Unemployment, Technology and the Welfare Effects of Immigration

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Abstract

This paper explores the effects of high and low skilled immigration to a host country with unionized low skilled labor and an unemployment insurance scheme. It is shown that the consequences for the labor market and the welfare of natives depend crucially on the host country's production structure. When high and low skilled labor are close substitutes, low skilled immigration boosts employment and can increase total native income. We provide conditions under which low skilled immigration is Pareto-improving. While high skilled immigration has adverse employment effects, the findings reverse for the case of close complementarity.

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I. Introduction

Most industrialized countries follow a strategy of treating potential immigrants differentiated according to their skills, with an emphasis on keeping back low skilled immigration on the one hand, and attracting high skilled labor on the other hand. This differentiation is rationalized by the expected fiscal and employment consequences: Apart from the downward pressure on wages due to increased labor market competition, successful low skilled immigrants are feared to drive natives into unemployment, while those migrants who do not find a job impose a net fiscal burden on the welfare state. Highly qualified individuals, in contrast, are regarded not only as fiscal contributors but also as means to stimulate the labor market and hence the employment prospects of the less skilled.

However, these fiscal and employment effects of labor mobility have been explored predominantly in isolation. On the one hand, the vast majority of studies linking immigration and the welfare state relies on the framework of fully competitive labor markets, and thus abstracts from the pressing problem of unemployment faced by many welfare states.[1] On the other hand, approaches incorporating labor market frictions disregard either the existence of unemployment or unemployment insurance (Razin and Sadka, 1995, Dolado et al., 1996, Fuest and Thum, 2000) or budgetary repercussions (Brecher and Choudri, 1987, Schmidt et al., 1994). On top of that, the effects of high skilled immigration have received little attention in the literature hitherto.

Therefore, this paper tackles the issue from a more comprehensive perspective, examining the effects of both high and low skilled immigration on a host economy suffering from unemployment due to the existence of trade unions and an unemployment insurance scheme. The resulting interplay between the qualifications of immigrants, the wage setting process and the unemployment insurance scheme allows to disentangle some novel effects. We show that the labor market ramifications are characterized by the production technology of the host country. In particular, direction and strength of employment effects are determined by the elasticity of substitution between high and low skilled labor. When this elasticity exceeds unity, as suggested by many empirical studies (Johnson, 1997), inputs are close substitutes,

1 Examples include Wildasin (1994), Razin and Sadka (1995), Wellisch and Walz (1998), Michael and Hatzipanayotou (2001) and Michael (2003).

and low skilled immigration leads to a more than proportional increase in low skilled employment, while high skilled immigration reduces low skilled employment. However, when inputs are close complements, high skilled immigration promotes low skilled employment and low skilled immigration increases the low skilled unemployment rate.

These findings translate into some important consequences for the assessment of immigration policies. For a high degree of substitutability between skills, low skilled immigrants can increase the total income accruing to the native population whereas high skilled immigrants have an adverse effect. Moreover, low skilled immigration may enhance the labor market prospects so much that the expected utility of a native low skilled increases. Therefore, the host country may achieve a Pareto-improvement by allowing low skilled labor to migrate in. By driving the low skilled into unemployment and reducing the high skilled wage, high skilled immigration may make all those already in the country worse off. However, this pattern reverses for close complementarity between inputs.

To the best of our knowledge, these findings have not been derived before. Schmidt et al. (1994) find low skilled immigration to have no effect on the wage set by a rent-maximizing trade union. However, that model neglects any fiscal repercussions of immigration by renouncing on a balanced budget restriction for the welfare state, allowing both the contribution rate and the unemployment benefit to remain constant. Dolado et al. (1996) derive a sufficient condition for low skilled immigration to have a positive effect on the level of low skilled employment. While these authors show that this condition is the more likely to be fulfilled, the better inputs can be substituted, they consider neither the effects on unemployment rates nor native incomes and welfare. Fuest and Thum (2000) find ambiguous effects of immigration on total native income for a dual labor market with homogenous labor. In their model, increases in native income originate in a significant reallocation of workers from the unionized to the competitive sector in a full employment setting, with the strength of the reallocation depending on the production functions of both sectors.[2]

2 Kemnitz (2003) uses a model related to the one presented here in order to scrutinize the thesis that low skilled immigration makes the native population better off due to the existence of unfunded old age security (Razin and Sadka, 2000). However, refining to a Cobb-Douglas production function, that approach assumes away the important role of the host country's technology.

Both Ortega (2000) and Epstein and Hillman (2003) have presented circumstances under which immigration can be Pareto-improving. However, these mechanisms differ substantially from the one advanced here. In Ortega (2000), positive effects arise from enhancing the matching probability between workers and firms. The argument by Epstein and Hillman (2003) rests on the existence of labor market discrimination against immigrants in an efficiency-wage model: although the overall unemployment rate rises, natives enjoy a higher probability to capture a job. Without such discrimination, natives necessarily lose. In the present model, however, beneficial effects arise from a reduction in the low skilled unemployment rate being to the benefit of both natives and immigrants.

The paper is organized as follows. Section II derives the labor market equilibrium of the host economy. Section III addresses the effects of high and low skilled immigration on the labor market and the economic position of natives. Section IV offers some concluding remarks.

II. The Host Economy

Consider an economy where the single output good is produced by two inputs, called high and low skilled labor H and L, according to a constant-elasticity-of substitution production function:

$$Y = [\alpha H^{\rho} + (1-\alpha)L^{\rho}]^{\frac{1}{\rho}}, \tag{1}$$

with $\rho < 1$ and $\alpha \in (\frac{1}{2}, 1)$, because higher skills are more productive. As is well known, this formulation represents a number of popular production functions like perfect substitutes ($\rho \to 1$), perfect complements ($\rho \to -\infty$) or the Cobb-Douglas ($\rho = 0$).[3] For further analysis, it is convenient to adopt the usual classification of calling high and low skilled labor *close substitutes* when $\rho > 0$ and *close complements* when $\rho < 0$.[4] For $\rho = 0$, inputs are neither close substitutes nor complements. A

3 We omit the polar case $\rho = 1$ for two reasons. First, when workers are perfect substitutes, it may be hard to justify that the low skilled are unionized while the high skilled are not. Second, the wage elasticity of the demand for low skilled labor would be $-\infty$. Degenerating the tradeoff between wages and employment presented below, unemployment could never be an equilibrium outcome for such an economy.

