PART II: MIGRATION TO THE WELFARE STATE

CHAPTER 3: INTERTEMPORAL SOCIAL INSURANCE AND MIGRATION

Introduction

In Part I we dealt with factor mobility. We distinguished between the factor of production and its owner. By factor mobility we referred to the mobility of the factor itself, without the owner changing her country of residence. This distinction might be applicable to capital or, in the case of labor, to guest workers. However, in the case of labor, the relevant mobility typically includes both the factors of production and the owner of the factor. This kind of mobility is referred to as migration.

Migration is intertwined with welfare issues. The incentives for migration are shaped by the various ingredients of the welfare state, beyond the economic return (i.e., the marginal product) of labor as a factor of production. Pension contributions and benefits, unemployment and disability benefits, public education to children, health care, etc., are all part and parcel of the incentives for migration. These elements may be equally important as the return to labor in the form of wages in generating the pull and push factors of migration. The size of the aforementioned payments and benefits, the scope and the composition of the income redistribution embodied in them, and the degree of eligibility of migrants to benefit from them determine not only the incentives to migrate, but also the effect of migra-
tion on the well-being of the native-born population and, consequently, the attitude of this population towards migration.

In this part we analyze these issues. To this end, we find it useful to distinguish between long-term, intertemporal aspects and short-term, intratemporal aspects. We start in this chapter with the intertemporal welfare analysis of migration. As the intertemporal social insurance (old age security) system is a central pillar (intertemporal and intergenerational) of the welfare state, we choose to focus on this system, analyzing its interaction with migration.

It is commonly agreed that the pension system is heavily burdened in most countries and is in need of reform.\(^1\) For instance, Gruber and Wise (1999, p.34), state that “the population in all industrialized countries is aging rapidly, and individual life expectancies are increasing. Yet older workers are leaving the labor force at younger and younger ages... Together, these trends have put enormous pressure on the financial solvency of social security systems around the world.” In many countries, the theoretical tax (contribution) rates, i.e., the rates that would balance the system, are significantly higher than the statutory rates. For example, Brugiavini (1999), reports that this theoretical rate could reach 44% for Italy in 1991.

Migration may have important implications for the financial soundness of the pension system. As put succinctly by the Economist: “Demography and economics together suggest that Europe might do better to open wider its doors. Europeans now live longer and have fewer babies than they used to. The burden of a growing host of elderly people is shifting on to a dwindling number of young shoulders” (February 15, 1992).
Naturally, a country is most likely to benefit from the migration of young, highly skilled individuals. This is because such migrants would typically be net contributors to the state pension system, that is, their contributions are expected to exceed their benefits (in present value terms). For instance, a recent study, initiated by the U.S. National Research Council, estimates the overall net fiscal contribution of migrants with at least high school education, who arrived in the U.S. at the age of 20-35, at about $150,000 over their own lifetime; see Smith and Edmonston (1997). Things are less obvious when the migrants are low-skilled. For instance, the aforementioned study estimates that migrants, with less than high school education, aged 20-40 years on arrival impose an overall net fiscal burden of $60,000-$150,000 over their own lifetime. Therefore, our analysis is focused on the case of young, unskilled migrants.

The flow of unskilled, low-earnings migrants to developed states with a comprehensive social security system, including old-age security, has attracted both public and academic attention in recent years. Being relatively low earners, migrants may be net beneficiaries of the welfare state.\(^2\) Therefore, there may arise an almost unanimous opposition to migration at the potential host countries. While young migrants, even if low-skilled, can help society pay the benefits to the current elderly, it may nevertheless be still reasonable to argue that these migrants would adversely affect the current young, if the migrants are net consumers of the welfare state.

