

Immigration, Unemployment and Pensions

*Alexander Kemnitz**

University of Mannheim, D-68131 Mannheim, Germany
kemnitz@econ.uni-mannheim.de

Abstract

This paper examines the impact of immigration on a host country with welfare state arrangements that support both the unemployed and the elderly. It is shown that low-skilled immigration increases the unemployment rate. Furthermore, it harms the low-skilled native population and benefits the high-skilled natives and pensioners. Nevertheless, as under competitive labor markets, immigration generates an unambiguous gain for the native population as a whole. However, in contrast to the findings under full employment, this gain can be dampened by an expansion of the pension system.

Keywords: Immigration; trade union; unemployment; pension; social security

JEL classification: F22; H55; J51; J61

I. Introduction

By now it is well understood that the aging of the populations in most industrialized countries threatens the sustainability of various parts of the welfare state, especially pension systems organized on a pay-as-you-go (PAYG) basis. One increasingly debated response to this problem is to open up the borders for international migration. The rationale behind this proposal is straightforward: as immigrants to industrialized countries typically display a much younger age structure than the host countries' populations, financing problems are alleviated by improving the old-age dependency ratio. Indeed, Razin and Sadka (2000) have shown that in an economy with PAYG pensions, immigration can be beneficial to all residents. This gives rise to the presumption that the existence of public pensions favors a larger inflow of foreign workers or, put differently, that a PAYG pension scheme generates original gains from immigration.

*Earlier versions have been presented at the Universities of Bonn, Mannheim and Munich, the Ruhrgas seminar on "Economics of Social Policy", Berlin, and the Annual Meetings of the European Association of Labor Economics, Jyväskylä, and the German Economic Association, Magdeburg. I would like to thank the participants at these seminars, Clemens Fuest, Volker Meier, Bernd Raffelhüschen, Marcel Thum and two anonymous referees for helpful comments and discussions. Financial support from the Ruhrgas Foundation is gratefully acknowledged.

However, the above analysis presupposes the existence of competitive labor markets.¹ This feature appears neither realistic nor innocuous, since many immigrants are low skilled, thereby facing a higher risk of becoming unemployed and relying on the welfare state; see e.g. Borjas (1994b) for empirical evidence from the US. Furthermore, a number of theoretical studies find that the effects of immigration under malfunctioning labor markets can deviate significantly from those obtained under full employment.² However, as wage incomes are the primary source of financing for public pension systems, labor-market effects are of particular relevance.

It is therefore the aim of this paper to assess the relation between social security and immigration in a framework of non-competitive labor markets. We consider a model where wages are set by trade unions to an above-competitive level, thereby generating unemployment. The social security system supports both the unemployed and the elderly and is financed by taxing labor income at fixed contribution rates.

The results are as follows. Low-skilled immigration decreases economy-wide per capita income and raises the unemployment rate. Furthermore, it splits the native population into two groups: high-skilled individuals and pensioners gain, while the low-skilled lose. Nevertheless, as in a fully competitive economy, immigration generates a gain to the native population as a whole: the total income accruing to the natives increases. This effect emerges irrespective of whether a PAYG pension or an unemployment insurance system is in place or not, and even though unemployment is relatively higher for immigrants than for natives. However, the pension scheme has an ambiguous effect on the gain from immigration. In the presence of unemployment, the PAYG system fosters the desirability of immigration only up to a certain critical level of labor inflow, and subsequently discourages it. Public pensions may thus serve to support small-scale immigration, but constitute a counterargument to large-scale immigration. The critical immigration level is lower, the higher is the contribution rate to the pension system.

Two basic mechanisms are responsible for these results. First, in the monopoly union model, wages are flexible and reflect the marginal productivity

¹Of course, Razin and Sadka (2000) make further assumptions which render immigration Pareto-improving, namely that capital is perfectly mobile and that educational decisions are not distorted. These assumptions also hold in our model.

²The standard reference on the positive effect of immigration under competitive labor markets is Berry and Soligo (1969). Ambiguous or negative effects of immigration to economies with labor-market distortions are reported by e.g. Schmidt, Stilz and Zimmermann (1994), Razin and Sadka (1995) and Fuest and Thum (2000). However, it is not true that immigration is necessarily harmful for host countries which suffer from unemployment. Apart from the findings derived below, Ortega (2000) has shown that immigration is Pareto-improving in the setting of a two-country labor-matching economy.

of labor. Consequently, as under full employment, cf. Berry and Soligo (1969), the increase in remuneration to the high skilled more than offsets the reduction in low-skilled wages. Second, by imposing an additional fiscal burden on labor, the PAYG pension system contributes—albeit indirectly—to unemployment. Thus, it decreases the economic gains from admitting a given number of immigrants.

The paper is organized as follows. The next section introduces the basic features of the model and derives the equilibrium for a given level of immigrants. Section III turns to the distributional and macroeconomic analysis of this equilibrium. Section IV is devoted to the impact of the pension scheme. Section V concludes.

