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## **The Economic Benefits from Immigration**

George J. Borjas

**T**he rapid increase in the size of the immigrant flow reaching the United States, the major changes in the national origin composition of the immigrant population, and the decline in the skills of immigrants relative to the skills of native workers have rekindled the debate over immigration policy. The current debate revives the old concerns over immigrants “taking jobs away” from native workers and finding it difficult to adapt in the American economy, as well as questions whether immigrants pay their way in the welfare state.

A large literature investigates each of these issues in detail; Borjas (1994) offers a survey. The empirical evidence indicates that more recent immigrant waves will remain economically disadvantaged throughout their working lives; that this disadvantage may be partly transmitted to their offspring; that recent immigrants are more likely to participate in welfare programs than natives; and that immigration may have contributed to the increase in wage inequality observed during the 1980s.

Table 1 summarizes some of the key trends in immigrant skills and welfare participation. The relative educational attainment of successive immigrant waves fell dramatically in recent decades. In 1970, the typical immigrant who had just arrived in the United States had 11.1 years of schooling, as compared to 11.5 years for the typical native worker. By 1990, the typical immigrant who had just

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Table 1

**Socioeconomic Characteristics of Immigrants and Natives in the United States, 1970–1990**

<i>Group/ Variable</i>	<i>1970</i>	<i>1980</i>	<i>1990</i>
Natives:			
Mean Educational Attainment (in years)	11.5	12.7	13.2
Percent of Households Receiving Public Assistance	6.0	7.9	7.4
All Immigrants:			
Mean Educational Attainment (in years)	10.7	11.7	11.6
Percent Wage Differential Between Immigrants and Natives	+ .9	−9.2	−15.2
Percent of Households Receiving Public Assistance	5.9	8.7	9.1
Recent Immigrants (< 5 years in U.S.):			
Mean Educational Attainment (in years)	11.1	11.8	11.9
Percent Wage Differential Between Immigrants and Natives	−16.6	−27.6	−31.7
Percent of Households Receiving Public Assistance	5.5	8.3	8.3

*Source:* Author's tabulations from 1970, 1980, and 1990 Public Use Samples of U.S. Census. Educational attainment and relative wages are calculated in the sample of working men aged 25–64. The fraction of households receiving public assistance is calculated in the sample of households where the household head is at least 18 years old.

arrived in the United States had 11.9 years of schooling, as compared to 13.2 years for natives. The data also reveal a corresponding decline in the relative wage of immigrants. The most recent arrivals enumerated in the 1970 Census earned 16.6 percent less than natives. By 1990, the wage disadvantage between the most recent immigrant wave and natives had grown to 31.7 percent.

Because less-skilled workers tend to qualify for and participate in public assistance programs, the deteriorating skill composition of the immigrant flow may have increased the fiscal costs of immigration substantially. Table 1 shows that immigrants were less likely than natives to receive public assistance in 1970. By 1990, the welfare participation rate of immigrant households had risen to 9.1 percent, or 1.7 percentage points higher than the participation rate of native households.

Overall, the available evidence extensively documents the various costs that immigration imposes on native workers and taxpayers. Surprisingly, the literature does not address an equally important set of issues: Do natives benefit from immigration? Where do these benefits come from? How are these benefits dispensed to the native population? And how large are the benefits? The absence of any serious discussion regarding the gains from immigration is

puzzling because costs must be contrasted with benefits before we conclude that immigrants are a “boon or bane” for the United States.<sup>1</sup> If the economic benefits from immigration are sufficiently large, for example, the costs resulting from increased expenditures in social programs can be reinterpreted as the outlay on an investment that has a very high rate of return.

This paper uses a simple economic framework to describe how natives benefit from immigration, provides a back-of-the-envelope calculation of these benefits, and suggests the parameters of an immigration policy that would maximize the economic benefits. The discussion indicates that natives do benefit from immigration mainly because of production complementarities between immigrant workers and other factors of production, and that these benefits are larger when immigrants are sufficiently “different” from the stock of native productive inputs. The available evidence suggests that the economic benefits from immigration are relatively small, on the order of \$7 billion, and almost certainly less than \$25 billion, annually. The discussion also indicates, however, that these gains could be increased considerably if the United States pursued an immigration policy that attracted a more skilled immigrant flow.

The analysis presented below discusses the impact of immigration on a host country within a competitive, market-clearing framework. In this context, as long as there are no externalities, an application of the fundamental theorems of welfare economics and the principles of free trade suggests that allowing factors of production to move from one country to another increases total welfare and efficiency. Because of the potential implications of the results, however, it is important to point out at the outset that the discussion ignores some very important issues. For example, by focusing on the economic benefits accruing to natives residing in the host country, the study ignores the impact of immigration both on the immigrants themselves and on the persons who remain in the source countries. Similarly, by focusing on a competitive economy with market-clearing and full employment, the analysis ignores the potentially harmful effects of immigration when there is structural unemployment in the host economy, and jobs might be a “prize” that are captured partly by immigrants.

## The Immigration Surplus

We begin by specifying the production technology in the host country (which, for concreteness, will be the United States throughout the discussion). Suppose that the technology can be summarized in terms of an aggregate production function with two inputs, capital ( $K$ ) and labor ( $L$ ), so that output  $Q = f(K, L)$ . The workforce is composed of  $N$  native workers and  $M$

<sup>1</sup>A number of theoretical models in the international trade literature explore how immigrants affect the welfare of natives; see, for example, Bhagwati and Srinivasan (1983) and Ethier (1985). A rare empirical analysis is given by Svorny (1991), who estimates the gains to American consumers from the immigration of physicians.

immigrant workers. Initially, let's assume that all capital is owned by natives, so that we ignore the possibility that immigrants might augment the host country's capital stock. We will also ignore skill differentials among immigrant and native workers and assume that all workers are perfect substitutes in production (hence  $L = N + M$ ). Finally, we will assume that the supplies of capital and of both native- and foreign-born labor are perfectly inelastic.<sup>2</sup>

The aggregate production function exhibits constant returns to scale. As a result, the entire output is distributed to the owners of capital and to workers. The equilibrium in this economy prior to the admission of  $M$  immigrants requires that each factor price equals the respective value of marginal product. Suppose that the price of capital is initially  $r_0$  and the price of labor is  $w_0$ . The price of the output is the numeraire (so that the input prices are measured in units of output). Before the admission of immigrants, therefore, the national income accruing to natives,  $Q_N$ , is the price of capital times the quantity used, plus the price of labor times the number of workers hired, or  $Q_N = r_0K + w_0N$ .