However, here comes into play the ingenuity of Paul Samuelson’s concept of the economy as an everlasting machinery even though each one of its human components is finitely lived (Samuelson (1958)). In this chapter we employ this concept in a dynamic
model of a welfare state with immigration and show that even though the migrants may be low-skilled and net beneficiaries of a pension system, nevertheless all the existing income (low and high) and age (young and old) groups living at the time of the migrants’ arrival would be better off. Therefore, on these grounds, the political economy equilibrium will be overwhelmingly pro-migration. Furthermore, this migration need not put any burden on future generations.\(^3\)

This unambiguous result obtains whether or not the low-skilled migrants are net beneficiaries or net contributors to the old-age social security system. That is, the result obtains both when the contributions of the migrants to the pension system fall short of or exceed the present value of the pension benefits. Indeed, when the market rate of interest exceeds the biological rate of interest (i.e., the population growth rate), which is usually the case, and the percentage of skilled in the native-born population is relatively small, then the low-skilled migrants may even be net contributors to (rather than net consumers of) the pension system.\(^4\)

The unequivocal Pareto-improving effect of migration in our welfare state is obtained in a fixed factor price environment which is typical for a small open economy due to either capital mobility or factor-price-equalizing trade in goods. However, when migration affects factor prices\(^5\), particularly depressing wages of unskilled labor,\(^6\) it may create some anti-migration elements that may counterbalance the initial positive effect on the pension system. Indeed, with a sufficiently small substitution between capital and labor the factor price effect may well inflict losses on some income groups of the current generation and some future generations.
Before turning to the analytical study outlined above, in the next section we briefly review some new evidence from the U.S. on the fiscal burden of migration.

The New Americans

Recently, the U.S. National Research Council sponsored a comprehensive study on the overall fiscal impact of immigration into the U.S. The study looked carefully at all layers of government (federal, state and local), all programs (benefits) and all types of taxes. For each cohort, defined by age of arrival to the U.S., the benefits (cash or in kind) received by migrants over their own lifetimes and the lifetimes of their first-generation descendents were projected. These benefits include Medicare, Medicaid, Supplementary Security Income (SSI), Aid for Families with Dependent Children (AFDC), food stamps, Old Age, and Survivors, and Disability Insurance (OASDI), etc. Similarly, taxes paid directly by migrants and the incidence on migrants of other taxes (such as corporate taxes) were also projected for the lifetimes of the migrants and their first-generation descendents. Accordingly, the net fiscal burden were projected and discounted to the present.

In this way, the net fiscal burden for each age cohort of migrants was calculated in present value terms. Within each age cohort, these calculations were disaggregated according to three educational levels: less than high school education, high school education, and more than high school education.

The findings are summarized in Figure 3.1 which is also Figure 7.10 in Smith and Edmonston (1997). Chart A suggests that migrants with less than high school education are typically a net fiscal burden which can reach as high as about $200,000 in present value, when the migrants’ age on arrival is 50-55 years. On the other hand, a young migrant,
aged about 20 years on arrival, with more than high school education, is expected to make a positive net fiscal contribution of about $300,000 in present value.

We now return to an analytical examination of the welfare implications of migration on the pension system, the central pillar of the intertemporal, intergenerational redistribution of the modern welfare state.

Pension and Migration: Fixed Factor Prices

Consider an overlapping-generations model, where each generation lives for two periods. In each period a new generation with a continuum of individuals is born. Each individual possesses a time endowment of one unit in the first period (when young), but no labor endowment in the second period (when old). There is a pay-as-you-go, defined-benefit (PAYG-DB) state pension system. At each period, the benefits paid to the elderly are fully financed by the contributions made by the current working young, and there is no pension fund accumulated. The benefits that each individual receives at old age are predetermined by the government, and are typically unequal on an actuarial basis to the contributions made by this individual at her working age.

Innate Ability and Schooling

There are two levels of work skill, denoted by “low” and “high”. A low-skill individual is also referred to as unskilled and a high-skill individual as skilled. Born unskilled, she can nevertheless acquire skills and become a skilled worker by investing $e$ units of time in schooling. The remainder of her time is spent at work as a skilled worker. There is also a fixed pecuniary cost of education denoted by $\gamma = 0$. 
The individual-specific parameter $e$ reflects the innate ability of the individual in acquiring a work skill. The lower is $e$, that is, the less time she needs for acquiring a work skill, the more able is the individual. The parameter $e$ ranges between 0 and 1 and its cumulative distribution function (c.d.f.) is denoted by $G(\cdot)$, that is $G(e)$ is the number of individuals with an innate ability parameter below or equal to $e$. For the sake of simplicity, we normalize the number of individuals born in period zero, when we begin our analysis of the economy, to be one, that is:

$$G(1) = 1$$  \hspace{1cm} (3.1)

For the sake of simplicity again, we model the difference between skilled and unskilled workers by assuming that a skilled worker provides an effective labor supply of one unit per each unit of her working time; while an unskilled worker provides only $q < 1$ units of effective labor per each unit of her working time.