II. The Model

Consider an economy where people work in the first period of life and retire in the second. The economy is small and has access to the international capital market, where the exogenous interest factor R prevails. We distinguish between two types of labor in the production process: high skilled and low skilled. Residents may choose to become high-skilled workers by investing in education. The native population of size N is immobile, yet, in the period considered here, workers may immigrate from other countries. Consequently, the arrival of M immigrants increases the total population to $N + M$.

All of these immigrants are assumed to be low skilled, although identical to the natives in all other respects, including fertility and the ability of their offspring to invest in skills. Thus, there is no reason for labor-market discrimination. This admittedly simplifying assumption is in line with the literature and serves as a useful starting point for the analysis; see Schmidt *et al.* (1994) and Fuest and Thum (2000). Furthermore, immigration is unexpected in the sense that the host population can neither anticipate nor respond to the inflow of low-skilled labor. This assumption highlights potentially negative effects of immigration by acknowledging the fact that in general many of the low skilled, especially those who are older, are unable to revise their educational decisions in response to changing labor-market conditions.

The sequence of events is as follows.³ First, residents choose whether to invest in education. Second, immigration takes place. Then, wages and

³Owing to the perfect integration of immigrants' offspring and the constant-returns-to-scale production function, the economy displays no dynamics. Immigration matters only in the period in which it occurs. Therefore, we can concentrate on the equilibrium of that period and omit time subscripts. A fully fledged OLG formulation would introduce additional formalism, but yield identical results.

employment are determined, and social security benefits adjust to balance the respective budgets.

Wage Bargaining and Social Security

Given perfect capital mobility, the production function of the representative firm can be written in reduced form as a function of high- and low-skilled labor H and L only.⁴ For convenience, we assume a Cobb–Douglas, constant-returns-to-scale technology:

$$Y = H^\alpha L^{1-\alpha}.$$

Wages are exogenous for the firm, so it adjusts its labor inputs according to the marginal productivity conditions:

$$\frac{\partial Y}{\partial H} = \alpha H^{\alpha-1} L^{1-\alpha} = w_H, \quad (1)$$

$$\frac{\partial Y}{\partial L} = (1 - \alpha) H^\alpha L^{-\alpha} = w_L. \quad (2)$$

In the competitive high-skilled labor market, the wage w_H adjusts to equal demand and (at this stage fixed) supply, so all high skilled become employed. Low-skilled labor, however, is represented by trade unions which operate at the firm level in order to maximize their members' utility. For simplicity, we assume that the union takes into consideration the interest of all N_L low skilled, regardless of whether they are natives or immigrants.⁵ Furthermore, utility is linear in income.⁶

For an employed member, net labor income is $(1 - \tau - c)w_L$, where w_L is the gross low-skilled wage, $\tau \geq 0$ and $c \geq 0$, $\tau + c < 1$ denote the contribution rates to the unemployment insurance and pension systems,

⁴Implicitly, we assume that all production factors are hired simultaneously. All our results could be reproduced by considering a more complicated setting *à la* Hoel and Moene (1988), where firms first choose the levels of physical capital and high-skilled labor, and then bargain over the low-skilled wage.

⁵This assumption could be dispensed with and the results would not change: maximizing the expected income of a native low skilled amounts to $\max_{w_L} L/N_L((1 - \tau - c)w_L - b) + \bar{C}$, leading to (4) as well.

⁶This assumption is not only standard in the literature, as in Schmidt *et al.* (1994) and Fuest and Thum (2000), but can also be justified as follows. Let individuals be characterized by an expected utility function with CES utility over consumption in both periods. As individuals determine their savings after they have become employed or not, utility in each state is linear in income. Thus, except for a scaling factor, expected utility and expected income coincide.

respectively.⁷ The unemployed receive unemployment support b . Thus, the maximization problem of the (representative) union corresponds to:⁸

$$\max_{w_L} L((1 - \tau - c)w_L - b) + C, \quad (3)$$

subject to the labor demand curve defined by (2), where C is a constant encompassing the reference utility $b \cdot N_L$ and future pension benefits.⁹ This gives:

$$(1 - \alpha)(1 - \tau - c)w_L = b. \quad (4)$$

The union chooses the wage w_L such that the gross wage is a constant markup on the unemployment benefit. These benefits are financed by levying wages. Assuming that only low-skilled workers contribute to the system, as they are the only group exposed to the problem of becoming unemployed (see footnote 10), we arrive at the budget constraint:

$$b(N_L - L) = \tau w_L L. \quad (5)$$

In equilibrium, (4) and (5) must hold simultaneously. Solving directly for employment, we get

$$L = (1 - \alpha)(1 - \tau - c)/(\tau + (1 - \alpha)(1 - \tau - c))N_L,$$

and thus:

Proposition 1. *Low-skilled employment L is a constant fraction:*

$$\varphi(\tau, c) = \frac{(1 - \alpha)(1 - \tau - c)}{\tau + (1 - \alpha)(1 - \tau - c)} \quad (6)$$

of the total low-skilled labor force N_L , with this fraction determined by the contribution rates to the social security system.