Figure 1 illustrates this initial equilibrium in the labor market. Because the supply of capital is inelastic, the area under the marginal product of labor curve ( $MP_L$ ) gives the economy's total output. Prior to the entry of immigrants, therefore, the national income accruing to natives  $Q_N$  is given by the trapezoid  $ABN0$ .

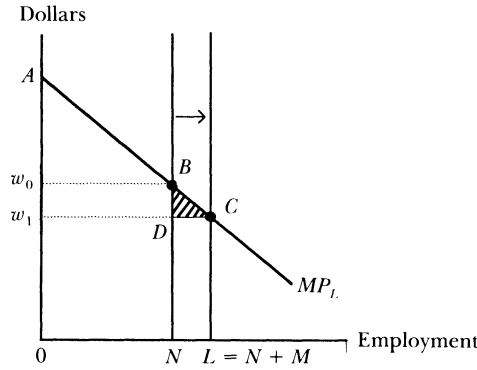
What happens to national income when immigrants enter the country? The supply curve shifts, and the market wage falls to  $w_1$ . National income is now given by the area in the trapezoid  $ACL0$ . Part of the increase in national income, however, is distributed directly to immigrants (who get  $w_1M$  in labor earnings). Inspection of Figure 1 thus reveals that the increase in national income accruing to natives, or the *immigration surplus*, is given by the triangle  $BCD$ . Because the market wage equals the productivity of the last immigrant hired, immigrants increase national income by more than what it costs to employ them.

Note that if the demand curve for labor were perfectly elastic, so that immigrants had no impact on the wage rate, immigrants would receive the entire additional product, and natives would gain nothing from immigration. An immigration surplus arises only when the native wage falls as a result of immigration. Although native workers get a lower wage rate, these losses are more than offset by the increase in income accruing to capitalists, through a higher rental price of capital  $r$ .

The immigration surplus is given approximately by the area of the triangle  $BCD$ , which can be calculated as  $\frac{1}{2} \times (w_0 - w_1) \times M$ . By manipulating this formula, it is easy to show that the immigration surplus, as a fraction of national

<sup>2</sup>It is easy to relax the assumption of inelastic supply curves. However, the calculation of the gains from immigration would be more cumbersome because we would have to account for the change in utility experienced by native workers as they move between the market and nonmarket sectors.

Figure 1  
**The Immigration Surplus**



income, equals:<sup>3</sup>

$$\frac{\Delta Q_N}{Q} = -\frac{1}{2}sem^2,$$

where  $s$  is labor's share of national income;  $e$  is the elasticity of factor price for labor (that is, the percentage change in the wage resulting from a 1 percent change in the size of the labor force); and  $m$  is the fraction of the workforce that is foreign born ( $m = M/L$ ).

What does this formulation imply about the size of the immigration surplus in the United States? The share of labor income is on the order of 70 percent, and the fraction of immigrants in the workforce is slightly less than 10 percent. The vast empirical evidence on labor demand, surveyed recently by Hamermesh (1993), suggests that the elasticity of factor price for labor is on the order of  $-.3$ , so that a 10 percent increase in the number of workers reduces the wage by 3 percent.<sup>4</sup> The immigration surplus, therefore, is only on the order of .1 percent of GDP (that is, one-tenth of 1 percent!). The economic gains from immigration in a \$7 trillion economy, therefore, are relatively small, about \$7 billion per year or less than \$30 per native-born person in the United States. Even if we assume that the elasticity of factor price is  $-1$  (so that a 10 percent increase in labor supply decreases the native wage rate by 10 percent), the gains from immigration would still be on the order of \$25 billion per year.

It is important to note that the immigration surplus is proportional to the elasticity of factor price for labor  $e$ . If the increase in labor supply greatly

<sup>3</sup>In particular, note that if we let  $(w_1 - w_0) \approx (\Delta w / \Delta L) \times M$ , the immigration surplus can be rewritten as:

$$\frac{\Delta Q_N}{Q} = -\frac{1}{2} \cdot \left( \frac{\Delta w}{\Delta L} \cdot M \right) \frac{M}{Q} = -\frac{1}{2} \cdot \frac{wL}{Q} \cdot \left( \frac{\Delta w}{\Delta L} \frac{L}{w} \right) \cdot \frac{M}{L} \cdot \frac{M}{L}.$$

<sup>4</sup>If there are only two factors of production, the elasticity of factor price for labor must equal  $(1 - s)^2 / \eta$ , where  $\eta$  is the output-constant elasticity of labor demand (Hamermesh, 1993, pp. 26–29). There is some consensus that  $\eta$  is about  $-.3$ . Because the share of labor income is  $.7$ , the elasticity of factor price is also  $-.3$ .

reduces the wage, natives *as a whole* gain substantially from immigration. If the native wage is not very sensitive to the admission of immigrants, the immigration surplus is nearly zero. The elasticity of factor price is small (in absolute value) when the labor demand curve is elastic. In other words, the immigration surplus is small when labor and capital are easily substitutable. The elasticity of factor price is large (in absolute value) when the labor demand curve is inelastic, implying that natives have much to gain from immigration when labor and capital are more complementary. The immigration surplus, therefore, arises because of the complementarities that exist between immigrants and native-owned capital.<sup>5</sup>