In the first period of her life, the individual decides whether to acquire or not acquire skill; she also works; brings $1 + n$ children; consumes a composite, all purpose good; and saves for retirement which takes place in the second period. In the latter period she only consumes her retirement savings and her pension benefit.

Consider the schooling decision of the individual. If she acquires a skill by investing $e$ units of her time, she will earn an after-tax income of $(1 - e)w(1 - \tau) - \gamma$, where $w$ is the wage rate per unit of effective labor and $\tau > 0$ is a flat social security contribution (tax) rate. It is assumed that the fixed pecuniary cost of education ($\gamma$) is not tax deductible, as
is usually the case in reality. If she does not acquire a skill, that is, spends all of her time endowment at work, she earns an after-tax income of $qw(1 - \tau)$. Thus, there will be a cutoff level of $e$, denoted by $e^*$ and given by,

$$ (1 - e^*)(1 - \tau)w - \gamma = (1 - \tau)qw, \quad (3.2'') $$

so that every individual with an innate ability parameter below $e^*$ will acquire skill and become a skilled worker, while all individuals with innate ability parameters above $e^*$ will not acquire skill and remain unskilled. Rewriting (3.2''), we explicitly define $e^*$ by,

$$ e^* = 1 - q - \frac{\gamma}{(1 - \tau)w}. \quad (3.2') $$

As one can see from (3.2) the tax has a distortionary effects: The higher the tax rate, the lower is $e^*$. That is, a higher tax rate leads less people to acquire skill. It is clear from (3.2'') or (3.2') that if $\gamma$ were replaced by $(1 - \tau)\gamma$, that is, the pecuniary cost of education were tax deductible, then the tax would have had no effect on $e^*$. Similarly, when $\gamma = 0$, the tax is neutral with respect to the decision of acquiring skill. In this chapter we focus on the distributional aspects of the old-age security system abstracting from its distortionary effect. We therefore set $\gamma$ equal to zero in this chapter so that:
\[ e^* = 1 - q. \]  

(3.2)

We reinstate a positive \( \gamma \) in chapter 4 where the distortionary effects of the tax system play a major role in the determination of the overall tax burden.

**Consumption and Saving**

Denoting first-period and second-period consumption by \( c_1 \) and \( c_2 \), respectively, an individual born at period zero and onward faces the following intertemporal budget constraint:

\[ c_1 + \frac{c_2}{1 + r} = W(e)(1 - \tau) + \frac{b_1}{1 + r}. \]  

(3.3)

where \( r \) is the interest rate, \( W(e) \) is the before-tax wage income for an individual with an innate ability parameter of \( e \), and \( b_1 \) is the social security demogrant benefit paid to retirees at period one.\(^7\) Note that:

\[
W(e) = \begin{cases} 
    w(1 - e) & \text{for } e \leq e^* \\
    qw & \text{for } e \geq e^*
\end{cases}
\]  

(3.4)

We assume that preferences over first-period and second-period consumption are identical for all individuals and given by a Cobb-Douglas, log-linear utility function:
where $\delta < 1$ is the subjective intertemporal discount factor. These preferences give rise to the following saving, first-period consumption and second-period consumption functions for a young individual of type $e$:

$$S(e) = \frac{\delta}{1 + \delta}W(e)(1 - \tau) - \frac{b_1}{(1 + \delta)(1 + r)},$$

(3.6)

$$c_1(e) = \frac{1}{1 + \delta} \left[ W(e)(1 - \tau) + \frac{b_1}{1 + r} \right],$$

(3.7a)

and

$$c_2(e) = \frac{\delta}{1 + \delta} \left[ W(e)(1 - \tau) + \frac{b_1}{1 + r} \right] (1 + r).$$

(3.7b)

The Current Old

In period zero there are also $1/(1 + n)$ old (retired) individuals who were born at period -1. The consumption of each one of them is equal to her savings from the first period, plus the social security benefit, denoted by $b_0$. In each period the aggregate savings of the old
(retired) generation constitutes the aggregate stock of capital.