The intuition behind this result is as follows. For given contribution rates, the budget constraint (5) implies that the ratio of employed to unemployed is a constant fraction of the gross wage and the unemployment benefit. However, by (4), this fraction is constant due to the constant elasticity of the Cobb–Douglas production function. Thus, the ratio of employed to

⁷When $c = 0$, the economy has a fully funded pension system.

⁸To simplify matters, we use the standard monopoly union model of wage determination; see Dunlop (1944). All of the following results are qualitatively unaffected by considering either the more general right-to-manage bargaining model of Layard and Nickell (1986) or Stone–Geary preferences over wages and employment; see Pencavel (1984).

⁹It is straightforward to show that these benefits have no effect on wage setting.

unemployed and hence relative employment is determined by the contribution rates only.

As might be expected, a *ceteris paribus* increase of the contribution rate to the unemployment insurance system decreases employment:

$$\varphi_\tau = -\frac{(1-\alpha)(1-c)}{(\tau + (1-\alpha)(1-\tau-c))^2} < 0.$$

The same is true for the pension contribution rate:

$$\varphi_c = -\frac{(1-\alpha)\tau}{(\tau + (1-\alpha)(1-\tau-c))^2}, \quad (7)$$

provided that τ is positive. This caveat holds because unemployment insurance is the primary source for unemployment: for $\tau=0$ we have $b=0$ and hence $\varphi(\tau,c)=1$. But when the unemployment insurance scheme is in effect, a higher contribution rate depresses the gross wage in (4), so that for a given unemployment benefit, the union demands a higher net wage. This behavior is a consequence of the fact that unemployment benefits are not subject to social security contributions, a feature confirmed by Daveri and Tabellini (2000) for many OECD countries.

The fact that $\varphi(\tau,c)=1$ for $\tau=0$ also implies that our formulation nests the special case of fully competitive labor markets. This facilitates identification of the labor-market consequences of the welfare state.¹⁰ From the above findings, it is straightforward to determine the wages and the unemployment support:

$$w_L = (1-\alpha)\varphi(\tau,c)^{-\alpha} \left(\frac{H}{N_L} \right)^\alpha, \quad (8)$$

$$b = (1-\alpha)^2(1-\tau-c)\varphi(\tau,c)^{-\alpha} \left(\frac{H}{N_L} \right)^\alpha, \quad (9)$$

$$w_H = \alpha\varphi(\tau,c)^{1-\alpha} \left(\frac{H}{N_L} \right)^{\alpha-1}, \quad (10)$$

Thus, the economy displays wage flexibility despite the presence of unemployment. This differs from the analyses of both Razin and Sadka (1995), who assume rigid wages, and Schmidt *et al.* (1994). In the latter

¹⁰Taxing the high skilled at the rate $\gamma\tau$, $\gamma \geq 0$ to support the unemployment insurance scheme would lead to a qualitatively equivalent result:

$$L = \frac{(1-\alpha)^2(1-\tau-c)}{(1-(1-\gamma)\alpha)\tau + (1-\alpha)^2(1-\tau-c)} N_L.$$

model, the wage set by a wage-bill maximizing union is not affected by the amount of labor available. Our result differs because we assume a balanced unemployment insurance system. Hence, benefits have to be adjusted in response to changing labor-market conditions. In Schmidt *et al.* (1994), in contrast, the unemployment insurance scheme runs a surplus that simply diminishes with higher unemployment.

The pension system distributes total contributions $cw_L L + cw_H H = cY$ as a demogrant:¹¹ $p = cY/N$. Since immigration is treated as an exogenous, unanticipated event which takes place between educational investment and wage negotiations, we can proceed to the educational decision problem.

Educational Choice

At the beginning of the period, residents can decide whether to invest in education and become high skilled or to remain low skilled. As in Razin and Sadka (2000), investment in education requires time: all individuals have to spend a fraction e of their working life to acquire skills.¹² Whether investment in education is worthwhile or not depends on the comparison of earnings.¹³ While a high skilled earns $(1 - c)w_H(1 - e)$, a low skilled expects to receive $\pi(1 - \tau - c)w_L + (1 - \pi)b$, where $\pi = L/N_L = \varphi(\tau, c)$ denotes the probability of becoming employed, which is the same for all low skilled.