4 In a related study, Schmidt et al. (1994) distinguish between high and low skilled labor being q-complements, where the marginal productivity of low skilled labor increases in the quantity

number of recent studies (Johnson, 1997; Fitzenberger, 1999; Card and Lemieux, 2001) indicates close substitutability to be the empirically more relevant case with ρ averaging around 1/3. However, as estimates show some variation (see, e.g., the collection of results in Hamermesh, 1993), we examine all possible cases for ρ.

The native population consists of both high and low skilled workers N_H and N_L, respectively. Immigrants are either high or low skilled, arrive in amounts M_H and M_L and are identical to the natives in all respects. With any objective reason for discrimination lacking, it is reasonable to presume that immigrants face the same labor market prospects as the low skilled natives.[5]

Firms hire both factors according to the marginal productivity conditions:

$$\frac{\partial Y}{\partial H} = [\alpha H^{\rho} + (1-\alpha)L^{\rho}]^{\frac{1}{\rho}-1}\,\alpha H^{\rho-1} = w_H, \tag{2}$$

$$\frac{\partial Y}{\partial L} = [\alpha H^{\rho} + (1-\alpha)L^{\rho}]^{\frac{1}{\rho}-1}\,(1-\alpha)L^{\rho-1} = w_L. \tag{3}$$

The high skilled labor market is perfectly competitive, hence the wage w_H adjusts such that this type of labor is fully employed: $H = N_H + M_H$. Low skilled labor, however, is unionized. Thus, the low skilled wage w_L results from bargains between trade unions and firms. In accordance with most of the literature, we assume that both unions and firms are so small that they neglect macroeconomic repercussions of their behavior.

Instead of committing to one of the standard formulations of wage setting in unionized markets, we model the negotiation process in a rather flexible way. Inspired by Pencavel (1984), we assume that the bargained wage maximizes a weighted surplus of per capita net income and employment, compared to the reference situation. As bargaining partners are small relative to the economy, the reference situation corresponds to no employment in that firm and all workers receive the alternative income $\bar{w}$, to be presented in detail below. Thus, the wage negotiation surplus is:

$$\Omega = \gamma \log[(1-\tau)w_L - \bar{w}] + (1-\gamma)\log(1-\pi)L, \tag{4}$$

of high skilled labor employed, and q-substitutes, where the opposite holds. This should not be confused with the above definition. It is easy to verify that high and low skilled labor must be q-complements in (1) (Hamermesh, 1993).

5 In general, arguments for both better and inferior labor market chances for immigrants can be made. The vast majority of the theoretical literature considers natives and immigrants as identical, see e.g. Schmidt et al., (1994), Razin and Sadka (1995), Fuest and Thum (2000), Casarico and Devillanova (2003).

where $\gamma \in [0, \frac{1}{2}]$ captures the relative priority of income over employment, τ denotes the contribution/ tax rate to unemployment insurance, and L is determined by (3), with the fraction $\pi > 0$ of these jobs to be occupied by workers from outside the home firm. This labor market turnover could be justified by various arguments not really crucial for the results. We offer the interpretation of Kaas and von Thadden (2001) according to which some home workers turn out to be unproductive at their workplace for reasons not explicitly modelled and are replaced by outside applicants.[6] For further reference, we denote the first term in (4) as the income rent and the second term as the employment rent.[7]

This wage negotiation function covers the most relevant situations advanced in the literature. The case $\gamma = \frac{1}{2}$ corresponds to the maximization of the income of the low skilled, that is rent maximization. When $\gamma = 0$, only employment matters, because of either a very low bargaining power or a very high employment preference on part of the union. Other values of γ reflect intermediate cases.

It should be stressed that (4) need not necessarily be identified as the target function of trade union members. Rather, it depicts the total rent gained by both union representatives and firm managements from wage negotiations given the economy's formal or informal labor market institutions. We therefore treat unions and firms as an entity, and refer to them as *wage setters*. One implication of this approach is that the negotiated wage may fail to maximize low skilled utility not only due to low union power, but also because of a divergence of interests between union representatives and members.

Differentiating (4) with respect to w_L leads to the first-order condition:[8]

$$\frac{\gamma(1-\tau)w_L}{(1-\tau)w_L - \bar{w}} + (1-\gamma)\varepsilon = 0, \tag{5}$$

where ε is the wage elasticity of labor demand.

6 A similar turnover could be introduced for the high skilled as well without affecting any of our findings.

7 We assume that trade setters care for immigrants as much as they do for natives. This assumption is common in the literature (Fuest and Thum, 2000) and seems plausible in the light of the perfect congruency of immigrant and native low skilled. But even only the well-being of native workers counted (Schmidt et al., 1994), the wage setting relation derived below would remain unchanged.

8 The restriction $\gamma \leq 1/2$ ensures that the respective second-order condition is fulfilled, so (5) describes always a maximum of the wage setters' objective.

The optimal choice of wage setters is characterized by the equalization of the marginal gains and costs of increasing the low skilled wage. Put differently, the marginal income rent $\gamma(1-\tau)w_L/((1-\tau)w_L-\bar{w})$ and the marginal employment rent $-(1-\gamma)\varepsilon$ coincide. Rearranging (5) shows that the net wage can be expressed as a markup $(1-\gamma)\varepsilon/(\gamma+(1-\gamma)\varepsilon)$ on the alternative wage, which depends negatively on the elasticity of labor demand. Incentive compatibility requires that markup to exceed unity, which implies that wage setters' choices must be located in a sufficiently elastic part of the demand curve for low skilled labor: $\varepsilon < -\frac{\gamma}{1-\gamma}$.