Migrants

Consider the following exercise: In period zero \( m \) migrants are allowed in, but no more migrants are allowed later on.\(^9\) It is assumed that these migrants are all young and unskilled workers and they possess no capital. Once they enter the country, they adopt the domestic norms of the native-born population. Specifically, they grow up at the same rate \((n)\), they have the same preferences (as given by \((3.5)\)), and the ability index of their offspring is distributed similarly (according to the c.d.f. \(G\)). The assumption of identical preferences is inessential for the conclusion and is made purely to simplify the exposition. However, the equal ability distribution assumption may be a subject of open debate in some rich countries. It may be argued that children of immigrants appear to have attributes such as relatively low birth weight and low school completion rates that weaken their earnings’ potential later in life. However, to the extent that this slow integration process is not permanently extended forward to the next generations, our qualitative results are not significantly altered. Furthermore, a new empirical study by Card, DiNardo and Estes (1998) challenged the claim that the children of unskilled migrants (from Mexico and Latin America) to the U.S. are likely to assimilate slowly into the labor market. Using Current Population Surveys, this study found that these children tend to close about 50% to 60% of the gap between average U.S. wages and the earnings of their fathers’ ethnic immigrant group. Even more striking, immigrants’ children do better than natives’ children: Among American children with parents of the same socioeconomic class, those born to immigrants tend to attain more education and to enjoy higher earnings in their jobs.
Labor Supply

The aggregate supply of effective labor in period zero is given by:

\[ L_o = \int_0^{e^*} (1 - e) dG + q [1 - G(e^*)] + qm. \] (3.8)

The first term on the right-hand side of (3.8) is the effective labor supply of the native-born skilled workers. The second term is the effective labor supply of the native-born unskilled workers (note that there are \(1 - G(e^*)\) of them), and the last term is the effective labor supply of the unskilled migrants.

The aggregate supply of effective labor in period one is given by:

\[ L_1 = (1 + m)(1 + n) \left\{ \int_0^{e^*} (1 - e) dG + q [1 - G(e^*)] \right\}. \] (3.9)

Note that due to migration and natural growth there are altogether \((1 + m)(1 + n)\) young individuals born in period one.

The Stock of Capital

The aggregate stock of capital in period zero which is owned by the current old (born in period -1) is denoted by \(K_0\). The aggregate stock of capital in period one consists of the savings of both the native-born young generation of period zero and the migrants. Thus, it is equal to:
\[ K_1 = \int_0^{e^*} \left[ \frac{\delta}{1 + \delta} w(1 - e)(1 - \tau) - \frac{b_1}{(1 + \delta)(1 + r)} \right] dG \\
+ \left[ \frac{\delta}{1 + \delta} qw(1 - \tau) - \frac{b_1}{(1 + \delta)(1 + r)} \right] [1 - G(e^*) + m], \quad (3.10') \]

where use is made of the saving and earned income equations (3.6) and (3.4). The term in the first square brackets is the saving of a skilled person with an ability parameter of \( e \). The term in the second square brackets is the saving of an unskilled person. Note that due to migrations there are \( 1 - G^*(e) + m \) unskilled individuals in period zero. Upon some rewriting (1) becomes:

\[ K_1 = \frac{\delta}{1 + \delta} w(1 - \tau) \left\{ \int_0^{e^*} (1 - e) dG + q[1 - G(e^*) + m] \right\} - \frac{b_1(1 + m)}{(1 + \delta)(1 + r)}. \quad (3.10) \]

