transportation workers and others who work with fruit pickers to bring fruits to markets. Finally, because immigrants not only work, but also spend their income, the increased demand for goods and services will create jobs and raise wages throughout the economy. Thus immigration generates extra income for the U.S. economy, even as it pushes down wages for some workers. The gain in productivity yields extra income for U.S. natives, which is termed the immigration surplus.

Several studies have quantified the effects of immigrants on the U.S. economy.[1] At the national level, George Borjas used a partial equilibrium economic framework to describe how natives benefit from immigration (Borjas, 1995). Borjas concluded that the annual increase in national income accruing to natives, or the immigration surplus due to all immigrants was about 0.1 percent of GDP in 1995. Borjas (1995) shows that the immigration surplus, as a fraction of national income, equals $-\frac{1}{2}S\varepsilon M$, where S is labor's share of national income; ε is the elasticity of factor price for labor (i.e., the percentage change in the wage resulting from 1 percent change in the size of the work force); and M is the fraction of the workforce that are immigrants.[2]

Gordon Hanson (2007) estimated that the annual immigration surplus due to all immigrants in the United States was about 0.2 percent of GDP in 2004. Hanson's estimate of the immigration surplus is higher than Borjas' because the fraction of immigrants in the workforce had grown from less than 10 percent in 1995 to slightly over 14 percent in 2004.

Peter Dixon, Martin Johnson, and Maureen Rimmer (2008) used a dynamic applied general equilibrium model to simulate the effects of potential government programs aiming to restrict the employment of illegal immigrants in the United States. Their economic framework, USAGE-M, is labor-market-extended version of USAGE-ITC, the model that we use in this paper. Dixon *et al.* estimated that U.S. GDP would decline by 1.6 percent due to a policy that brings about a 28.6 percent reduction in the employment of undocumented workers.[3]

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[1] For surveys of this literature, see Gordon Hanson (2005), James Smith and Barry Edmonston (1997) and George Borjas (1999a, 1999b).

[2] The empirical literature suggests that the price elasticity of factor demand for labor is about -0.3 (Hamermesh, 1993). The share of labor in national income is about 0.7.

[3] Among studies which focus at the effects of immigration at the local level, David Card (1990) studied the 1980 Mariel boat lift, during which 125,000 Cubans arrived in South Florida with approximately half remaining in the Miami area, and increasing the city's labor force by 7 percent. Card concluded that the Mariel

In this paper, we apply a large-scale applied general equilibrium model, the USAGE-ITC[4] model, to simulate the effects of undocumented workers on the U.S. economy.

Overview of the USAGE-ITC Framework

The USAGE-ITC framework has been developed by the Centre of Policy Studies (CoPS), Monash University, Australia and the U.S. International Trade Commission. The theory of the USAGE-ITC model is described in Dixon and Rimmer (2002). The USAGE-ITC model is specified at the 498 industries contained in the published input-output accounts for the United States (Lawson, 1997). The USAGE-ITC data in this paper reflect economic conditions in 2002 (Dixon and Rimmer, 2001 and 2003, Dixon *et al.*, 2004, and US ITC, 2004).

The USAGE-ITC framework has three components: (i) I-O accounts, (ii) behavioral parameters, and (iii) a system of economy-wide conditions. While the I-O accounts specify the initial equilibrium for the U.S. economy, behavioral equations and parameters determine how economic agents would respond to an exogenous change. The following parameters are used by USAGE-ITC:

1. Elasticities of substitution between imported and domestic goods;
2. Elasticities of import supply and export demand;
3. Elasticities of input substitution for U.S. producers; and
4. Income and price elasticities for U.S. households.

Where possible, parameters have been estimated. In other cases, parameter specification relied on published studies. The elasticities of substitution between imported

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influx appears to have had virtually no effect on the wages or unemployment rates of less-skilled workers. Jennifer Hunt (1992) and Rachel Friedberg (2001) have reached similar conclusions for the return migration of ethnic French from Algeria to France in 1962 and the exodus of 600,000 Russian Jews to Israel in the early 1990's.