The fraction of natives investing in education, x , is determined as follows. Because the inflow of low-skilled labor is not anticipated, education is deemed profitable until lifetime incomes equalize in the absence of immigration, that is, for xN high- and $(1 - x)N$ low-skilled individuals. Then, effective labor supplies are $\varphi(\tau, c)(1 - x)N$ and $(1 - e)xN$, respectively. From this, we get:

Proposition 2. *The welfare state does not distort educational decisions. The fraction of people who invest in education is independent of τ and c : $x = \alpha$.*

This result is easily established by equalizing lifetime incomes and using (1) and (2). It obtains because of the balance between two countervailing

¹¹This is a common assumption in the literature on migration and pensions, see e.g. Razin and Sadka (2000) and Casarico and Devillanova (2001), and does not affect the qualitative results. It is easy to check that a pension system where benefits are proportional to former income alters neither the unions' behavior nor educational choices.

¹²Differences in talents or abilities could be introduced without affecting the results.

¹³Again, it is straightforward to see that the pensions received are irrelevant for educational choices.

effects: increasing τ and/or c raises not only the relative wage of the low skilled, but also the probability of not getting a job. As both effects precisely offset each other, the welfare state leaves investment in education unaffected.

III. The Effects of Immigration

Let us now consider the effects on the macroeconomic variables per capita income:

$$y = \frac{\varphi(\tau, c)((1 - \alpha)N + M)}{N + M} \left(\frac{\alpha(1 - e)N}{(1 - \alpha)N + M} \right)^\alpha$$

and the unemployment rate:

$$\phi = \frac{(1 - \varphi(\tau, c))((1 - \alpha)N + M)}{N + M}$$

to get:

Proposition 3. *Immigration decreases economy-wide per capita income, and increases the economy-wide unemployment rate.*

This follows immediately from differentiating the above expressions. The intuition for the decrease in per capita income is as follows. The welfare state does not distort educational investments, thus $x = \alpha$ maximizes per capita income. Unexpected immigration distorts relative factor supplies from the efficient level, and per capita income declines.

The higher unemployment rate results despite the constancy of the employment probabilities for both high and low skilled. It is caused by a composition effect. Immigration increases the share of the population exposed to the risk of unemployment; the fraction of immigrants relying on unemployment benefits is $\varphi(\tau, c)$, while it is only $(1 - \alpha)\varphi(\tau, c)$ for the natives. The model is therefore also consistent with empirical findings of higher welfare-state participation on the part of immigrants; see Borjas (1994b). Although overall evidence is mixed, a number of empirical studies support our positive relation between the unemployment rate and the number of immigrants; see Borjas (1994a) and Zimmermann (1995). Furthermore, in accordance with most studies, the unemployment effects are small. A 1 percent increase in immigration increases the unemployment rate by less than 1 percent:

$$\partial\phi/\partial M \cdot M/\phi = \alpha M/((1 - \alpha)N + M) < 1.$$

With respect to the effects of immigration on the income of the natives, we discuss the distributional consequences first. As immigrants influence neither educational decisions nor future pensions, they exert only relative wage effects:

$$\frac{\partial w_L}{\partial M} = \frac{-\alpha(1-\alpha)\varphi(\tau, c)^{-\alpha}}{(1-\alpha)N + M} \left(\frac{\alpha(1-e)N}{(1-\alpha)N + M} \right)^{\alpha} < 0 \quad (11)$$

$$\frac{\partial w_H}{\partial M} = \frac{\alpha(1-\alpha)\varphi(\tau, c)^{1-\alpha}}{(1-\alpha)N + M} \left(\frac{\alpha N}{(1-\alpha)N + M} \right)^{\alpha-1} > 0. \quad (12)$$

For further reference, it is helpful to calculate the following relation between the two effects:

$$(1-e)\alpha N \frac{\partial w_H}{\partial M} = -\varphi(\tau, c)((1-\alpha)N + M) \frac{\partial w_L}{\partial M}. \quad (13)$$

Consideration of (11) and (12) leads us to:

Proposition 4. *Immigration benefits the high skilled and pensioners, and harms the low skilled.*

This holds because the after-tax wage income of the high skilled $(1-c)w_H(1-e)$ is increasing in M , due to $\partial w_H/\partial M > 0$. The opposite is true for the low skilled, since their wage declines: both the after-tax wage income of the employed $(1-\tau-c)w_L$ and the unemployment benefit $b = \varphi(\tau, c)/(1-\varphi(\tau, c)) \cdot \tau w_L$ decrease in M . Both effects are in line with empirical evidence, although the latter is not undisputed; see Borjas (1994a).

Next, the marginal impact on a pensioner amounts to:

$$\frac{\partial p}{\partial M} = c \frac{\varphi(\tau, c)w_L}{N}. \quad (14)$$

This can be explained as follows. Per capita pension benefits are a constant fraction of total output, divided by the fixed number of pensioners. An additional immigrant increases total output by his marginal product, which amounts to $\varphi(\tau, c)w_L$, his wage multiplied by the probability that he becomes employed.