Output

In a small economy with a free access to the world capital markets the domestic return to capital will converge to the world rate of interest. Thus, migration has no effect on the domestic rate of interest. When furthermore the technology exhibits constant returns to scale, migration will have no effect on wages as well. Alternatively, one may view our single good as a composite of two traded goods. In a small Heckscher-Ohlin economy, the domestic good prices are nailed down by the world prices. Consequently, domestic factor prices are equated to the exogenously given world prices. Thus, in either case, gross national output (denoted by \( F(K, L) \)) is given by:
\[ F(K, L) = wL + (1 + r)K. \] (3.11)

We assume, with no loss of generality, that capital fully depreciates at the end of the production process. In this setup, \( w \) is the (fixed) marginal product of labor and \( r \) is the (fixed) net-of-depreciation marginal product of capital.

**The Pension System**

As was already mentioned, we consider a pay-as-you-go, defined benefit (PAYG-DB) pension system. The pensions to retirees are paid entirely from current contributions made by workers and the benefit takes the form of a demogrant. In period zero, total contributions amount to:

\[
T_0 = \tau w \left\{ \int_0^e (1 - e)dG + q[1 - G(e^*) + m] \right\},
\] (3.12)

since the term in the curley brackets is the effective labor supply. Thus, the demogrant benefit \( b_0 \) is equal to:

\[
b_0 = (1 + n)\tau w \left\{ \int_0^e (1 - e)dG + q[1 - G(e^*) + m] \right\},
\] (3.13)

because there are \( 1/(1 + n) \) retirees at period zero. Total contributions in period one are
equality to

\[ T_1 = \tau w \left\{ \int_{0}^{e^*_0} (1 - e) dG + q [1 - G(e^*_0)] \right\} (1 + m)(1 + n), \]  

(3.14)

since there are \((1+m)(1+n)\) individuals in period one who are the indistinguishable offspring of the native-born in period zero and the migrants; and since a proportion \(1 - G(e^*_0)\) of these individuals is unskilled. The demogrant benefit in period one is equal to:

\[ b_1 = \tau w \left\{ \int_{0}^{e^*_0} (1 - e) dG + q [1 - G(e^*_0)] \right\} (1 + n), \]  

(3.15)

because there are \(1 + m\) native-born and migrant retirees in period one.

Dynamics

The dynamics of this economy is quite simple. Due to the constancy of the factor prices, the economy converges to a steady state within two periods. The pension benefit in period two is going to be equal to \(b_1\), the pension benefit in period one, because the common characteristics of the offspring of the migrants and of the offspring of the native-born population of period zero are stationary. Thus, the pension benefits will equal \(b_1\) from period one onward. The stock of capital will stabilize from period two onward because in period one it is still affected by the contribution to savings of the migrants who arrived in period zero.

In this stylized model, the welfare impact of migration on the economy is manifested through the pension benefit only. This is because factor prices are constant and schooling
decisions are unaffected by migration.

The Benefits from Migration

Upon inspection of equation (3.13), one can observe that \( b_0 \), the pension benefit to retirees at period zero (in which the migrants arrive), increases in the number of migrants. Thus, as expected, the old generation at period zero is clearly better-off with migration. This is because migration increases the number of workers and, consequently, the tax base. Upon inspection of equation (3.15), one can observe that \( b_1 \), the pension benefit paid to retirees in period one and onward, is unaffected by migration. In particular and somewhat surprisingly, the young generation at the time in which the migrants arrive (both its skilled and unskilled members), is not adversely affected by migration. Thus, the existing population (both young and old) in period zero will welcome migration.

Furthermore, by creating some surplus in the pension system in period zero (that is, by lowering \( b_0 \) somewhat), the gain that accrues only to the old in our setup could be spread over to future generations as well. Thus, migration is a Pareto-improving change with respect to the existing and future generations of the native born. Evidently, such a Pareto-improvement will be experienced in each period in which a new wave of migrants comes in.