For the following analysis, it is useful to write this elasticity as a function of relative factor endowments and the low skilled unemployment rate $u = (N_L+M_L-L)/(N_L+M_L)$:

$$\varepsilon = \frac{\alpha H^\rho + (1-\alpha)L^\rho}{(\rho-1)\alpha H^\rho} = \frac{1+\frac{1-\alpha}{\alpha}\left(\frac{(1-u)(N_L+M_L)}{N_H+M_H}\right)^\rho}{\rho-1}. \tag{6}$$

An increase in low skilled employment (a ceteris paribus increase N_L or M_L or a decrease of u) decreases (increases) this elasticity when inputs are close substitutes (complements), and leaves ε constant for the Cobb-Douglas case:

$$\begin{aligned} \frac{\partial\varepsilon}{\partial N_L} = \frac{\partial\varepsilon}{\partial M_L} &= -\frac{1-u}{N_L+M_L}\frac{\partial\varepsilon}{\partial u} \\ &= \frac{\rho}{\rho-1}\frac{(1-\alpha)}{\alpha(N_L+M_L)}\left(\frac{(1-u)(N_L+M_L)}{N_H+M_H}\right)^\rho \lesseqgtr 0 \Longleftrightarrow \rho \lesseqgtr 0. \end{aligned} \tag{7}$$

An increase in high skilled employment has just the opposite effect:

$$\frac{\partial\varepsilon}{\partial H} = -\frac{\partial\varepsilon}{\partial N_L}\frac{(1-u)(N_L+M_L)}{N_H+M_H} \gtreqless 0 \Longleftrightarrow \rho \gtreqless 0. \tag{8}$$

In the aggregate, a pool of $N_L+M_L-(1-\pi)L$ low skilled workers does not get a job in the home firm and applies abroad to earn an expected gross wage Ew_L, if successful. Since there are πL vacancies, the probability of getting such a job, conditional on not being hired at the home firm is

$$\xi(u) = \frac{\pi L}{N_L+M_L-(1-\pi)L} = \frac{\pi(1-u)}{1-(1-\pi)(1-u)},$$

with $\xi'(u) < 0$, $\xi(0) = 1$ and $\xi(1) = 0$. When applications are unsuccessful, which occurs with the residual probability $1-\xi(u)$, workers rely on unemployment benefits. As a consequence, the alternative wage corresponds to:

$$\bar{w} = \xi(u)(1-\tau)Ew_L + (1-\xi(u))b. \tag{9}$$

The welfare state provides support to all unemployed workers. Benefits are financed by charging all earnings at the rate τ, leading to the government budget constraint:

$$b(N_L + M_L - L) = \tau w_L L + \tau w_H H. \tag{10}$$

Thus, the welfare state is outright redistributive, as the high skilled contribute to the system although they do not face any unemployment risk.

With respect to the choice of the unemployment benefit level, we assume that the government is guided by two countervailing concerns: on the one hand, it wants to maintain a constant net replacement ratio, on the other hand, the cost of maintaining that protection are taken into account. This tradeoff is captured in the following relationship:

$$b = r(\tau)(1-\tau)w_L, \tag{11}$$

with $r(0) = r_0 \geq 0, r(\tau^*) = 0$ with $\tau^* < 1$, $r'(\tau) \leq 0$ for $\tau \in [0, \tau^*]$ and $r'(\tau) = 0$ for $\tau \in [\tau^*, 1]$. Thus, the effective ratio between benefit and net wage - if positive - is a decreasing function of the contribution rate. While too high contribution rates ($\tau > \tau^*$) are never acceptable for the state, r_0 is a measure of the general orientation towards the interests of the unemployed. $r_0 = 0$ obviously rules out the existence of a welfare state.

Using this dependency, (2) and (3) and the definition of the low skilled unemployment rate, the government budget constraint results as:

$$BB \;=\; r(\tau) - \frac{\tau}{1-\tau}\frac{1-u}{u}\left[1 + \frac{\alpha}{1-\alpha}\left(\frac{H}{(1-u)(N_L+M_L)}\right)^{\rho}\right] = 0, \tag{12}$$

while, because all firms are identical ($Ew_L = w_L$), the wage setting relation becomes:

$$WS = \frac{\gamma}{(1-\xi(u))(1-r(\tau))} + (1-\gamma)\varepsilon = 0, \tag{13}$$

with the first term denoting the economy-wide marginal income rent. The equilibrium of the host economy is thus given by (12) and (13), with the low skilled unemployment rate u and the contribution rate τ being the endogenous variables.

Proposition 1. *For every $r_0 < 1$, there exists at least one stable labor market equilibrium with some low skilled unemployment.*

Proof. (12) is continuously increasing in (u, τ)-space, with $\tau = 0$ if $u = 0$ and $\tau = 1$ when $u = 1$. (13) is a continuous function in the interval $[\underline{u}, 1]$, where $\underline{u}$ is the solution to $\gamma/(1 - \xi(\underline{u})) = -(1 - \gamma)\varepsilon$. Since $\xi(0) = 1$ and ε is finite for all $u < 1, \underline{u} > 0$. Along WS, we have $\tau = 1$ for $u = \underline{u}$ and $\tau < 1$ for $u = 1$. Therefore, at least one intersection of both curves in the interval $[\underline{u}, 1)$ must exist. □

While the welfare state budget establishes a stable positive link between the tax rate and the low skilled unemployment rate ($\frac{d\tau}{du}\big|_{BB} = -(dBB/du)/(dBB/d\tau) > 0$), the behavior of the wage setting relation turns out to depend on the elasticity of substitution:

$$\left.\frac{d\tau}{du}\right|_{WS} = -\frac{dWS/du}{dWS/d\tau} = \frac{\overbrace{\gamma\xi'(u)/[(1-\xi(u))^2(1-r(\tau))]}^{(<0)} + \overbrace{(1-\gamma)\partial\varepsilon/\partial u}^{\gtrless 0 \iff \rho \gtrless 0}}{\underbrace{-\gamma r'(\tau)/[(1-\xi(u))(1-r(\tau))^2]}_{(>0)}}. \quad (14)$$