Thus immigration creates a distributional conflict within the resident population: the natives holding the factor which becomes more scarce

gain, while those holding the factor which becomes more abundant lose. This is caused by the flexibility of wages and is reminiscent of the effects under competitive labor-market conditions.¹⁴ Moreover, the group of pensioners unambiguously gains from admitting foreign workers.

The distributional analysis is certainly helpful in assessing the economic and political desirability of immigration policies; see e.g. Benhabib (1996). However, the theoretical literature usually focuses on the *total* income of natives.¹⁵ Adding up the incomes of the various native groups yields:

$$NI = \underbrace{(1 - e)\alpha Nw_H + \varphi(\tau, c)(1 - \alpha)Nw_L}_{NGW} + \underbrace{c\varphi(\tau, c)Mw_L}_{IPC}. \quad (15)$$

Total native income consists of the gross wage earnings of both high- and low-skilled natives (native gross wages, *NGW*) and the contribution of migrant workers to the pension system (immigrant pension contributions, *IPC*). This results from the fact that some of the redistributive flows offset each other. First, there is no fiscal redistribution between high- and low-skilled workers. Owing to this and the absence of labor-market discrimination, the unemployment assistance system does not redistribute between native and foreign workers. Second, all native pension contributions also accrue to the natives. However, the number of low-skilled contributors has increased by the number of immigrants.

Differentiating (15) with respect to M , we get:

$$\frac{\partial NI}{\partial M} = \underbrace{(1 - e)\alpha N \frac{\partial w_H}{\partial M} + (1 - \alpha)N\varphi(\tau, c) \frac{\partial w_L}{\partial M}}_{\partial NGW / \partial M} + \underbrace{c\varphi(\tau, c) \left(w_L + \frac{\partial w_L}{\partial M} M \right)}_{\partial IPC / \partial M}. \quad (16)$$

Hence, there are two channels through which immigration affects total native income: first, native gross wages, and second, immigrants' contributions to the PAYG scheme. The first effect is always non-negative, as can be seen from using (13):

¹⁴See e.g. Berry and Soligo (1969). These distributional effects are examined under various migration scenarios by Casarico and Devillanova (2001). These effects are absent in Razin and Sadka (2000), where high- and low-skilled labor are perfect substitutes and capital mobility renders the wage rate constant.

¹⁵See e.g. Schmidt *et al.* (1994), Razin and Sadka (1995) and Fuest and Thum (2000). This focus need not only be due to efficiency motives (provided, of course, that proper redistribution devices exist) or utilitarian considerations. It can also be justified from a politico-economic perspective along the lines of Coughlin's (1986) work on probabilistic voting theory.

$$\frac{\partial NGW}{\partial M} = \frac{(1-e)\alpha NM}{(1-\alpha)N+M} \frac{\partial w_H}{\partial M} \left\{ \begin{matrix} > \\ = \end{matrix} \right\} 0 \Leftrightarrow M \left\{ \begin{matrix} > \\ = \end{matrix} \right\} 0.$$

For the first marginal immigrant, the increase in the income of the high skilled corresponds to the decrease in the income of the low skilled. For further immigration, the net effect is positive. Despite the distortion in employment level, this result holds because low-skilled labor is paid its marginal product. As the marginal product falls short of the average product, increasing low-skilled labor by means of immigration redistributes in favor of the high skilled; see Proposition 4. The gains from this redistribution accrue completely to the natives, while for $M > 0$ the costs are borne partially by immigrants.¹⁶ Thus, the gross wage effect is stronger, the more sensible is the reaction of the high-skilled wage (the larger $\partial w_H / \partial M$).¹⁷

The immigrant-contribution effect is positive, provided that $c > 0$:

$$\frac{\partial IPC}{\partial M} = cw_L \left[1 - \frac{\alpha M}{(1-\alpha)N+M} \right] \left\{ \begin{matrix} > \\ = \end{matrix} \right\} 0 \Leftrightarrow c \left\{ \begin{matrix} > \\ = \end{matrix} \right\} 0. \quad (17)$$

This result holds because higher employment increases the wage bill, as the union chooses a wage in the elastic part of the labor demand curve; see Schmidt *et al.* (1994).¹⁸ A positive fiscal-contribution effect of immigration is reported in a number of quantitative studies; cf. Bonin, Raffelhüschen and Walliser (2000) or Storesletten (2000).

As both the gross wage and the immigrant-contribution effect are always non-negative, we can establish:

Proposition 5. *For every τ , $c \geq 0$, $\tau + c < 1$, marginal immigration ($M=0$) never decreases and infra-marginal immigration ($M > 0$) always increases total native income.*

¹⁶The relative wage effects net out when all workers are considered; see (13).

¹⁷This finding is related to the results in Fuest and Thum (2000), who consider an economy with a unionized and a competitive sector, where the latter serves as the outside option for wage bargaining in the unionized sector. They find that their effects of immigration coincide with the *laissez-faire* effects only if labor demand is equally elastic in both sectors. A similar condition holds in our model: the unemployment benefit, which is the outside option here, displays the same elasticity as labor demand.