Even though the immigration surplus is small, immigration has a substantial economic impact. In particular, immigration causes a large redistribution of wealth from labor to capital. In terms of Figure 1, native workers lose the area in the rectangle  $w_0BDw_1$ , and this quantity plus the immigration surplus accrues to capitalists. Expressed as a fraction of GDP, the net change in the incomes of native workers and capitalists are approximately given by:<sup>6</sup>

$$\frac{\text{Change in Native Labor Earnings}}{Q} = sem(1 - m),$$

$$\frac{\text{Change in Income of Capitalists}}{Q} = -sem\left(1 - \frac{1}{2}m\right).$$

If the elasticity of factor price is  $-.3$ , native workers lose about 1.9 percent of GDP, or \$133 billion in a \$7 trillion economy; native capital gains about 2.0 percent of GDP, or \$140 billion. The small immigration surplus of \$7 billion thus disguises a sizable redistribution of wealth from workers to the users of immigrant labor.

The relatively small size of the immigration surplus—particularly when compared to the very large wealth transfers caused by immigration—probably explains why the debate over immigration policy has usually focused on the

<sup>5</sup>It is easy to see this point with a CES production function, so that  $Q = [\delta_1 K^\rho + \delta_2 L^\rho]^{1/\rho}$ . The immigration surplus is then given by:

$$\frac{\Delta Q_N}{Q} = \frac{1}{2} \frac{s(1-s)m^2}{\sigma},$$

where  $\sigma$  is the elasticity of substitution between labor and capital. Natives have less to gain from immigration when the elasticity of substitution is large.

<sup>6</sup>To calculate the total losses accruing to native workers, again let  $(w_1 - w_0) \approx (\Delta w / \Delta L) \times M$ . The reduction in total labor income, as a fraction of GDP, can then be written as:

$$\frac{(w_1 - w_0)N}{Q} = \left(\frac{\Delta w}{\Delta L} \cdot M\right) \cdot \frac{N}{Q} = \frac{wL}{Q} \left(\frac{\Delta w}{\Delta L} \frac{L}{w}\right) \cdot \frac{M}{L} \cdot \frac{N}{L}.$$

The gains accruing to capitalists are calculated by adding the absolute value of this expression to the immigration surplus (that is, to the area of the triangle).

potentially harmful labor market impacts rather than on the overall increase in native income. In other words, the debate stresses the distributional issues (the transfer of wealth away from workers) rather than the efficiency gains (the positive immigration surplus). If the social welfare function depends on *both* efficiency gains and the distributional impact of immigration, the slight benefits arising from the immigration surplus may well be outweighed by the substantial wealth redistribution that takes place, particularly since the redistribution goes from workers to owners of capital (or other users of immigrant services).

Putting aside the distributional impact of immigration, it is of great interest to compare the immigration surplus with estimates of the fiscal cost of immigration. Recent estimates of the *net* fiscal benefits (that is, of the difference between the taxes paid by immigrants and the cost of services provided to immigrants) range from a positive net fiscal benefit of about \$27 billion calculated by Passel and Clark (1994), to a \$16 billion net loss reported by Borjas (1994), to a net loss of over \$40 billion estimated by Huddle (1993).

It is doubtful, however, that *any* of these numbers estimates accurately the gap between the taxes paid by immigrants and the cost of services provided to immigrants. For example, Passel and Clark conclude that immigrants pay their way in the welfare state and contribute a net of \$27 billion to native taxpayers by assuming that immigrants do not increase the cost of most government programs other than education and social welfare programs. In contrast, Borjas assumes that the marginal cost of providing immigrants with a vast array of public services equals the average cost of providing these same services to natives. We do not know by how much immigrants increase the cost of freeways, national parks, and even national defense. As a result, accounting exercises that claim to estimate the net fiscal impact of immigration should be viewed with a great deal of suspicion. Because the immigration surplus is only on the order of \$7 billion, however, it is evident that the net economic benefits from immigration are very small and could even be negative.

### **Some Problems with the Calculation of the Immigration Surplus**

A number of restrictive assumptions are built into the calculation of the immigration surplus.

For example, the analysis assumes that immigration augments only the economy's labor endowment. What if immigration also augments the host country's capital stock? Interestingly, the immigration surplus might be even smaller if immigrants bring in capital. To see why, suppose that immigrants increase both the size of the labor force and the capital stock by 100 percent (perhaps through the use of "investor visas" requiring that immigrants invest in the host country). Because the production function has constant returns to scale, this type of immigration would not change the factor prices  $r$  and  $w$ . As a result, immigration would have *no* impact on the national income accruing to natives. As long as immigrants replicate the existing economy, therefore,

immigrants get the total returns from their product, and the immigration surplus is zero.

The calculation of the immigration surplus also assumes that immigrants *do* have an impact on the earnings of native workers. This assumption seems to contradict much of the available empirical evidence (Borjas, 1994; Friedberg and Hunt, this issue). Many studies have found a negative, but weak, correlation between the native wage in a particular labor market and the immigrant share of the workforce in the locality. This weak correlation is then interpreted as evidence that immigrants do not reduce the earnings of native workers.

It is important to note, however, that the weak correlation between the native wage and the immigrant share need not indicate that immigrants have little impact on native earnings opportunities. In particular, the interpretation of this correlation as a causal relationship between immigration and native wages presumes that the local labor markets are closed (once immigration takes place). Metropolitan areas in the United States, however, are not closed economies; labor, capital, and goods flow freely across localities and tend to equalize factor prices in the process. As long as native workers and firms respond to the entry of immigrants by moving to areas offering better opportunities, there is no reason to expect a correlation between the wage of natives in a particular locality and the presence of immigrants. As a result, the cross-section or time-series comparison of local labor markets may be masking the “macro” effect of immigration.