When inputs are not close substitutes ($\rho \leq 0$), (14) is negative, implying the uniqueness of equilibrium. This is not ensured for $\rho > 0$, since $\partial\varepsilon/\partial u > 0$ may render the wage setting relation increasing in (u, τ)-space at least in a range. Nevertheless, as $r(1) = 0$ and $\varepsilon < -\gamma/(1 - \gamma)$, full unemployment is compatible only with a contribution rate smaller than unity. Therefore, WS crosses BB at least once from above in (u, τ)-space, establishing the existence of at least one stable equilibrium for all ρ. In what follows, we assume throughout that the economy is in such a stable equilibrium, which means that the determinant of the system:

$$|D| = \frac{\partial WS}{\partial u}\frac{\partial BB}{\partial \tau} - \frac{\partial BB}{\partial u}\frac{\partial WS}{\partial \tau}$$

has a positive sign. Only if this condition is fulfilled, will an increase in r_0 have the expected effect of reducing low skilled employment:

$$\frac{du}{dr_0} = \frac{1}{|D|}\frac{\gamma\, r(\tau)}{(1-\xi(u))(1-r(\tau))^2(1-\tau)\tau} \gtrless 0 \iff |D| \gtrless 0. \quad (15)$$

One interesting feature of the model is the existence of equilibrium unemployment even in the absence of a social safety net. This must be the case because, whatever the level of r_0, full employment implies the equality of bargained and alternative

earnings. However, this would generate an infinitely high marginal income rent which can never result from a wage setters' optimal choice, since the marginal employment rent is finite for $u = 0$.

Therefore, for $r_0 = 0$, the fraction $\underline{u}$ of low skilled, characterized by:

$$\frac{\gamma(1-(1-\pi)(1-u_0))}{(1-\gamma)u_0} = \frac{1+\frac{1-\alpha}{\alpha}\left(\frac{(1-u_0)(N_L+M_L)}{N_H+M_H}\right)^{\rho}}{1-\rho},$$

does not get a job in equilibrium. This minimum unemployment rate is the higher, the higher the degree of labor market turnover π and the more income matters in the wage bargain (the higher γ).

III. The Effects of Immigration

How do inflows of high and low skilled labor affect the host economy? This section answers this question in detail, distinguishing between the consequences on unemployment, the welfare state budget and the economic position of natives.

Labor Market Consequences

Starting with the employment effect of low skilled immigrants, differentiation of the system (12)-(13) with respect to M_L yields:

Proposition 2. *Low skilled immigration increases total low skilled employment and decreases the low skilled wage. It decreases (increases) the low skilled unemployment rate if and only if high and low skilled labor are close substitutes (complements).*

Proof. The second part of the proposition follows from Cramer's Rule:

$$\frac{du}{dM_L} = \frac{\overbrace{-\frac{\partial WS}{\partial M_L}}^{(\gtreqless 0 \iff \rho \gtreqless 0)}\overbrace{\frac{\partial BB}{\partial \tau}}^{(<0)} + \overbrace{\frac{\partial BB}{\partial M_L}}^{(\gtreqless 0 \iff \rho \gtreqless 0)}\overbrace{\frac{\partial WS}{\partial \tau}}^{(<0)}}{\underbrace{|D|}_{(>0)}} \lesseqgtr 0 \iff \rho \gtreqless 0. \tag{16}$$

The effect on total low skilled employment is thus:

$$\frac{dL}{dM_L} = (1-u) - \frac{du}{dM_L}(N_L + M_L), \tag{17}$$

which is positive if and only if $\frac{du}{dM_L} < (1-u)/(N_L+M_L)$. Using (16), this condition is equivalent to:

$$\underbrace{\frac{\partial WS}{\partial \tau}}_{(<0)}\left[\frac{\partial BB}{\partial M_L}+\frac{1-u}{N_L+M_L}\frac{\partial BB}{\partial u}\right] < \underbrace{\frac{\partial BB}{\partial \tau}}_{(<0)}\left[\frac{\partial WS}{\partial M_L}+\frac{1-u}{N_L+M_L}\frac{\partial WS}{\partial u}\right]. \qquad (18)$$

Since

$$\begin{aligned}\frac{\partial BB}{\partial M_L}+\frac{1-u}{N_L+M_L}\frac{\partial BB}{\partial u} &= \frac{1-u}{u^2(N_L+M_L)}\frac{\tau}{1-\tau}(1+\frac{\alpha}{1-\alpha}\left(\frac{H}{L}\right)^{\rho}) > 0,\\ \frac{\partial WS}{\partial M_L}+\frac{1-u}{N_L+M_L}\frac{\partial WS}{\partial u} &= \frac{\gamma\xi'(u)(1-u)}{(1-\xi(u))^2(1-r(\tau))(N_L+M_L)} < 0,\end{aligned}$$

(18) is always fulfilled. Because of (3), an employment increase must be accompanied by a wage decrease.□

The first part of the proposition is driven by the increase in the low skilled workers' pool. Putting a fiscal strain on the welfare state and diminishing the probability of getting a job outside the home sector, low skilled immigration reduces the marginal income rent. Wage setters with wage cuts raising total employment.[9] Thus, unlike a number of previous studies (Razin and Sadka, 1995, Schmidt et al., 1994), wages are flexible despite the presence of unemployment.

The strength of the employment effect, however, is determined by the production structure of the host economy. Consider as reference the Cobb-Douglas case ($\rho = 0$), where both (12) and (13) do not depend on the level of low skilled employment but only on the unemployment rate. Inspection of (12) shows that the effective replacement ratio can be sustained with a constant τ for a proportional employment increase. At the same time, that employment increase just balances marginal income and employment rents for a constant contribution rate. Hence both curves remain unaltered in (u,τ)-space and the equilibrium unemployment rate does not change.