¹⁸For the Cobb–Douglas production function, low-skilled labor demand is elastic everywhere. Thus, the immigrant-contribution effect is necessarily positive in our model.

IV. Pensions and the Desirability of Immigration

We now address the impact of the PAYG system on the assessment of immigration policies. Proposition 5 implies that despite the presence of unemployment, low-skilled immigration is positive for the native population as a whole. With the exception of the first marginal immigrant, this positive effect does not hinge on the existence of the PAYG system, but also arises in a fully funded economy. Thus, the pension scheme has no qualitative positive effect on the desirability of immigration.

But what about the quantitative effects? Does the pension scheme always increase the generally positive gains from immigration? Differentiation of (16) with respect to c :

$$\frac{\partial^2 NI}{\partial M \partial c} = (1-e)^\alpha \alpha^\alpha (1-\alpha)^2 ((1-\alpha)N + M)^{\alpha-1} \times [\varphi(\tau, c)^{-\alpha} \varphi_c(\alpha M + c(1-\alpha)N) + \varphi(\tau, c)^{1-\alpha}], \quad (18)$$

and examination of the term in square brackets using (7) leads to:

$$\frac{\partial^2 NI}{\partial M \partial c} \underset{<}{>} 0 \leftrightarrow M \underset{<}{>} \tilde{M} = \frac{(1-\tau-c)(\tau + (1-\alpha)(1-\tau-c) - \tau c(1-\alpha))}{\tau \alpha} N,$$

and, thus:

Proposition 6. *For a full-employment economy ($\tau = 0$), the marginal gain from immigration is increasing in the pension contribution rate. In the presence of unemployment ($\tau > 0$), however, the marginal benefit from immigration is increasing in the pension contribution rate only if the number of immigrants is sufficiently small.*

The economic forces behind this result are as follows. For $\tau > 0$, a higher contribution rate dampens the gross wage effect: the higher the contribution rate c , the lower is low-skilled employment and the less scarce is high-skilled labor. Owing to diminishing marginal productivities, the increase in high-skilled wages becomes smaller. Second, in the presence of unemployment, the immigrant-contribution effect is only increasing in c when the contribution rate is not too high. Differentiating (17) with respect to c yields:

$$\frac{\partial^2 IPC}{\partial M \partial c} = \left[1 - \frac{\alpha M}{(1-\alpha)N + M} \right] (1-\alpha) \varphi_c \varphi(\tau, c)^{-\alpha} \left(c + \frac{\varphi(\tau, c)}{(1-\alpha) \varphi_c} \right)$$

and, hence:

$$\frac{\partial^2 IPC}{\partial M \partial c} \underset{<}{>} 0 \leftrightarrow c - \frac{(1 - \tau - c)(\tau + (1 - \alpha)(1 - \tau - c))}{\tau(1 - \alpha)} \underset{>}{<} 0. \quad (19)$$

The LHS of this expression is continuously increasing in c and is positive for $c = 1 - \tau$. Therefore, there must exist a contribution rate $\tilde{c} < 1 - \tau$, such that the immigrant-contribution effect declines for $c > \tilde{c}$. In such a situation, both the immigrant-contribution and the gross-wage effect are smaller, the higher the contribution rate to the pension system is. But even when the immigrant-contribution effect increases, the loss in the gross-wage effect becomes dominant for large M . This holds because NGW is convex in M , while IPC is concave.

However, all of these negative effects vanish under full employment: then $\varphi_c = 0$ and, as in Razin and Sadka (2000), the only impact of a higher c is to enhance the immigrant-contribution effect.

Hence the PAYG scheme has an ambiguous impact on the desirability of immigration when the host country suffers from unemployment. It is not a prerequisite for a positive impact, except for the single case of the first marginal immigrant, but diminishes the positive marginal impact for large-scale immigration. Consequently, a country with a relatively more generous pension scheme might want to choose a more restrictive immigration policy. When there are, for example, social costs of integration that have to be weighted against the economic benefits, a higher c might actually lower the number of immigrants admitted, namely when the equilibrium immigration level exceeds \hat{M} .

