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A note on the redistributive effect of immigration

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Abstract

Employing a stylized model to analyse changes in earnings because of immigration, we propose a new method to tally up changes to the gain on the aggregated level. The amounts involved in redistribution exceed those reported by a previous study.

Keywords: Immigration; Wages; Economic welfare; Redistribution

JEL classification: D30; D60; F22; J31; J61

1. Introduction

Immigration causes gains and losses that accrue to natives. The gain on the aggregated level is called the 'immigration surplus' (Borjas, 1999). We derive changes in earnings of native owners of production factors by employing a stylized model with three production factors. For the sake of transparency, we start with an economy with two production factors.

2. Two production factors

Suppose the production technology in the host country can be summarized by a twice-differentiable and continuous linear homogeneous production function with inputs capital K and labour L so that

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output $Q=f(K,L)$. The work force L contains N native and M immigrant workers, and workers are perfect substitutes in production ($L=M+N$). Natives own the entire capital stock. The supplies of native and immigrant workers are perfectly inelastic.

In a competitive economy, each factor price equals the respective value of marginal productivity. Let the price of output Q be numeraire. The rental rate of capital in the pre-immigration equilibrium is $r_0=f_K(K,N)$ and the price of labour is $w_0=f_L(K,N)$. Assuming the production function to exhibit constant returns to scale, the entire output is distributed to capital owners and workers. In the pre-immigration regime, the national income accruing to natives Q_N is given by

$$Q_N = r_0K + w_0N \tag{1}$$

As the demand curve for labour may be nonlinear, we approximate the gain in national income accruing to natives ΔQ_N, the immigration surplus, by a triangle with area $1/2(w_0 - w_1)M$. As we cannot observe wages with and without immigration at the same time we need to approximate the difference in wages as well. We use a first order approximation: $(w_0 - w_1) \approx -(\partial w/\partial L)M$. The immigration surplus as a fraction of national income Q is given by:

$$\frac{\Delta Q_N}{Q} \approx \frac{\frac{1}{2}(w_0 - w_1)M}{Q} \approx \frac{-\frac{1}{2}\left(\frac{\partial w}{\partial L}M\right)M}{Q} = -\frac{1}{2}\left(\frac{wL}{Q}\right)\left(\frac{\partial w}{\partial L}\frac{L}{w}\right)\left(\frac{M}{L}\right)^2 = -\frac{1}{2}\alpha_L \varepsilon_{LL} m^2 \tag{2}$$

where α_L is labour's share of national income; ε_{LL} is the elasticity of factor price for labour; and m is the fraction of immigrants in the work force.

Immigration redistributes income from labour to capital. Native workers loose and this loss plus the immigration surplus accrues to capital owners. Expressed as a fraction of GDP the immigration surplus consists of the net changes in incomes of native workers and capital owners:

$$\frac{\Delta Q_N}{Q} = \frac{K(r_1 - r_0)}{Q} + \frac{N(w_1 - w_0)}{Q} \tag{3}$$

Both the gain of capital owners and the loss of workers may be calculated by using the same first order approximation as above: $(w_1 - w_0) \approx (\partial w/\partial L)M$ and $(r_1 - r_0) \approx (\partial r/\partial L)M$. The resulting immigration surplus can be written as a weighted sum of the immigration elasticities of factor prices:

$$\frac{\Delta Q_N}{Q} \approx \alpha_K^m\left[\frac{\partial r}{\partial M}\frac{M}{r}\,\Big|_{L=M+N}\right] + \alpha_L^m\left[\frac{\partial w}{\partial M}\frac{M}{w}\,\Big|_{L=M+N}\right] \tag{4}$$

with weighting factors $\alpha_K^m = \alpha_K$ and $\alpha_L^m = (1-m)\alpha_L$ and immigration elasticities of factor prices that are equal to $\varepsilon_{KL}m$ and $\varepsilon_{LL}m$.

As the immigration surplus of Eq. (2) and the gains and losses of Eq. (4) are based on first order approximations, it is not obvious that tallying them up leads to the same size of the immigration surplus. In fact, using identity $\alpha_K\varepsilon_{KL} + \alpha_L\varepsilon_{LL} = 0$, it can be shown that the immigration surplus of the latter equation is twice as large as the one reported by the former equation.