A number of recent studies suggest that natives respond to immigration by “voting with their feet” (Filer, 1992; Frey, 1994). In particular, natives tend to move out of areas where immigrants choose to live, and this migration flow may have accelerated during the 1980s, resulting in what has been called “the new white flight.” To the extent that these migration flows (as well as flows of capital and goods) disperse the adverse impact of immigration on the wage over the entire economy, the weak correlations reported in the literature bear no relationship to the structural parameter required to estimate the immigration surplus. Moreover, some recent empirical studies that look more closely at the impact of immigration on the aggregate economy (rather than on a particular locality) find that immigration may have had a significant impact on the relative wage of unskilled workers during the 1980s (Borjas, Freeman, and Katz, 1992; Topel, 1994).

The conclusion that the immigration surplus is .1 percent of GDP assumes that the elasticity of factor price for labor is  $-.3$ , so that a 10 percent increase in the size of the labor force reduces the wage level by about 3 percent. If the native wage is *less* responsive to immigration, the immigration surplus would be correspondingly *smaller*. If we wish to believe that native workers are unaffected by immigration, therefore, we would also be forced to conclude that immigrants get the entire fruits of their labor and that there is no immigration surplus. Ironically, even though the debate over immigration policy views the possibility that immigrants lower the wage of native workers as a harmful

consequence of immigration, the economic benefits from immigration arise only when immigrants *do* lower the wage of native workers.<sup>7</sup>

## External Effects and the Immigration Surplus

A number of recent studies have argued that an increase in trade generates external returns in the aggregate economy (see, for example, Helpman and Krugman, 1985). Immigration expands the size of the market. It can introduce many new interactions among workers and firms, so that both workers and firms might “pick up” knowledge without paying for it. As a result, even though the production technology at the firm level has constant returns to scale, the external effects resulting from immigration might lead to increasing returns on the aggregate.

To represent these external effects, suppose that the firm’s production function is given by  $Q_F = f(K, L)Q_E^\gamma$ , where  $Q_F$  is the representative firm’s output and  $Q_E$  is the aggregate output in the economy (which the firm takes as given). As immigrants expand the scale of the economy, the marginal product of both labor and capital increases (assuming  $\gamma > 0$ ). The parameter  $\gamma$  gives the percentage increase in the marginal product of labor or capital resulting from a 1 percent increase in aggregate output.

As illustrated in Figure 2, the external effects of immigration can increase the size of the immigration surplus substantially. As the economy expands, the marginal product of labor curve shifts from  $MP_L$  to  $MP'_L$ . The change in national income accruing to natives is then given by the sum of the triangle  $BCD$  and the area of the trapezoid  $ABEF$ , which measures the impact of immigration on natives’ total product. The Appendix shows that the immigration surplus, as a fraction of GDP, in the presence of external effects is approximately given by:

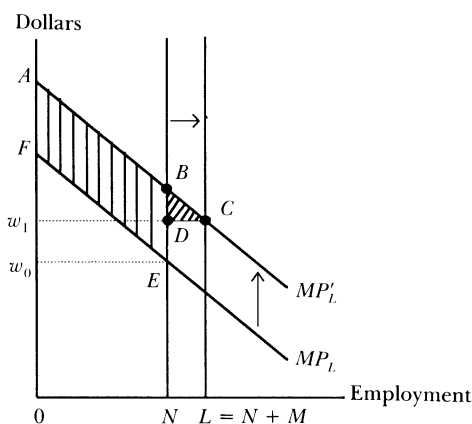
$$\frac{\Delta Q_N}{Q} = -\frac{1}{2}sem^2 + \frac{\gamma sm}{1 - \gamma}(1 - sm),$$

where the first term gives the area of the triangle, and the second term gives the change in the value of natives’ total product attributable to external effects.

As before, suppose that the share of labor income is approximately .7, and that immigrants make up 10 percent of the workforce. If we assume that the elasticity of marginal product with respect to aggregate output (or  $\gamma$ ) is .05, the external effects increase the national income accruing to natives by about .3 percent of GDP, or \$21 billion. If  $\gamma$  is .1, external effects increase the immigration surplus by .7 percent of GDP, or about \$49 billion. Adding the \$7 billion

<sup>7</sup>This implication is analogous to the result from international trade theory, which shows that cheap foreign imports, typically seen as having harmful and disruptive effects, often benefit the importing country.

Figure 2

**The Immigration Surplus in the Presence of External Effects**

surplus resulting from the triangle implies that the total contribution of immigrants to native income would be between \$30 billion and \$55 billion.

Although models that incorporate external effects in the aggregate economy are used frequently in modern discussions of the gains from trade, there is little empirical evidence supporting the existence, let alone measuring the magnitude, of the external effects (for an exception, see Dekle and Eaton, 1994). As a result, the numerical exercise presented here should not be interpreted as indicating that immigrants contribute substantially to the incomes of natives, but rather as giving a ballpark estimate of what the gains would be *if* immigration indeed generated increasing returns in the aggregate economy. Despite the current popularity of external effect models in the theoretical international trade literature, it is difficult to imagine that immigrants entering an economy as large as that of the United States could generate these types of externalities. Most likely, immigration would lead to increased congestion and decreasing returns to scale because other factors of production remain fixed.

**Immigrant Skills and the Immigration Surplus**

The previous section illustrates how and why the gains from immigration arise in competitive economies. Perhaps the most restrictive aspect of the model is that it ignores the skill differentials that exist both within and across the native and immigrant populations. Because immigration policy can encourage or prevent the admission of certain classes of workers, it is of interest to investigate the relationship between the immigration surplus and the skill composition of the immigrant flow. In other words, which type of immigrant

flow, a skilled flow or an unskilled flow, generates the largest increase in national income for native workers?