When high and low skilled labor are close substitutes ($\rho > 0$), however, an increase in total low skilled employment decreases the high skilleds' income share and hence their relative fiscal contribution. As budget balance can be restored only by an increase in the contribution rate for a given unemployment rate, or, equivalently, by a more than proportional employment increase for given τ, this shifts the BB-curve upwards in (u,τ)-space. Moreover, the marginal employment rent becomes an

9 Adverse, but small effects of immigration on low skilled wages are found in a number of empirical studies, see, e.g. DeNew and Zimmermann (1994).

increasing function of the employment level ($\frac{d\varepsilon}{dM_L} < 0$), leading to a shift of the WS curve: for a proportional employment increase, the marginal income rent falls short of the marginal employment rent. Hence, marginal rents are equalized by a higher rise in employment. In a sense, low skilled immigrants reduce the relative price of employment in wage setters' objectives: The higher the degree of substitutability, the less income has to be sacrificed in order to achieve a given employment increase, and hence the more jobs are generated. For $\rho > 0$, the elasticity of low skilled labor is decreasing in total low skilled employment. Hence, employment increases can be created by smaller and smaller wage reductions, such that the terms of trade between income and employment shift continuously towards the latter.[10] Thus, the WS-curve shifts downward in (u, τ)-space, which reinforces the reduction in u brought about by the shift of BB. Note that either of the two shifts is sufficient for low skilled immigration to decrease the low skilled unemployment rate.

The less than proportional employment effect of low skilled immigration for $\rho < 0$ can be explained by the same line of reasoning. First, as the high skilled bear an increasing part of welfare state contributions, a less than proportional employment increase suffices to fulfill the budget balance restriction for given τ. Consequently, the BB-curve shifts downwards. Second, job creation becomes increasingly costly in terms of wage income as low skilled labor becomes less elastic, implying an upward shift of the WS-curve. Either shift generates a rise of the low skilled unemployment rate.

Turning to the effects of high skilled immigrants, we find:

Proposition 3. *An inflow of high skilled workers decreases (increases) total low skilled employment if and only if high and low skilled labor are close substitutes (complements).*

Proof. Total low skilled employment reacts according to:

$$\frac{dL}{dM_H} = -\frac{du}{dM_H}(N_L + M_L), \tag{19}$$

10 This finding differs significantly from a result derived by Schmidt et al. (1994), where native unemployment increases the less with immigration, the higher the degree of complementarity between high and low skilled labor. However, that result relies upon the assumption of the union being interested in the well being of the high skilled.

the sign of which is determined by:

$$\frac{du}{dM_H} = \frac{\overbrace{-\frac{\partial WS}{\partial M_H}}^{(\lessgtr 0 \iff \rho \gtrless 0)} \overbrace{\frac{\partial BB}{\partial \tau}}^{(<0)} + \overbrace{\frac{\partial BB}{\partial M_H}}^{(\lessgtr 0 \iff \rho \gtrless 0)} \overbrace{\frac{\partial WS}{\partial \tau}}^{(<0)}}{\underbrace{|D|}_{(>0)}} \gtrless 0 \iff \rho \gtrless 0. \square \tag{20}$$

The economic mechanisms behind this result resemble those presented above and are discussed in some detail for the case $\rho > 0$. The increase in high skilled employment makes the demand for low skilled labor less elastic. Thus low skilled employment becomes more costly in terms of income, raising wage demands for a given contribution rate. This upward shift of the WS-curve in (u, τ)-space is accompanied by a upward shift of BB: The new high skilled improve the fiscal condition of the welfare state, such that a higher number of low skilled unemployed can be catered for by a constant contribution rate. In total, the low skilled unemployment rate must rise, which implies lower total low skilled employment, as the total number of low skilled is constant. While the effects reverse for $\rho < 0$, both the WS and the BB-curve remain unaffected for the Cobb-Douglas technology, as both the wage markup and the fiscal condition depend on the low skilled unemployment rate only.

These insights have immediate implications for the effects of immigration on the native unemployment rate $uN_L/(N_L + N_H)$.

Corrolary 1. *When high and low skilled labor are close substitutes (complements), high skilled immigration increases (decreases) the native unemployment rate, while low skilled immigration decreases (increases) it.*

This is a consequence of the native unemployment rate being a linear transformation of the low skilled unemployment rate. Empirical studies, focussing mostly on the impact of low skilled immigrants on native unemployment, show no clear cut results. While Winkelmann and Zimmermann (1993) find a small negative effect for Germany and Hunt (1992) identifies a similar effect for France, such an effect seems to be absent in other countries like Austria (Winter-Ebmer and Zweimüller, 1997) and Spain (Dolado, Jimeno and Duce, 1996).[11]

11 Some contributions focus on the effects of low skilled immigration on the *economy-wide* rather than the native unemployment rate. Zimmermann (1995), e.g., finds a negative link between the two variables in a cross-section of countries. In the present setup, it is easy to show that the economy-wide unemployment rate must increase (decrease) when inputs are not close

Welfare State Consequences

Maybe surprisingly, the consequences for the contribution rate to the unemployment insurance scheme are less unambiguous than the employment effects:

Proposition 4. *For $\rho = 0$, the contribution rate is independent of either type of immigration. For $\rho \neq 0$, there exists a critical level of unemployment $\tilde{u} \in (0,1)$, such that low skilled immigration increases (decreases) the contribution rate for all $u < \tilde{u}$ when inputs are close substitutes (complements), while the contribution rate decreases (increases) for $u > \tilde{u}$:*

$$sign \frac{d\tau}{dM_L} = sign\ \rho\ [\tilde{u} - u]. \tag{21}$$

The opposite holds for high skilled immigration:

$$sign \frac{d\tau}{dM_H} = sign\ \rho\ [u - \tilde{u}]. \tag{22}$$

Proof. See Appendix.

The ambiguous behavior of the contribution rate is the result of differing relative strengths of the shifts of both wage setting and budget balance relations. When $\rho > 0$, the changing budgetary condition calls for a rise in τ, the extent of which decreases in the low skilled unemployment rate. Wage setters' reactions, however, imply a reduction of the tax rate, which is the stronger, the more the marginal employment rent is affected, that is, the higher is the low skilled unemployment rate. Hence the reduction of the tax rate when unemployment is high. For $\rho < 0$, the pattern reverses as wage setting implies an increase and the welfare state a reduction of τ.