Somewhat surprisingly, this result obtains even though the unskilled migrants may well be net beneficiaries of the redistributive pension system, in the sense that the present value of their pension benefits exceeds their pension contributions. To see this, let us calculate the net benefit to an immigrant. The present value of her benefit is \( b_1/(1+r) \), while her contribution is \( \tau qw \). Substituting for \( b_1 \) from equation (3.15), we can rewrite the
net benefit (denoted by NB) as:

\[ NB = \frac{1+n}{1+r} \tau w \left\{ \int_{0}^{e^*} (1-e) dG + q (1-G(e^*)) \right\} - \tau qw. \]  \hspace{1cm} (3.16)

Employing (3.2) one can show (see the appendix) that \( NB \geq 0 \), if:

\[ \frac{G(e^*)(e^* - e^-)}{1-e^*} R \frac{r-n}{1+n}, \]  \hspace{1cm} (3.17)

where \( e^- \) is the mean ability parameter of the skilled workers. Note that \( e^* > e^- \), because \( e^* \) is the upper bound of the ability parameter of skilled individuals, while \( e^- \) is its mean. Thus, the left-hand-side of (3.17) must be positive. Hence, if \( r < n \), then \( NB \) is certainly positive, that is the migrants are net beneficiaries of the pension system. However, it is typically assumed that \( r > n \) (dynamic efficiency considerations). \(^{10}\) In this case, if a large share of the population is skilled, then \( NB \) is still positive. To see this, observe that when the share of the skilled population (\( e^* \)) approaches one, then the left-hand-side of (3.17) increases without bound. Hence, the left-hand-side of (3.17) will exceed its right-hand-side. In this case, migrants are net beneficiaries of the pension system.

However, when \( r \) is significantly larger than \( n \); the share of skilled in the native-born population (namely, \( G(e^*) \)) is low; and the relative productivity of unskilled (namely, \( q = 1-e^* \)) is high, then \( NB \) will be negative. The intuition of how low-skilled migrants can still be net contributors to a progressive pension system is grounded in the dynamic feature
of the pay-as-you-go system. The benefits that the migrants are entitled to at old age grow in a pay-as-you-go system only at the rate of the population growth rate \( (n) \). However, in order to compare these benefits to the taxes paid by the migrants at their working age, we have to discount these benefits by the market rate of interest \( (r) \). Thus, ceteris paribus, the larger is the gap \( r - n \), the smaller is the present value of the net benefit to the migrants. Now, if migrants and the native-born were all similar (that is, \( q = 1, e^* = 0 \) and \( G(e^*) = 0 \)), then no redistribution is performed by the social security system and the migrants, like all the native-born, are net contributors to the system. By continuity considerations, one can conclude that if the migrants are not substantially different from the native-born (that is, \( q \) is not significantly below one, \( e^* \) is not very high, and \( G(e^*) \) is not very large), then they are net contributors to the pension system in the dynamically efficient case of \( r > n \).

What we have established is that regardless of whether or not the migrants are net consumers of the pension system, all existing and future generations may gain from migration. In our simple parable migration was a one-time episode. Naturally, if this one-time immigration episode repeats itself in the future to generate a steady flow of migrants in each period, the gain that we showed to exist for the contemporaneous old generation would repeat itself too for all future old generations. Thus, a steady flow of low-skilled migrants would generate a steady flow of benefits to the native-born.

**Interpretation**

An important lesson from this parable is that in a dynamic setup, which is both natural and essential for analyzing some important ingredients of the welfare state such as old age security, certain seemingly costly shocks could turn out to be beneficial. The migrants
could be net beneficiaries of the welfare state, so that, at first thought, they seem to impose a burden on the native-born population. However, in a dynamic context, this net burden could change to a net gain because the burden may be shifted forward indefinitely. If, hypothetically, the world would come to a full stop at a certain point in time, the young generation at that point would bear the cost of the present migration.

To illustrate this point, we construct the following example. Consider a finite-time (two-period) modified version of our model. Suppose the young generation of period zero and the migrants that arrive then bear no children and the world ceases after period one. Suppose further that the social security contribution (tax) rate remains $\tau$ in period zero. Hence, $b_0$ does not change (see equation (3.13)) and, as before, the old living in period zero benefit from migration.