### A Simple Case: Ignoring Capital

To illustrate how the skill composition of the immigrant flow affects the economic gains from immigration, consider the case where there are only two skill classes in the workforce, skilled workers ( $L_S$ ) and unskilled workers ( $L_U$ ), and initially ignore the role of capital in the production process. The fraction of skilled workers in the native population is  $b$ , and the respective fraction among immigrants is  $\beta$ . We assume that the supply of workers to the labor market is perfectly inelastic. Finally, suppose that the aggregate production function is linear homogeneous and that there are no external effects, so that  $Q = f(L_S, L_U)$ .

Under these conditions, the immigration surplus is positive as long as the skill composition of the immigrant flow differs from that of native workers (that is, as long as  $\beta$  is not equal to  $b$ ). If the skill composition of immigrants were the same as that of natives, the constant returns to scale production function implies that the wages of skilled and unskilled workers are unaffected by immigration, and hence natives have nothing to gain from immigration. (This result, of course, parallels our earlier discussion where the production function depends on labor and capital, and immigrants increase both labor and capital by the same proportion.) As stressed earlier, a key lesson of economic analysis is that natives benefit from immigration only if immigrants are different from natives.

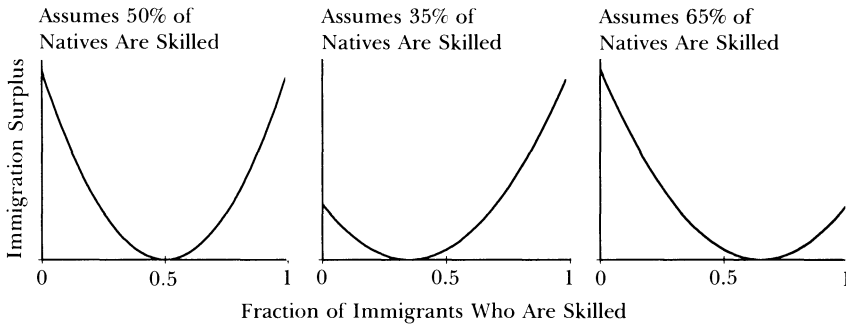
If the skill composition of immigrants differs from that of natives, the magnitude of the immigration surplus depends on exactly how different immigrants are. Figure 3 illustrates the relationship between the immigration surplus and the skill composition of the immigrant flow (as measured by  $\beta$ , the fraction of immigrants who are skilled).<sup>8</sup> The left panel shows the situation when 50 percent of the native workforce is skilled (or  $b = 1/2$ ). As noted above, there is no immigration surplus if half of the immigrant flow is also composed of skilled workers. Natives do gain, however, whenever the skill composition of immigrants differs from that of natives. In fact, the immigration surplus is maximized when the immigrant flow is composed of exclusively

<sup>8</sup>The immigration surplus, as a fraction of GDP, is given by:

$$\frac{\Delta Q_N}{Q} = -\frac{1}{2} \frac{s_S e_{SS} (\beta - b)^2}{p_S^2 (1 - p_S)^2} (1 - m)^2 m^2,$$

where  $s_S$  is the share of national income accruing to skilled workers;  $e_{SS}$  is the elasticity of factor price for skilled workers (that is, the percentage change in the skilled wage with respect to a 1 percent change in the number of skilled workers); and  $p_S$  is the fraction of the labor force that is composed of skilled workers. Figure 3 is obtained by differentiating the immigration surplus with respect to  $\beta$  and assuming that immigration is “small” so that the fraction of the workforce that is skilled is not affected by immigration (that is,  $\partial p_S / \partial \beta = 0$ ).

Figure 3

**The Immigration Surplus and Immigrant Skills, in a Model Without Capital**

unskilled or exclusively skilled workers. Either policy choice generates an immigrant flow that is very different from the native workforce, and hence maximizes the immigration surplus. Because 50 percent of natives are skilled, there is no particular advantage (from the point of view of maximizing the immigration surplus) to admitting either an all-skilled or an all-unskilled immigrant flow.<sup>9</sup>

Economic incentives for pursuing an immigration policy that selects either an all-skilled or an all-unskilled immigrant flow arise when the native workforce is predominantly skilled or predominantly unskilled. Suppose, for example, that the native workforce is relatively unskilled (or  $b < 1/2$ ). As illustrated in the middle panel of Figure 3, the immigration surplus is maximized by admitting immigrants who complement the native workforce, and this is accomplished by admitting only skilled workers. If, in contrast, the native workforce is relatively skilled (as illustrated in the right panel of the figure), the immigration surplus is maximized when immigrants are unskilled.

The United States presumably has a relatively skilled workforce. Economic analysis thus implies that, *in the absence of capital*, the immigration surplus would be maximized by pursuing an immigration policy that only admitted unskilled workers. This type of immigration policy maximizes the economic gains to natives by fully exploiting the production complementarities between immigrants and natives.

**Capital and the Skills of Immigrants**

The conclusion that an unskilled immigrant flow maximizes the immigration surplus in the United States hinges crucially on the assumption that capital plays no role in the production process. To see how the existence of a native-owned capital stock affects the relative gains to skilled and unskilled migration flows, suppose that the technology in the host country is given by the

<sup>9</sup>This conclusion is closely related to the result from international trade theory that the benefits from trade are larger when the trading countries differ greatly in their factor endowments.

linear homogeneous production function  $Q = f(K, L_S, L_U)$ . As before, we assume that all factors of production are supplied inelastically to the economy.