This means that starting from a high employment equilibrium ($u > \tilde{u}$), small scale low skilled immigration reduces the tax rate for $\rho > 0$. However, as the unemployment rate declines, u may pass the critical level $\tilde{u}$ and the tax rate may increase again. Whether this is the case depends on whether $\tilde{u}$ exceeds the minimum unemployment rate $\underline{u}$, which in turn hinges on the degree of labor market turnover and

substitutes and immigration is low (high) skilled. This holds because immigration affects the proportion of the population subject to unemployment risk. For close substitutes, however, the change in the low skilled unemployment rate works against this compositional effect, making the overall impact ambiguous. Consistent with this, Gross (2002) detects a reduction of the French unemployment rate due to low skilled immigration.

trade union preferences. In a cross-section of countries, Razin, Sadka and Swagel (2003) find low skilled immigration to have a negative effect on the income tax rate and the level of social transfers. While that approach resorts to a politico-economic interpretation of this phenomenon, we provide an alternative explanation based on the existence of labor market distortions. In what follows, we will call unemployment high (low) if u is above (below) $\tilde{u}$.

Corrolary 2. *When inputs are close substitutes (complements), low skilled immigration decreases the relative size of the welfare state and increases the effective replacement ratio $r(\tau)$ if and only if unemployment is high (low).*

Proof. The share of GDP controlled by the government is:

$$\tau(w_L(1-u)(N_L+M_L)+w_H(N_H+M_H))/Y=\tau.$$

Hence, welfare state payments make up for a larger (smaller) fraction of GDP whenever the tax rate increases (decreases). Since $r'(\tau)<0$, the inverse relation holds for the effective replacement ratio. □

Thus, although low skilled immigrants do not "pay their way" because they are net beneficiaries of the social safety net (Borjas, 1994), they may induce welfare state adjustments that lead to both a better relative (but not absolute) protection of the unemployed and a lower government's share in GDP. Whether this is the case, depends both on the degree of labor market distortions and technology.

Income and Utility Consequences

The labor market consequences of immigration play a contentious role when assessing the impact on the economic position of natives. Since the seminal contribution by Berry and Soligo (1969), total native income is the most popular measure for the aggregate gain immigration provides for the host country.[12] We also use this measure, which amounts to:

$$\begin{aligned} TNI &= (1-\tau)w_H H+(1-u)(1-\tau)w_L N_L+ubN_L \\ &= w_H N_H+\frac{N_L}{N_L+M_L}w_L L+\tau w_H H\left[\frac{N_L}{N_L+M_L}-\frac{N_H}{N_H+M_H}\right]. \end{aligned} \quad (23)$$

12 See, e.g. Schmidt et al. (1994), Razin & Sadka (1995), Fuest & Thum (2000).

Total native income is the sum of native gross earnings plus immigrants' net fiscal contribution. The latter term is positive (negative) if and only if immigrants increase (decrease) the share of high skilled in the economy.

Proposition 5. *Marginal low (high) skilled immigration increases (decreases) total native income for close substitutes when the contribution rate is not too high. When high and low skilled labor are not close substitutes, marginal low (high) skilled immigration decreases (increases) total native income.*

Proof. The marginal effect of pure low skilled immigration on total native income is:

$$\begin{aligned}\frac{\partial TNI}{\partial M_L} &= \frac{\partial w_H}{\partial L}\frac{dL}{dM_L}N_H - \frac{N_L w_L L}{(N_L+M_L)^2} + \frac{N_L}{N_L+M_L}\left[\frac{\partial w_L}{\partial L}L + w_L\right]\frac{dL}{dM_L} \\ &\quad + H\left[\frac{N_L}{N_L+M_L} - \frac{N_H}{N_H+M_H}\right]\left[w_H H\frac{d\tau}{dM_L} + \tau\frac{\partial w_H}{\partial L}\frac{dL}{dM_L}N_H\right],\end{aligned}$$

which for $M_L = M_H = 0$ reduces to:

$$\frac{N_L w_L}{N_L+M_L}\left[\frac{\partial L}{\partial M_L} - (1-u)\right] - \frac{\tau w_H H N_L}{(N_L+M_L)^2}. \tag{24}$$

The second term is negative for $\tau > 0$ and zero for $\tau = 0$. The first term is positive (negative) for $\rho > (<) 0$. By continuity, the overall effect must be positive for $\rho > 0$ and some positive τ. The impact of a marginal high skilled immigrant is:

$$\tau w_H + w_L\frac{\partial L}{\partial H},$$

such that a negative effect on total native income emerges for $\tau = 0$ and $\rho > 0$. □

The first (marginal) low skilled immigrant exerts two effects on aggregate native income. First, he earns $w_L(1-u)$, his gross wage multiplied by the probability of getting a job and raises total production by $w_L\frac{\partial L}{\partial M_L}$. This marginal employment effect raises native factor earnings if and only if inputs are close substitutes. Second, he is a net fiscal beneficiary of the welfare state, distracting resources from the natives. However, this effect vanishes when $\tau = 0$ while the first one is positive; hence the overall impact must be positive when the tax rate is not too high. For high skilled immigration, the opposite holds: when the tax rate is sufficiently low, the net fiscal contribution is too low to compensate the reduction in low skilled employment.

We have thus identified situations where low skilled immigration increases total native income, although the host country suffers from unemployment. However, depending on the production structure, low skilled immigration can also be harmful for the natives, even though wages are flexible and fiscal redistribution is low or even absent ($\tau = 0$).[13]

These effects differ substantially from those obtained under full employment. In a setting formally comparable to the one presented here, Michael (2003) has shown that marginal immigration must have a negative effect on total native income/welfare when immigrants are net beneficiaries of the welfare state and the labor market is perfectly competitive.[14] The difference to the present result is easy to establish: under full employment, the marginal employment effect is necessarily zero such that only the fiscal redistribution effect is relevant.

While the above proposition was concerned with the effects of the marginal immigrant, the findings continue to hold for small scale immigration by continuity.[15] However, with a larger inflow, the picture becomes more complex. Depending on the evolution of factor supplies and the contribution rate, fiscal redistribution from natives to immigrants can increase or decrease. However, the complementarity between the inputs lets the average product of each factor exceed its marginal product, for which reason immigration of either type raises the remuneration of the other input at the expense of the own wage. Since immigrants bear the more of this wage decline the more enter the country, this factor remuneration effect adds to an overall positive effect for either type of immigration. While this is a finding well known from the analysis of full employment economies (see, e.g. Berry and Soligo, 1969), such models predict the total native gain from a given number of immigrants to be increasing in the degree of factor complementarity:[16] the factor remuneration effect, determining the overall impact, is the stronger, the higher the difference between the average and the marginal product of low skilled labor, that is, the degree of

13 Using wages as a proxy for income, some studies identify a negative overall effect of immigration on all natives (Hunt, 1992, DeNew and Zimmermann, 1994). However, Pischke and Velling (1994) arrive at just the opposite result.