Of course, not only marginal, but also total benefits from immigration can be relevant. Therefore we also consider the total gains from immigration $\Delta_{NI}(M) = NI(M) - NI(0)$ and find:

Proposition 7. Let $\hat{\tau} = (\alpha - 1)/2\alpha + \sqrt{1 + 2\alpha - 3\alpha^2}/2\alpha$. (i) If $\tau \geq \hat{\tau}$, there exists an immigration level \hat{M} for every $c \in [0, 1 - \tau]$, such that:

$$\frac{\partial \Delta_{NI}(M)}{\partial c} < 0 \quad \text{for all } M > \hat{M}.$$

(ii) If $\tau < \hat{\tau}$, there exist contribution and immigration levels \hat{c} and \hat{M} such that for $c > \hat{c}$:

$$\frac{\partial \Delta_{NI}(M)}{\partial c} < 0 \quad \text{for all } M > \hat{M}.$$

The mathematics behind this result are relegated to the Appendix. It has the following simple interpretation: when labor-market distortions are severe enough, the aggregate loss in the gross-wage effect exceeds the possibly positive aggregate gains from higher immigrant pension contributions. In such a situation, the gains from immigration would be higher under a lower contribution rate to the pension system. In particular, an economy with fully funded pensions can benefit more from immigration than an economy with a PAYG system.

V. Conclusion

The purpose of our model was to examine the effects of low-skill immigration in an economy with unemployment and public pensions. It was shown that the admittance of foreign workers has an adverse effect on the unemployment rate and the income of low-skill residents. On the other hand, high-skilled natives and pensioners gain. These gains are so large that, from an aggregate point of view, it is generally beneficial to attract immigrants. The pension system plays an ambiguous role in this context. First, the general desirability of an influx of immigrants does not hinge on the existence of a public pension system, except for a single case. Still, the marginal gains from immigration may be enhanced by a PAYG scheme, as it shifts part of the foreigners' working income to the natives. However, the pension system diminishes productivity by increasing unemployment, thereby reducing the beneficial effects of increases in the workforce. For large-scale immigration, the second effect dominates. Then, immigration is beneficial not because of, but rather despite the existence of public pensions.

In order to make these points, the model was constructed to be as simple as possible, for example by using a Cobb–Douglas technology. This is a standard assumption in the literature; see e.g. Razin and Sadka (1995), Fuest and Thum (2000), Storesletten (2000) and Casarico and Devillanova (2001). Furthermore, it generates a unique labor-market equilibrium. A more general production function can give rise to either the non-existence or multiplicity of labor-market equilibria, problems not initially related to the basic question of the paper. These problems originate in a possibly inelastic labor demand. As trade unions always operate in the elastic part of the labor demand curve, wage setting and budget balance can become incompatible for at least some contribution rates. Apart from the problem of non-existence, multiple labor-market equilibria might emerge, since the unemployment benefit would not necessarily continue to be increasing in employment.

Of course, we have also abstracted from effects that may arise when assessing immigration in reality, such as costs of social integration or discrimination on the labor market. However, the consequences of discrimination

are open in our model. Immigration could then have a stronger positive effect on gross native earnings by giving the low-skilled natives a larger share of the (unchanged) total rise in employment. In the meantime, however, the immigrants' inferior employment prospects would increase the wedge between native gross and net earnings and decrease the pension-contribution effect. Furthermore, we have considered constant contribution rates to the social security systems. Alternatively, the contribution rates could be adjusted in order to keep the replacement ratios fixed, as has been the policy in Germany for a long time. This would obviously alter the distributional results, as the pensioners' gain would then shift to the working population. The other results of the paper, however, would remain unaffected on a qualitative basis.

Most of the findings still carry through when the high skilled also contribute to unemployment benefits. The most important difference is that on the aggregate level, an additional negative fiscal-contribution effect emerges, as immigrants receive more than their marginal product. Therefore, immigration will not always be beneficial for the native population as a whole. As before, however, the general role of the pension system remains ambiguous: it tends to raise gains for small-scale immigration (the pension-contribution effect counteracts the fiscal-redistribution effect), but to create negative effects for large-scale immigration by dampening the native gross-wage effect and increasing the fiscal-contribution effect by generating higher unemployment.

Another important issue neglected here concerns the effects of the PAYG scheme on the incentives to immigrate. Unless the host country adheres to an immigration policy that renders the economy dynamically inefficient, a higher c reduces the lifetime incomes of all but the initial retirees. Therefore, immigration motivated by cross-country income differentials would decline. Finally, no attempts have been made to justify the existence of the welfare state or to consider immigration-induced adjustments in the contribution rates.¹⁹ However, the model is intended to serve as a point from which a richer analysis of immigration policies may depart.

Appendix

Proof of Proposition 7

We use (15) to obtain the following expression for the total gain from immigration:

$$\Delta_{NI}(M) = (1 - e)\alpha N \varphi(\tau, c)^{1-\alpha} [\alpha((1 - \alpha)N + M)^{1-\alpha} - ((1 - \alpha)N)^{1-\alpha} + (1 - \alpha)((1 - \alpha)N + M)^{-\alpha}((1 - \alpha)N + cM)].$$

¹⁹Politico-economic repercussions of immigration on the sustainability of old-age social security are discussed by Casarico and Devillanova (2001).