We maintain the hypothesis that Eq. (2) gives a reasonable approximation of the immigration surplus. Borjas (1999) does so as well. The ultimate goal of this paper is to find an approximation method for the amount of redistribution that is consistent with the immigration surplus of Eq. (2).

Table 1 presents the effects of immigration. The first column presents the effect on earnings: a fraction of immigrants of 10% decreases wages by 3% and increases the return of capital by 7% (using $\alpha_K\varepsilon_{KL} + \alpha_L\varepsilon_{LL} = 0$). The amount of redistribution between the native production factors should be in line with the price effects. We discuss three approximation methods: two proposed by Borjas, and one proposed by us.

Method 1 (Borjas, 1999, Section 2.1) uses the linear approximation to calculate the total loss in earnings of workers: $(w_1 - w_0) \approx (\partial w/\partial L)M$:

$$\frac{N(w_1 - w_0)}{Q} \approx \alpha_L\varepsilon_{LL}m(1-m) \tag{5}$$

The gain of capital owners is calculated as a remainder by adding up the absolute value of the loss of workers and the immigration surplus. In the example the total loss in earnings of workers is 1.89% of GDP and the total gain in earnings of capital owners is 2.00% of GDP.

Method 2 (Borjas, 1999, Section 2.2) is based on the notion that when the partial derivatives of factor prices $\partial r/\partial M$ and $\partial w/\partial M$ are evaluated at the initial equilibrium, without immigration, the

Table 1
Simulation of economic costs and benefits from immigration[a]

	On the basis of elasticities	Method 1	Method 2	Method 3
Earnings of capital (rental rate)[b]	7.00	6.67	3.50	7.00
Earnings of labour (wage)[b]	– 3.00	– 3.00	– 1.50	– 3.00
Immigration surplus[c]		0.11	0.11	0.11
Total native earnings of capital[c]		2.00	1.05	2.10
Total native earnings of labour[c]		– 1.89	– 0.94	– 1.99

[a] All simulations assume that the labour share in national income α is 70%; that the elasticity of factor price for labour supply ε_{LL} is -0.3 and that the fraction of immigrants in the workforce is 10%. The explanation of the calculation methods can be found in the text of this section.

[b] Change in percentages.

[c] Change in percentages of GDP.

infinitesimal increase in national income accruing to natives is zero (Baghwati and Srinivasan, 1983). To calculate finite changes, he evaluates the immigration surplus using an 'average' rate for the partial derivatives. The averages are defined by:

$$\frac{\partial r}{\partial M} \approx \frac{1}{2}\left(\frac{\partial r}{\partial M}\bigg|_{L=N} + \frac{\partial r}{\partial M}\bigg|_{L=N+M}\right) \tag{6}$$

$$\frac{\partial w}{\partial M} \approx \frac{1}{2}\left(\frac{\partial w}{\partial M}\bigg|_{L=N} + \frac{\partial w}{\partial M}\bigg|_{L=N+M}\right)$$

This is a special case of Borjas (1999), who applies this notion to the economy with three production factors. In practice, Borjas 'averages' the price effects of immigration leading to effects that are too small. The example in Table 1 shows that the changes in earnings are halved compared to the results on the basis of the elasticities.

Method 3 is our own proposal: as we employ the elasticities of factor prices, ε_{KL} and ε_{LL}, to approximate the price effects of immigration we need to find weighting factors for Eq. (4) that give the immigration surplus of Eq. (2). Define:

$$\frac{\Delta Q_N}{Q} \approx \alpha_K^* \left[\frac{\partial r}{\partial M}\frac{M}{r}\mid_{L=M+N}\right] + \alpha_L^* \left[\frac{\partial w}{\partial M}\frac{M}{w}\mid_{L=M+N}\right] \tag{7}$$

with $\alpha_i^*=(\alpha_i^0+\alpha_i^m)/2$ $(i=K,L)$, where α_i^0 is the share in national income of natives in the pre-immigration regime ($\alpha_K^0=\alpha_K$ and $\alpha_L^0=\alpha_L$) and α_i^m is the share in national income of natives assuming that a fraction m of workers are immigrants ($\alpha_K^m=\alpha_K$ and $\alpha_L^m=(1-m)\alpha_{\mathrm{L}}$). So where method 2 averages the price effects of immigration, our method averages the weighting factors. It can be shown that Eq. (7) leads to the immigration surplus of Eq. (2).