It is instructive to compare the immigration surplus resulting from two alternative policy choices. Suppose initially that the United States decides to admit only skilled immigrants. As shown in the Appendix, the immigration surplus (as a fraction of GDP) would then be given by:

$$\frac{\Delta Q_N \text{ if U.S. admits only skilled immigrants}}{Q} = -\frac{1}{2} \frac{s_S e_{SS}}{p_S^2} m^2,$$

where  $s_S$  is the share of income that goes to skilled workers,  $e_{SS}$  is the elasticity of factor price for skilled workers (that is, the percentage change in the wage of skilled labor resulting from a 1 percent change in the number of skilled workers); and  $p_S$  is the fraction of the workforce that is skilled.<sup>10</sup>

If the United States instead pursues an immigration policy that admits only unskilled workers, the immigration surplus is given by a parallel formulation:

$$\frac{\Delta Q_N \text{ if U.S. admits only unskilled immigrants}}{Q} = -\frac{1}{2} \frac{s_U e_{UU}}{p_U^2} m^2,$$

where  $s_U$  is the share of income that goes to unskilled workers;  $e_{UU}$  is the elasticity of factor price for unskilled workers (that is, the percentage change in the wage of unskilled labor resulting from a 1 percent change in the number of unskilled workers); and  $p_U$  is the fraction of the workforce that is unskilled.

Note that each immigration surplus is proportional to the relevant elasticity of factor price. As long as the immigration of skilled workers reduces the wage of skilled workers or the immigration of unskilled workers reduces the wage of unskilled workers, there is a positive immigration surplus regardless of whether the United States admits exclusively skilled or exclusively unskilled workers.

Which immigration policy leads to a larger immigration surplus? Although there is a great deal of dispersion in the estimated elasticities, many studies surveyed in Hamermesh (1993, ch. 3), suggest that the elasticity of factor price is greater (in absolute value) for skilled workers than for unskilled workers. The fact that the wages of skilled workers are more responsive to a shift in supply than the wages of unskilled workers (that is,  $e_{SS} < e_{UU}$ ) introduces a new set of incentives that suggest the immigration surplus may be larger when the immigrant flow is composed of skilled workers.

<sup>10</sup>The reader will note that this formulation is closely related to the original calculation of the immigration surplus in the model that had only an aggregate labor input and capital. Instead of depending on the share of income going to all workers, the immigration surplus now depends on the share going to skilled labor. Similarly, instead of depending on the elasticity of factor price for all labor, the formula now depends on the elasticity of factor price for skilled workers (as well as on the fraction of the workforce that is skilled).

To see this point, suppose that the fraction of skilled workers in the native workforce is one-half. Suppose also that immigration is relatively small, so that the fraction of skilled workers in the population ( $p_S$ ) is approximately one-half. Our earlier discussion indicated that as long as we ignored capital, the immigration surplus was maximized whenever the immigrant flow was either exclusively skilled or unskilled. The introduction of capital, however, implies that as long as  $e_{SS} < e_{UU}$ , the United States is better off admitting an exclusively skilled immigrant flow.<sup>11</sup>

A skilled immigrant flow generates a larger immigration surplus partly because of the production complementarities that exist between skilled labor and capital. A very negative elasticity of factor price for skilled workers implies that skilled workers are highly complementary with other factors of production. In contrast, a numerically small elasticity of factor price for unskilled workers implies that unskilled workers are not highly complementary with other factors of production. Because the complementarities across factors play a central role in generating the gains from immigration, the immigration surplus is maximized when the immigrant flow is skilled. In other words, the complementarity between capital and skills provides an economic rationale for admitting skilled workers.<sup>12</sup>

Of course, this conclusion is reinforced if we allow for the possibility that the human capital imported by immigrants has external effects in production. It is also reinforced by the fact that unskilled immigrants are more likely to increase expenditures on such government programs as unemployment compensation and means-tested entitlement programs, and are less likely to pay sufficient taxes to offset those costs.

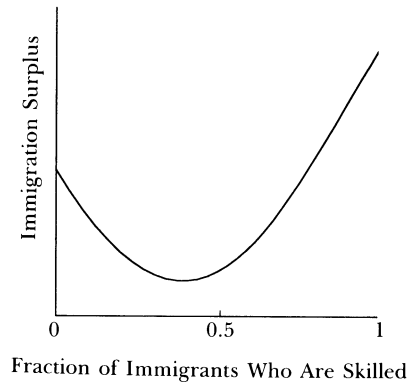
Figure 4 illustrates the relationship between the immigration surplus and the fraction of the immigrant flow that is skilled in an economy with capital (assuming that 50 percent of the native workforce is skilled). As drawn, the immigration surplus is at a minimum when the immigrant flow is “mixed” in terms of skilled and unskilled workers.<sup>13</sup> Because skilled workers are more complementary with other inputs than unskilled workers, however, the host country benefits more from the admission of an exclusively skilled immigrant

<sup>11</sup>Because  $p_S = 1/2$ , the share of income accruing to skilled workers  $s_S$  exceeds the share of income accruing to unskilled workers  $s_U$ .

<sup>12</sup>The empirical evidence supporting the capital-skill complementarity hypothesis reflects an important property of technology in the postwar era. Because the production function is not stable over time, the technology available in earlier time periods may reflect different relationships among the various inputs. For instance, it seems plausible that unskilled workers and some fixed factors of production (such as land) were complements in the U.S. economy at the end of the nineteenth century. In fact, there is some empirical evidence (James and Skinner, 1985) suggesting that, around 1850, skilled labor and capital were better substitutes than unskilled labor and capital. As a result, the theoretical implication that the immigration surplus is maximized by admitting a skilled immigrant flow might not have applied to the United States in earlier time periods.

<sup>13</sup>If skilled workers and unskilled workers are sufficiently “strong” substitutes (in the sense that an increase in the quantity of one of the inputs reduces the wage of the other), it is possible for the minimum point to occur at the corner where the immigrant flow is exclusively unskilled.

*Figure 4*  
**The Immigration Surplus and Immigrant Skills, in a Model With Capital**  
*(assuming 50 percent of natives are skilled)*



flow. This conclusion, of course, may change if the native workforce is predominantly skilled. In particular, when the native workforce is predominantly skilled, the gains from admitting a skilled immigrant flow resulting from capital-skill complementarity might be outweighed by the gains from admitting immigrants who differ from native workers.