14 See Michael (2003), proposition 1 for the case of no international capital mobility, which corresponds to the number of high skilled being fixed in the present model.

15 While high skilled migration is typically quite limited in size, also low skilled immigration seems to be much less than public opinion expects, see, e.g. Bauer and Zimmermann (1999) for the Eastern Enlargement of the European Union.

16 Berry and Soligo (1969), footnote 7, provide a first informal statement of this point based on the elasticity of labor demand. See also Borjas (1999), section 2.

input complementarity. This does not hold in the present setup: The labor market frictions generate a countervailing effect on employment probabilities reverting the qualitative relation between factor complementarity and native income gains for at least small scale immigration.

Of course, the public discussion about immigration policies is shaped not only by the effect on the natives in the aggregate. Rather, the distribution of the gains and losses among the population plays a decisive role, in particular when policies are subject to a vote (Benhabib, 1996). Therefore, we elaborate on the distributional consequences of immigration in detail.

Proposition 6. *The effects of immigration on a native's utility are in general ambiguous. However, high skilled natives gain (lose) unambiguously from low skilled immigration when inputs are close substitutes (complements) and unemployment is high (low). Moreover, low (high) skilled immigration can increase (decrease) the utility of each low skilled native, when inputs are close substitutes and effective social protection is low.*

Proof. Since the high skilled get a job with certainty, only the change in net income is decisive:

$$\frac{\partial I_H}{\partial M_i} = -\frac{d\tau}{dM_i} + (1-\tau)\frac{dw_H}{dM_i},$$

with $i \in L, H$. For low (high) skilled immigration, the second term is positive (negative), while the sign of the first term is given by Proposition 4. Let $V_L = (1-u)v((1-\tau)w_L) + u\,v(r(\tau)(1-\tau)w_L)$ denote expected low skilled utility. Then:

$$\begin{aligned}\frac{dV_L}{dM_i} &= \frac{du}{dM_i}\left[v(r(1-\tau)w_L) - v((1-\tau)w_L)\right] \\ &\quad + \left[(1-\tau)\frac{\partial w_L}{\partial L}\frac{dL}{dM_i} - \frac{d\tau}{dM_i}\right]\left[(1-u)v'((1-\tau)w_L) + uv'(r(1-\tau)w_L)\right] \\ &\quad + r'(\tau)(1-\tau)\frac{d\tau}{dM_i}uv'(r(1-\tau)w_L).\end{aligned}$$

To show that low (high) skilled immigration can make a native low skilled better (worse) off, apply a logarithmic utility function $v(I) = \log I$, simplifying the above derivative to:

$$\frac{dV_L}{dM_i} = \frac{du}{dM_i}\log r(\tau) - \frac{d\tau}{dM_i}\left[\frac{1}{1-\tau} - \frac{ur'(\tau)}{r(\tau)}\right] + \frac{1-u}{\varepsilon L} - \frac{du}{dM_i}\frac{1}{\varepsilon(1-u)}.$$

For $\rho > 0$ and $i = L$, the first term dominates when $r(\tau)$ is sufficiently low. Moreover, the second term is positive when unemployment is high. Since $sign\frac{du}{dM_H} = -sign\frac{du}{dM_L}$ and $sign\frac{d\tau}{dM_H} = -sign\frac{d\tau}{dM_L}$, native low skilled utility is decreasing in the number of high skilled immigrants under those conditions. □

For the native high skilled, two effects arise: on the one hand, the factor remuneration effect lets the gross wage increase or decrease, depending on whether immigration makes their own factor relatively more scarce or abundant. On the other hand, immigration affects the tax rate. This may either dampen or intensify the gross wage effect, making the overall effect unambiguous only for some constellations. While these arguments apply also to the low skilled, risk aversion introduces some additional influences to be considered: Then, utility is not determined only by expected income, but also by the distribution of income between the employed and the unemployed state and the probability to enter these states. Low skilled immigration influences all these parameters: it decreases the income in both states, it changes the relative distance between net wage and benefit and it affects the probability to become employed. The example presented in the proof of Proposition 5 shows that the latter effect has the potential to be dominant for $\rho > 0$. Then, low skilled immigration reduces the probability to end up unemployed, which more than compensates the loss of expected income whenever utility in the bad state of unemployment is very low.[17]

A substantial part of the public debate on immigration policies is affected by the positions of trade unions and employers. Therefore, we finally investigate the impact of immigration on the wage bargaining surplus.

Proposition 7. *For the Cobb-Douglas technology, low (high) skilled immigration increases (decreases) the wage bargaining surplus. The same holds for close substitutability (complementarity), if unemployment is high (low).*

Proof. Differentiate (4) with respect to M_i and M_H, respectively and use (13) to get:

$$\frac{\partial \Omega}{\partial M_i} = -\frac{\gamma}{(1-\tau)w_L(1-\xi(u))(1-r(\tau))}\left[\frac{d\tau}{dM_i} + \frac{d\bar{w}}{dM_i}\right].\square$$

17 While the proof has relied on logarithmic utility and benefits approaching zero, the same argument could be made for Stone-Geary preferences with benefits coming close enough to the subsistence level.

In their bargains, wage setters fail to internalize the effects immigration has on both the contribution rate and the alternative wage. A decrease of the alternative wage worsens the outside option, such that a given net wage provides a higher income surplus. The same is true for a lower contribution rate. Thus, for economies with close factor substitutability (complementarity) and high (low) unemployment rates, wage setters must benefit from low skilled immigration, whereas an inflow of high skilled labor provides them with a lower surplus.