[4] USAGE-ITC stands for U.S. applied general equilibrium-International Trade Commission.

and domestic goods (i.e., the Armington elasticities) are documented in Donnelly *et al*. and Hertel *et al*.

The final component of the USAGE-ITC framework is a system of three general conditions which ensure a competitive general equilibrium. First, all constant returns activities must earn zero profits. Second, the market for each product must clear such that supply equals demand. The third general condition is that income is exhausted on final demand and savings.

In addition, the following nine assumptions underlie the simulations in this paper:

1. The simulation has no effect on real national savings. Thus, the quantity of capital owned by U.S. residents is unaffected in the simulation.

2. Real government expenditures are not affected by the simulation.

3. The ratio of real public consumption to real private consumption is held constant.

4. Real private consumption is related to real disposable income. The government adjusts the tax rate on labor income to ensure that the simulation-induced movement in real private consumption is consistent with maintenance of real national savings.

5. The ratio of investment to capital (I/K) in each industry is held constant. Because the ratio I/K is a reflection of business confidence, this assumption implies that the simulation has no long-run effect on business confidence.

6. The average rate of return on capital across industries adjusts while capital stocks do not change, i.e., our simulations depict short-run effects.

7. Real wage rates adjust so that the simulation has no effect on aggregate employment of U.S. residents.

8. The simulation has no effect on technology or consumer preferences.

9. The simulation has no effect on the aggregate price index for private consumption; that is, this aggregate price index is the numeraire price.

Specification of the USAGE-ITC Model

The following sections describe briefly the three key components of the USAGE-ITC model: final demand behavior, production technology, and the trade equilibrium.

The USAGE-ITC model considers three separate components of domestic final demand: household consumption, government demand, and investment demand. Household consumption is derived from a linear expenditure system (LES) of commodity demands. The assumption of fixed real government spending is satisfied by endogenously adjusting government transfers to households. This adjustment assumes that changes in government revenues are compensated through a tax. For investment demand, capital creators in an industry are assumed to choose their input mixes to minimize the costs of producing new capital subject to a constant-returns-to-scale capital-creation function. The only prices affecting the demand for domestic and imported inputs to capital creation are the prices of these inputs.

Input-output technologies are modeled with nested substitution/transformation functions. Value-added and intermediate inputs are combined to produce a composite industry output. Intermediate inputs do not substitute for one another and for value added. Land, capital and labor are combined to produce value-added. Substitution possibilities between land, labor and capital are based on the CRESH (i.e., constant ratios of elasticities of substitution, homothetic) specification.

For each commodity in USAGE-ITC there is a distinction between two varieties. A domestic variety is destined for domestic consumption and exports and a foreign variety is

destined for domestic consumption. The substitution possibilities between the two varieties (i.e., the degree of product differentiation) are specified with a CES (constant elasticity of substitution) substitution parameter which is often referred to as the "Armington" elasticity (Armington, 1969). The modeling of trade equilibrium is completed by defining constant elasticity export demand and import supply functions.

Effects of Undocumented Workers on the U.S. Economy

To quantify the effects of undocumented workers on the U.S. economy we simulate the absence of those workers. Table 1 shows the share of undocumented workers for nine broad economic sectors.[5] There is a wide variation in the share of undocumented workers in each sector's labor force. Undocumented workers are more than 12 percent of the labor force in the two sectors representing farming, fisheries, and forestry and construction. For the rest of the economy, undocumented workers account from two to six percent of the labor force. For the U.S. economy as a whole, undocumented workers account for 4.9 percent of the labor force.

Table 2 shows some macro effects from the simulation. The labor wage rate increases by 1.8 percent.[6] The average capital rental rate declines by 3.1 percent. Real GDP declines by 3.5 percent (or $351.7 billion) which is roughly equal to the product of the share of labor (0.7) and the percentage decline in labor (4.9 percent). The immigration surplus, or the decline in income for natives, is about $20 billion (i.e., the GDP effect less the undocumented worker wage bill), which is about 0.19 percent of GDP.