As noted above, there is a great deal of uncertainty regarding the values of the elasticities that determine the immigration surplus in this model. Nevertheless, the simulations reported in Table 2 show that altering the skill composition of the immigrant flow can generate sizable gains for natives. If half of the natives are skilled, and if the elasticities of factor price are  $-.4$  and  $-.75$  for unskilled and skilled workers, respectively, the immigration surplus would be \$14 billion if only unskilled immigrants are admitted, but would jump to \$47.3 billion if only skilled immigrants are admitted. Even if the native workforce were predominantly skilled (so that 75 percent of the natives are skilled), these elasticity values suggest that the immigration surplus would increase from \$22.4 to \$28.0 billion if the United States pursued a more selective immigration policy. The complementarities in production between skilled workers and capital, therefore, may be sufficiently strong to suggest that natives gain if the immigrant flow is composed of exclusively skilled workers, even if the native workforce is predominantly skilled.

It is important to stress that the simulation results reported in Table 2 only suggest how a shift in the skill composition of the immigrant flow influences the immigration surplus. To calculate or predict the immigration surplus resulting from particular immigration policies, we would have to provide a much more complete description of what is meant by “skilled” and “unskilled” workers, as well as obtain robust estimates of the elasticities of factor price, which ultimately determine the size of the immigration surplus.

*Table 2*  
**Estimates of Immigration Surplus**  
*(in billions of dollars)*

	<i>25% of Natives are Skilled; 30% of National Income Goes to Skilled Workers</i>	<i>50% of Natives are Skilled; 45% of National Income Goes to Skilled Workers</i>	<i>75% of Natives are Skilled; 60% of National Income Goes to Skilled Workers</i>
<b>Admit Only Unskilled Immigrants:</b>			
Elasticity of Factor Price for Unskilled Workers is:			
– .2	5.0	7.0	11.2
– .4	10.0	14.0	22.4
– .6	14.9	21.0	33.6
<b>Admit Only Skilled Immigrants:</b>			
Elasticity of Factor Price for Skilled Workers is:			
– .5	84.0	31.5	18.7
– .75	126.0	47.3	28.0
– 1.0	168.0	63.0	37.3

*Notes:* The calculations assume that the GDP in the United States equals \$7 trillion; that the share of national income accruing to capital is 30 percent; and that immigrants make up 10 percent of the workforce.

## Conclusion

The family of economic models summarized in this paper provides the foundation for a positive theory of immigration policy. *If* we are willing to maintain the hypothesis that immigration policy should increase the national income of natives, the government's objective function in setting immigration policy is well defined: maximize the immigration surplus net of the fiscal burden imposed by immigrants on native taxpayers. The optimal size and skill composition of the immigrant flow would equate the increase in the immigration surplus resulting from admitting one more immigrant to the marginal cost of the immigrant.

It is reasonable to suppose that the net fiscal costs of immigration are larger for unskilled immigrant flows. After all, unskilled immigrants are more likely to use many government services *and* pay lower taxes. In addition, there are economic reasons, arising mainly from the complementarity between capital

and skills, that suggest that the immigration surplus might be larger when the immigration flow is composed exclusively of skilled workers. It seems, therefore, that on purely efficiency grounds there is a strong economic case for an immigration policy that uses skill filters in awarding entry visas.

The analysis, however, also revealed that these efficiency considerations may not be the most important consequences of choosing among alternative immigration policies. Immigration also generates a sizable redistribution of wealth in the economy, reducing the incomes of natives who are now competing with immigrant workers in the labor market and increasing the incomes of capitalists and other users of immigrant services.

It is worth stressing that the discussion in this paper considers only the “demand side” of the immigration market. The United States can attract only those immigrants who wish to enter the country.<sup>14</sup> If economic conditions in the United States are particularly attractive to unskilled workers from other countries, the demand side of the immigration market might only grant visas to skilled workers, but the supply side suggests that only unskilled workers are willing to make the move. It is possible, therefore, that ruling out the immigration of unskilled workers may greatly reduce the size of (and perhaps even cut off) the immigrant flow.

Finally, the positive theory of immigration policy suggested by the discussion is based on the idea that, distributional issues aside, the main objective of immigration policy should be to increase the national income accruing to natives. It is far from clear that immigration policy *should* pursue this objective. The immigration statutes reflect a political consensus that incorporates the conflicting social and economic interests of various demographic, socioeconomic, and ethnic groups, as well as political and humanitarian concerns. Nevertheless, the economic approach is useful because it tells us what we are giving up by pursuing immigration policies that minimize or ignore economic considerations.

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## Appendix

### The Mathematics of Calculating Surplus

#### The Immigration Surplus

To show how the immigration surplus can be calculated in more complicated models, it is instructive to provide an algebraic derivation of the surplus given by the triangle  $BCD$  in Figure 1. The linear homogenous production function is given by  $Q = f(K, L)$ , where  $L = N + M$ . The national income accruing to natives is  $Q_N = wN + rK$ . Assuming that native workers and capital are inelastically supplied to the economy, immigration increases  $Q_N$  by the

<sup>14</sup>See Borjas (1987) for an analysis of the immigration decision.

amount:

$$(A1) \quad \Delta Q_N = \left( K \frac{\partial r}{\partial L} + N \frac{\partial w}{\partial L} \right) \Delta L,$$

where  $\Delta L = M$ .