We can thus conclude that in the empirically corrobated scenario of a close substitutability between factors, low skilled immigration can be Pareto-improving: when unemployment is high ($u > \tilde{u}$) and the contribution rate is not too high, both the high and the low skilled natives as well as the wage setters can be better off. Under the same conditions, high skilled immigration would have adverse consequences on all natives. It should be emphasized that the possibility of Pareto-improving or deteriorating immigration does not arise despite, but *because* of the existence of unemployment. Low skilled immigration provides gains for the low skilled only if employment rises more than proportionally. But in an economy with full employment, low skilled immigration is bound to have just a proportional employment effect. As a consequence, the native low skilled must be harmed by the wage decrease induced by stronger labor market competition.

IV. Conclusion

This contribution has shown that the effects of immigration to a host country with labor market frictions depend crucially on the production structure. For the empirically more relevant case of high and low skilled labor being close substitutes, low skilled immigration is found to boost employment. Then, the low skilled unemployment rate falls, the total income accruing to natives increases, and the gains may be distributed in a Pareto-improving way. High skilled immigrants, however, encourage wage demands such that low skilled employment declines and natives as a whole can get worse off. As a consequence, this paper puts some caution on the conventional wisdom that high skilled immigration is preferable to low skilled immigration.

The findings of the paper can readily be applied to the case of emigration: For a small-sized welfare state, low skilled emigration decreases the total income of those left behind, while high skilled emigration has a positive aggregate effect. Hence, the

paper provides an explanation for positive effects of a brain drain, complementary to studies emphasizing positive effects on skill formation (Mountford, 1997). With migration flows being influenced by earnings differentials, however, increased mobility of the high skilled has much more mixed consequences: It is easy to devise of a situation where the migration of high skilled hurts both the high tax home country because of the loss in fiscal contributions, and the low tax host country because of an increase in low skilled unemployment. An analogous reasoning holds for low skilled migration from low to high redistribution countries.

Basically, all results continue to hold under some other welfare state designs like a constant contribution rate or a constant net replacement rate policy.[18] Also, the analysis is not really affected when assuming that unions are interested only in the employment of natives: Proposition 1 to 6 continue to hold. The only change refers to Proposition 7, where the wage decline is not fully offset by the employment increase, such that wage setters may be worse off from low skilled immigration in the presence of close substitutability. However, it should be stressed that the wage negotiation surplus comprises the interests of both trade unions and firms, where the latter should be interested in total and not native employment. Also, once immigrants have entered, trade unions have quite an interest to represent them in order not to lose coverage and bargaining power.

The model has neglected physical capital which amounts to presuming perfect international capital mobility. With the interest rate pegged fixed, the above production function can be regarded as the reduced form of a production function including physical capital. Alternatively, one could reinterpret human capital as physical capital (Berry and Soligo, 1969, Benhabib, 1996), such that effects are driven by the elasticity of substitution between capital and labor. On a qualitative basis, all results remain valid, the only exception being the distributional analysis. Then, the net economic position of a native would depend on his relative endowment with physical capital. However, the possibility of low skilled immigration creating a Pareto-improvement is unaffected by this reinterpretation.[19]

18 However, note that the latter policy obscures the interaction between the welfare state and low skilled employment, as the number of jobs would not depend on the contribution rate in that very special case (Pissarides, 1998). Moreover, the labor market equilibrium would lose its stability property for close substitutes. This nonwithstanding, the major difference to the results presented above would be that the effects on the tax rate would be determined only by shifts in the budget balance curve.

19 Actually, the congruence of personal and functional income distribution as presumed above is the most unfavorable setting to achieve such an improvement.

Native factor supplies were considered fixed. In a recent contribution, Casarico and Devillanova (2003) argue that increases in the skill premium driven by low skilled immigration create incentives to invest in education, thereby explaining the small effects of immigration on wages and employment reported by a number of empirical studies. The present approach adopts a rather pessimistic stance with respect to educational adjustments. Nevertheless, beneficial effects for the natives are possible here as well. Extensions of the model along the lines pursued by Casarico and Devillanova (2003) are straightforward.

Appendix

Proof of Proposition 3. Differentiation of the system (12)-(13) with respect to M_L yields:

$$\frac{d\tau}{dM_L} = \frac{\tau}{1-\tau}\frac{1-u}{u^2}\frac{\gamma\varepsilon}{(N_L+M_L)\,|D|} \rho\left[-\frac{\alpha}{1-\alpha}\left(\frac{N_H+M_H}{(1-u)(N_L+M_L)}\right)^{\rho}\frac{\pi(1-u)}{1-(1-\pi)(1-u)}+1\right]. \quad (25)$$

Thus, $\frac{d\tau}{dM_L}$ has a local extremum for $\tilde{u}$, implicitly defined by:

$$\frac{\alpha}{1-\alpha}\left(\frac{N_H+M_H}{(1-\tilde{u})(N_L+M_L)}\right)^{\rho}\frac{\pi(1-\tilde{u})}{1-(1-\pi)(1-\tilde{u})}=1. \quad (26)$$

Note, that all possible solutions to (26) imply an unemployment rate of less than 100%. The derivative of the term in square brackets in (25) is:

$$\frac{\alpha/(1-\alpha)\pi}{1-(1-\pi)(1-u)}\left(\frac{N_H+M_H}{(1-u)(N_L+M_L)}\right)^{\rho}\left[-\rho+\frac{1}{1-(1-\pi)(1-u)}\right]>0.$$

Consequently, $\frac{d\tau}{dM_L}$ is strictly convex or concave in u, depending on whether ρ is positive or negative. Therefore, the solution to (26) is unique, and $\tilde{u}$ is a minimum (maximum) of $\frac{d\tau}{dM_L}$ when inputs are close substitutes (complements). Since:

$$\frac{d\tau}{dM_H} = \frac{\tau}{1-\tau}\frac{1-u}{u^2}\frac{\gamma\varepsilon}{(N_L+M_L)\,|D|} \rho\left[\frac{\alpha}{1-\alpha}\left(\frac{N_H+M_H}{(1-u)(N_L+M_L)}\right)^{\rho}\frac{\pi(1-u)}{1-(1-\pi)(1-u)}-1\right], \quad (27)$$

opposite effects emerge for high skilled immigration.□

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