Differentiation with respect to c yields:

$$\begin{aligned} \frac{\partial \Delta_{NI}(M)}{\partial c} = & (1-e)\alpha N \\ & \times \{ (1-\alpha)\varphi_c[\alpha((1-\alpha)N + M)^{1-\alpha} - ((1-\alpha)N)^{1-\alpha} \\ & + (1-\alpha)((1-\alpha)N + M)^{-\alpha}(1-\alpha)N] \\ & + [\varphi(\tau, c) + c(1-\alpha)\varphi_c]M(1-\alpha)((1-\alpha)N + M)^{-\alpha} \}. \end{aligned}$$

From this we have:

$$\begin{aligned} \frac{\partial \Delta_{NI}(M)}{\partial c} < 0 \iff c + \frac{\varphi(\tau, c)}{(1-\alpha)\varphi_c} > \\ - \frac{\alpha((1-\alpha)N + M)^{1-\alpha} + (1-\alpha)^2((1-\alpha)N + M)^{-\alpha}N - ((1-\alpha)N)^{1-\alpha}}{M(1-\alpha)((1-\alpha)N + M)^{-\alpha}} \end{aligned} \quad (A1)$$

The RHS of this inequality is continuous and monotonously decreasing in M with $\lim_{M \rightarrow 0} RHS = 0$ and $\lim_{M \rightarrow \infty} RHS = -\alpha/(1-\alpha)$.

The LHS:

$$-c + \frac{(1-\tau-c)(\tau + (1-\alpha)(1-\tau-c))}{(1-\alpha)\tau}$$

corresponds to the LHS of (19), which is unambiguously positive for $c > \tilde{c}$. We therefore know that for every τ , there are contribution rates $\hat{c} < \tilde{c}$ such that the LHS is larger than $-\alpha/(1-\alpha)$. Then, we can find a corresponding immigration level \hat{M} , such that (A1) is fulfilled for $M > \hat{M}$. This establishes Proposition 7(ii). For $\tau > (\alpha-1)/2\alpha + \sqrt{1+2\alpha-3\alpha^2}/2\alpha$, the LHS is smaller than $-\alpha/(1-\alpha)$ even for $c=0$. Then, there exist immigration levels \bar{M} , such that (A1) is fulfilled for $M > \bar{M}$. This proves Proposition 7(i).

References

- Benhabib, J. (1996), On the Political Economy of Immigration, *European Economic Review* 40, 1737–1743.
- Berry, R. A. and Soligo, R. (1969), Some Welfare Aspects of International Migration, *Journal of Political Economy* 77, 778–794.
- Bonin, H., Raffelhüschen, B. and Walliser, J. (2000), Can Immigration Alleviate the Demographic Burden?, *Finanzarchiv* 57, 1–21.
- Borjas, G. (1994a), The Economics of Immigration, *Journal of Economic Literature* 32, 1667–1717.
- Borjas, G. (1994b), Immigration and Welfare, 1970–1990, NBER Working Paper no. 4872.

- Casarico, A. and Devillanova, C. (2001), Social Security and Migration with Endogenous Skill Upgrading, forthcoming in *Journal of Public Economics*.
- Coughlin, P. (1986), Elections and Income Redistribution, *Public Choice* 50, 27–91.
- Daveri, F. and Tabellini, G. (2000), Unemployment, Growth, and Taxation in Industrialized Countries, *Economic Policy* 30, 47–104.
- Dunlop, J. T. (1944), *Wage Determination under Trade Unions*, Macmillan, New York.
- Fuest, C. and Thum, M. (2000), Welfare Effects of Immigration in a Dual Labor Market, *Regional Science and Urban Economics* 30, 551–563.
- Hoel, M. and Moene, K. O. (1988), Profit Sharing, Unions, and Investment, *Scandinavian Journal of Economics* 90, 493–505.
- Layard, P. and Nickell, S. (1986), Unemployment in Britain, *Economica* 53, 121–169.
- Ortega, J. (2000), Pareto-improving Immigration in an Economy with Equilibrium Unemployment, *Economic Journal* 110, 92–112.
- Pencavel, J. H. (1984), The Tradeoff between Wages and Employment in Trade Union Objectives, *Quarterly Journal of Economics* 99, 215–231.
- Razin, A. and Sadka, E. (1995), Resisting Migration: Wage Rigidity and Income Distribution, *American Economic Review* 85, 312–316.
- Razin, A. and Sadka, E. (2000), Unskilled Migration: A Burden or a Boon for the Welfare State?, *Scandinavian Journal of Economics* 102, 463–479.
- Schmidt, C. M., Stilz, A. and Zimmermann, K. F. (1994), Mass Migration, Unions, and Government Intervention, *Journal of Public Economics* 55, 185–201.
- Storesletten, K. (2000), Sustaining Fiscal Policy Through Immigration, *Journal of Political Economy* 108, 300–323.
- Zimmermann, K. F. (1995), Tackling the European Migration Problem, *Journal of Economic Perspectives* 9, 45–62.

First version submitted March 2001;
final version received August 2002.