3. Three production factors

Suppose there are two types of workers in the host country's labour market, skilled (L_{S}) and unskilled (L_{U}). The production function:

$$Q=f(K,L_{\mathrm{S}},L_{\mathrm{U}})=f[k,bN+\beta M,(1-b)N+(1-\beta)M] \tag{8}$$

where b and β denote the fraction of skilled workers among natives and among immigrants. The price of each production factor is determined by the respective marginal productivity condition. We consider two kinds of economies: one with perfectly inelastic capital and one with perfectly elastic capital. The derivations are analogous to the case with two production factors; details on the economy with three production factors can be found in Borjas (1999) and details on the immigration surplus can de found in Euwals and Roodenburg (2003).

To illustrate the differences between the methods we provide simulations that extent the calculations of Section 2. To do this, we need to aggregate the labour market into two skill groups. We follow the second example of Borjas, which is based on high school and college equivalents in the US labour market. Using data from the Current Population Survey, he reports that 43% and 33% of the work force and the immigrant workers are high skilled ($p_S = 0.43$ and $\beta = 0.33$), and that the share of income accruing to skilled and to unskilled workers equal 37.1% and 32.9% ($\alpha_S = 0.371$ and $\alpha_U = 0.329$).

The outcomes of the simulations crucially depend on the responsiveness of factor prices to increases in labour supply. Borjas used the following range for the vector (ε_{SS},ε_{UU}): (– 0.5, – 0.3), (– 0.9, – 0.6), and (– 1.5, – 0.8). The cross elasticity ε_{SU} is set to 0.05 in all simulations. Because an elasticity matrix needs to fulfil two identities these assumptions determine all elasticities.

Table 2 presents the full set of simulations and focuses on methods 2 and 3. For the case with small elasticities, Borjas reports that wages of skilled and unskilled workers decrease by only 1.5% and 1.4%. The changes in wages are about twice as large for method 3. If capital is perfectly elastic the changes in wages are smaller, but the difference between the methods remains. In any case, the immigration surplus is exactly identical for the two methods.

Table 2
Simulation of economic costs and benefits from immigration[a,b]

	Method 2[c]		Method 3	
	Capital inelastic	Capital elastic	Capital inelastic	Capital elastic
Assume (ε_{SS},ε_{UU})=(– 0.5, – 0.3)				
Earnings of capital[d]	3.71		7.41	
Earnings of skilled labour[d]	– 1.50	0.37	– 3.25	0.80
Earnings of unskilled labour[d]	– 1.36	– 0.40	– 3.09	– 0.90
Immigration surplus[e]	0.11	0.01	0.11	0.01
Assume (ε_{SS},ε_{UU})=(– 0.9, – 0.6)				
Earnings of capital	7.54		15.07	
Earnings of skilled labour	– 2.92	0.67	– 6.32	1.46
Earnings of unskilled labour	– 2.92	– 0.73	– 6.62	– 1.65
Immigration surplus	0.22	0.01	0.22	0.01
Assume (ε_{SS},ε_{UU})=(– 1.5, – 0.8)				
Earnings of capital	11.67		23.35	
Earnings of skilled labour	– 5.04	0.95	10.92	2.05
Earnings of unskilled labour	– 3.96	– 1.02	– 8.97	– 2.32
Immigration surplus	0.33	0.02	0.33	0.02

[a] All simulations assume a labour share in national income of 70%, that $\varepsilon_{SU} = 0.05$, and that the fraction of immigrants in the workforce is 10%. The values for the other parameters are: $p_S = 0.43$, $\beta = 0.33$, $\alpha_S = 0.371$ and $\alpha_U = 0.329$. All entries are changes in percentages, except for the immigration surplus which is a percentage of GDP.

[b] An Excel-spreadsheet to calculate the effects of immigration is available upon request with the authors.

[c] In Table 1 of Borjas (1999) the changes in earnings of skilled and unskilled workers are additionally multiplied by $(1 - m)(b/p_S)$ and $(1 - m)((1 - b)/p_U)$.

[d] Changes in percentages.

[e] Changes in percentages of GDP.

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