In period one, the last period, there will be no young people, no labor supply and no social security benefits. National output is $(1 + r)K$. The young born in period zero and the migrants live off their period-zero savings (namely, $(1 + r)K$). Obviously, the young of period zero are not affected by migration. The migrants paid their social security taxes in period zero, receiving no benefits in return in period one. That is, the migrants are net contributors to the pension system (which ceased after period zero); they financed the increased benefit to the old of period zero with no compensation to themselves. In sum, the effect of migration is as follows: The old of period zero benefited; the native-born young generation was not affected, and the migrants financed in full the gain to the old. In essence, it is a zero-sum game. If, in this zero-sum environment, the migrants are compensated in period one in some way or another for their social security contributions in period zero, it
must be at the expense of the native-born old of period one (the native-born young of period zero).

**Summing Up**

Even though the migrants may be **net beneficiaries** of the pension system in **total** in the two periods they live in, they nevertheless provide a **net contribution** to the public finances in the period they arrive (namely, period zero). In this way, they exert a positive externality on the native population. In the next period (namely, period one), the migrants draw pensions themselves but they ensure the financing themselves by having reared enough children with sufficient human capital to take care of these additional pensions. Hence, the pensions of the migrants do not tax the children of the native population. Instead, the net cost that migrants impose when old (namely, in period one) is deferred to the indefinite future. Thus, overall, the migrants yield positive externalities on the native population.

If rearing children were costless, migration of unskilled labor would have been equivalent to a once-off boost to the birth rate of unskilled labor, generating a positive externality on the rest of the population by helping to finance the PAYG pensions. As realistically rearing children may be quite costly, migration of unskilled labor is **more** beneficial to the native population than a once-off boost to the birth rate of unskilled labor, because with migration of young working (already grown-up people) the child rearing cost is avoided.

Furthermore, very often migrants do not all belong to the bottom end of the skill distribution, as posited in our parable. The phenomenon of the brain-drain from the developing countries to the OECD countries is a good example of skilled migration. Such migration is a net contribution to the public finances of the welfare state from the outset.
Pension and Migration: Variable Factor Prices

We have shown in the preceding section that in an everlasting economy, the migrants have a positive contribution to the existing old and possibly all other generations as well. In this simplified account of migration, the larger the number of migrants the better-off everyone is. This can be seen from equation (3.13) where the larger the \( m \), the larger is \( b_0 \). Thus, the native-born population would opt for having as many migrants as possible. However, when factor prices are variable, migration will generate a downward pressure on wages. This pressure can come about if capital mobility is not perfect or, alternatively, when the Heckscher-Ohlin economy shifts across different industry structures as labor comes in; see Chapter 2. In this case of variable factor prices the welfare calculus of the preceding section may overturn.

Dynamics

Formally, national output is now given by a constant-returns-to-scale production function:

\[
F(K_t, L_t) = L_t F(K_t/L_t, 1) \equiv L_t f(k_t),
\]

where \( k_t = K_t/L_t \) is the capital-labor ratio.

This production function gives rise to the following factor price equations:

\[
1 + r_t = f'(k_t),
\]

(3.18)
and

\[ w_t = f(k_t) - (1 + r_t)k_t. \] (3.19)

In period zero, the capital-labor ratio is given by:

\[ k_0 = K_0 / L_0. \] (3.20)

where \( L_0 \) is given by (3.8). At period one, the stock of capital \( (K_1) \) consists of period-zero savings (of the native-born young and the migrants). This \( K_1 \) is given by equation (3.10) with \( w_0 \) replacing \( w \). Thus, the capital-labor ratio is hence:

\[ k_1 = L_1^{-1} \delta \frac{w_0(1 - \tau)}{1 + \delta} \left\{ \int_0^{e^*} (1 - e) dG + q [1 - G(e^*) + m] \right\} - L_1^{-1} \frac{b_1(1 + m)}{(1 + \delta)(1 + \tau)}. \] (3.21)