As a result of this simulation, the cost of producing U.S. commodities increases on average and thus the volume of total U.S. exports declines by 7.9 percent. Despite the

[5] The USAGE-ITC simulation in this paper is run at the 498-industry specification. We report effects for nine broad industry aggregates.
[6] The USAGE-ITC model has been calibrated to about a -0.37 price elasticity for labor demand.

increase in average U.S. costs of production, the volume of total U.S. imports declines by 4.3. Real consumption or welfare declines by 4.6 percent (or $333.7 billion).

Table 3 shows some of the sector-level effects from the simulation. Farming, fisheries, and forestry are affected the most by this simulation. About 12 percent of the labor in this sector is undocumented so its absence causes a decline of 8.5 percent in the sector's output. The share of undocumented labor in construction is about 12 percent too. This sector however is not affected much by the absence of undocumented labor because investment, the major market for construction, does not change much in this simulation.

The immigration surplus

Most of the undocumented workers in the United States are from Mexico, an economy with close trade linkages to the U.S. economy. Estimating the immigration surplus in partial or general equilibrium frameworks that do not consider the international trade consequences of immigration and remittances might lead to biased estimates. To assess the extent of bias we apply a global trade framework, the GTAP model of global trade (Hertel, 1997). We assume that all undocumented workers come to the United States from Mexico and that 80 percent of their labor wages are remitted to Mexico. The GTAP simulation consists of three shocks: a migration of undocumented unskilled labor from Mexico to the United States; the implied change in the populations of the two economies; and remittances from the United States to Mexico.[7] The GTAP simulation suggests that the arrival of undocumented workers in the United States would increase U.S. real income by $63 billion or 0.69 percent of GDP. This estimate of the immigration surplus due to undocumented

[7] We note that we use the GTAP model to simulate the effects of the arrival of the 7.2 million undocumented workers in the U.S. economy whereas we simulated the departure of those workers with the USAGE-ITC model.

workers is much higher than that obtained when ignoring the international consequences of remittances.

Summary and conclusions

We examined some of the economic impacts of the 7.2 million of undocumented workers in the United States. We used an applied general equilibrium model of the United States. Our simulation suggests that the immigration surplus is about $20 billion which is about 0.19 percent of GDP. To put this figure in perspective, we note that Anderson and Martin (2005) estimate that U.S. real income gains from full liberalization of global trade amount to 0.1 percent of GDP. Similarly, simulation estimates of the potential effects of NAFTA prior to entering into force suggested increases of U.S. real income of approximately 0.07 percent (U.S. ITC, 1992). Additional calculations with the GTAP model suggest that ignoring the international implications of immigration and remittances might underestimate the immigration surplus.

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Table 1. Employment share of undocumented workers in the United States, by sector

Sector	Share of undocumented workers
	percent
Farming, fisheries, and forestry	12.2
Mining	2.4
Construction	12.2
Durable manufacturing	6.0
Non-durable manufacturing	5.7
Transportation and utilities	2.8
Wholesale and retail trade	3.7
Finance, insurance, and real estate	2.2
Other services	4.4
U.S. economy as a whole	4.9

Sources: Passel (2006) and USAGE-ITC database.

Table 2.Simulating the absence of undocumented workers in the United States, selected macro effects

	percent change
Real consumption	-4.6
Real GDP	-3.5
Exports	-7.9
Imports	-4.3
Wage rate	1.8
Capital rental rate	-3.1

Source: USAGE-ITC model simulation.

Table 3.Simulating the absence of undocumented workers in the United States, selected sectoral effects

Sector	Labor employment	Supply	Exports	Imports
	---------- *percent change* ----------			
Farming, fisheries, and forestry	-19.5	-8.5	-17.6	-3.3
Mining	3.7	1.5	38.8	-4.1
Construction	-2.7	-1.0	-98.8	0.0
Durable manufacturing	-9.2	-7.4	-20.3	-3.7
Non-durable manufacturing	-7.9	-5.2	-8.1	-4.0
Transportation and utilities	-7.5	-4.2	40.7	-6.4
Wholesale and retail trade	-5.9	-5.3	26.2	0.0
Finance, insurance, and real estate	3.7	0.8	166.6	-5.4
Other services	-5.1	-4.4	-12.3	-4.5

Source: USAGE-ITC model simulation.