It is well known that when the derivatives in (A1) are evaluated at the initial equilibrium (where  $L = N$ ), the infinitesimal increase in national income accruing to natives is zero (Bhagwati and Srinivasan, 1983, p. 294). To calculate finite changes, therefore, we evaluate the immigration surplus using an “average” rate for  $\partial r / \partial L$  and  $\partial w / \partial L$ , where the average is defined by:

$$\frac{1}{2} \left( \frac{\partial r}{\partial L} \Big|_{L=N} + \frac{\partial r}{\partial L} \Big|_{L=N+M} \right),$$

with a similar definition for the average rate of change in the wage. Because evaluating the immigration surplus at  $L = N$  leads to a zero value for  $\Delta Q_N$ , this approximation implies that the finite change in the immigration surplus is half the gain obtained when equation (A1) is evaluated at  $L = N + M$ . Using this property and converting equation (A1) into percentage terms yields:

$$(A2) \quad \frac{\Delta Q_N}{Q} = \frac{1}{2} [(1 - s)e_{KL} + s(1 - m)e_{LL}]m,$$

where  $s = wL/Q$ ;  $m = M/L$ ;  $e_{LL} = d \log w / d \log L$ ; and  $e_{KL} = d \log r / d \log L$ . A weighted average of factor price elasticities adds up to zero (Hamermesh, 1993), so that  $(1 - s)e_{KL} + se_{LL} = 0$ . Substituting this fact into (A2) yields the area of the triangle reported in the text.

If there are external effects, the production function for the representative firm is given by  $Q_F = f(K, L)Q_E^\gamma$ . Because the firm ignores the external effects, input prices are given by the marginal productivity conditions  $r = f_K Q_E^\gamma$  and  $w = f_L Q_E^\gamma$ . Equation (A1) still gives the change in national income accruing to natives. Immigration changes input prices, and these changes depend on the external effects. To calculate the derivatives  $\partial r / \partial L$  and  $\partial w / \partial L$ , therefore, we use the equilibrium condition  $Q = f(K, L)^{1/(1-\gamma)}$ . The equation in the text reporting the magnitude of the immigration surplus in the presence of external effects is obtained by evaluating the contributions of external effects to the immigration surplus at the point where  $L = N + M$ .

### The Surplus and Immigrant Skills

To conserve space, the immigration surplus is derived only for the model that includes capital; a similar approach can be used to derive the equation reported in note 8 in the text. The concave linear homogeneous production function is given by:

$$(A3) \quad Q = f(K, L_S, L_U) = f(K, bN + \beta M, (1 - b)N + (1 - \beta)M),$$

where  $b$  and  $\beta$  denote the fraction of skilled workers among natives and immigrants, respectively. The wage of each factor of production (capital, skilled workers, and unskilled workers) is determined by the respective marginal productivity condition. The increase in national income accruing to natives is:

$$(A4) \quad \Delta Q_N = \left( K \frac{\partial r}{\partial M} + bN \frac{\partial w_S}{\partial M} + (1-b)N \frac{\partial w_U}{\partial M} \right) M.$$

Define  $e_{ij} = \partial \log w_i / \partial \log X_j$  (where  $X_j = K, L_S, L_U$ ), or the elasticity of factor price. If we convert equation (A4) into percentage terms, evaluate the various derivatives at the “average” point, and use the condition that a weighted average of elasticities of factor price equals zero, we obtain:

$$(A5) \quad \frac{\Delta Q_N}{Q} = -\frac{s_S e_{SS} \beta^2 m^2}{2p_S^2} - \frac{s_U e_{UU} (1-\beta)^2 m^2}{2p_U^2} \\ - \frac{s_S e_{SU} \beta (1-\beta) m^2}{2p_S p_U} - \frac{s_U e_{US} \beta (1-\beta) m^2}{2p_S p_U},$$

where  $s_S$  and  $s_U$  are the shares of national income accruing to skilled and unskilled workers, respectively, and  $p_S$  and  $p_U$  are the shares of the workforce that are skilled and unskilled. The equations reported in the text giving the immigration surplus when the immigrant flow is exclusively skilled or unskilled are obtained by evaluating the immigration surplus in (A5) at the values of  $\beta = 1$  or  $\beta = 0$ .

To show that the immigration surplus is positive, note that the elasticity of factor price  $e_{ij} = s_j c_{ij}$ , where  $c_{ij}$  is the elasticity of complementarity (defined as  $c_{ij} = f_{ij} f / f_i f_j$ ). We can then rewrite (A5) as:

$$(A6) \quad \frac{\Delta Q_N}{Q} = -\frac{s_S^2 c_{SS} \beta^2 m^2}{2p_S^2} - \frac{s_U^2 c_{UU} (1-\beta)^2 m^2}{2p_U^2} - \frac{s_S s_U c_{SU} \beta (1-\beta) m^2}{p_S p_U}.$$

The concavity of  $f(K, L_S, L_U)$  implies that:

$$f_{SS} \leq 0, \quad \begin{vmatrix} f_{SS} & f_{SU} \\ f_{US} & f_{UU} \end{vmatrix} \geq 0, \quad \text{and} \quad \begin{vmatrix} f_{SS} & f_{SU} & f_{SK} \\ f_{US} & f_{UU} & f_{UK} \\ f_{SK} & f_{KU} & f_{KK} \end{vmatrix} \leq 0.$$

The linear homogeneity of the production function implies that the determinant of the three-by-three matrix is zero. We can write the production function in its intensive form as  $Q = K q(L_S/K, L_U/K)$ . Assuming that  $q$  is strictly concave implies that  $f_{SS} f_{UU} - f_{SU}^2 > 0$ , so that  $c_{SS} c_{UU} - c_{SU}^2 > 0$ . This assumption guarantees that the isoquants between skilled labor and unskilled labor, for

a given capital, have the usual convex shape. Using this restriction, it can be shown that the immigration surplus in (A6) is positive. The relationship between the immigration surplus and  $\beta$  illustrated in Figure 4 is obtained by differentiating (A6) twice with respect to  $\beta$  (and evaluating these derivatives at  $p_S = p_U = 1/2$ ). Using various restrictions implied by  $c_{SS} c_{UU} - c_{SU}^2 > 0$  and assuming that  $c_{SS} < c_{UU}$ , it can be shown that the first derivative is positive at  $\beta = 1$  and that the second derivative is positive everywhere, so that (A6) is convex. The relationship between the immigration surplus and  $\beta$  therefore is either upward-sloping (and convex) throughout or has the *U*-shape illustrated in Figure 4.

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