The supply of labor is given by:

\[ L_t = (1 + m)(1 + n)^t \left\{ \int_0^{e^*} (1 - e) dG + q [1 - G(e^*)] \right\}, \quad t = 1 \] (3.22)

Henceforth, the capital-labor ratio is given by:
\[ k_t = \frac{1}{(1+n)(1+\delta)} \left[ \delta(1-\tau)w_{t-1} - \frac{\tau w_t(1+n)}{1+r_t} \right], \quad t = 2 \tag{3.23} \]

Note that the dynamics of \( k_t \) from \( t = 2 \) and on is different from the earlier periods \((t = 0, 1)\), because the composition of the skilled-unskilled population, which affects the savings of each period, does not depend on \( m \) for \( t = 2 \), as the offspring of the migrants are fully integrated in society.

The social security benefit in period zero, \( b_0 \), is given by (3.13) with \( w_0 \) replacing \( w \), that is:

\[ b_0 = (1+n)\tau w_0 \left\{ \int_0^{e^*} (1-e) dG + q[1 - G(e^*) + m] \right\}. \tag{3.13a} \]

Similarly, \( b_t \) for \( t = 1 \) is given by the right-hand-side of (3.15) with \( w_t \) replacing \( w \), that is:

\[ b_t = \tau w_t \left\{ \int_0^{e^*} (1-e) dG + q[1 - G(e^*)] \right\} (1+n), \quad t = 1 \tag{3.15a} \]

Finally, the net benefit to a migrant from the redistributive pension system is given by:
Simulation Results

We resort to numerical simulations in order to illustrate the gains and losses from migration. The results are shown in Tables 3.1 and 3.2.

Suppose first that the economy is in a steady state with no migration, i.e., \( m = 0 \). This is described in the first row of the two tables as period -1. Then, in period zero, the economy is shocked by an influx of \( m \) low-skilled migrants. We describe the path of the economy until it reaches a steady state again in period \( \infty \). Note that this new steady state is identical to the original one, as can be seen from the absence of \( m \) from (3.23), the dynamic equation of the model; compare the first and last rows in each table. The path of the capital-labor ratio \( (k_t) \), the social security benefit \( (b_t) \), and the welfare loss to members of each generation are presented for \( m = 0.1 \) and \( m = 0.2 \). This loss is measured as the percentage increases in life-time consumption that will restore utility to its pre-migration level.

The calculations were carried out for a Constant Elasticity of Substitution (CES) production function. Table 3.1 presents the results for the Cobb-Douglas case (i.e., for \( \sigma = 1 \), where \( \sigma \) is the elasticity of substitution). The labor share is assumed to be 2/3. The distribution of \( e \) is assumed uniform over the interval \([0, 1]\). Productivity of unskilled labor is one-half that of skilled labor, i.e., \( q = 0.5 \). The subjective discount rate is 5% annually; successive periods are 25 years apart from one another. The social security contribution
rate is 30%. The annual population growth rate \( (n) \) is 2%.

As migrants come in, the capital labor ratio \( (k_o) \) falls naturally. Also the pension benefit to the old \( (b_o) \) rises. The old of period zero gain on two grounds: First, \( b_o \) rises; and second, the rate of return to their capital \( (1 + r_o) \) rises, because \( k_o \) falls. Thus, the old in period zero always gain from migration. Thereafter, the capital-labor ratio rises monotonically back to its steady-state level. The pension benefit in period one falls below the steady-state level but then rises monotonically to its steady-state level.

In contrast to the fixed factor price case (i.e., \( \sigma = \infty \)), with variable factor prices and \( \sigma = 1 \), all income groups in every generation (except, of course, the retirees in period zero) lose from migration, as can be seen from the last four columns of Table 3.1. Furthermore, their loss is an increasing function of \( m \). Notice that the migrants are net contributors to the pension system, as \( NB < 0 \). Thus, their contribution could not even enhance the welfare of the old at the time of the migrants’ arrival without hurting every other generation.

For a higher value of \( \sigma \) than in the Cobb-Douglas case, some income groups in some generations may still gain. Table 3.2 presents simulation results for \( \sigma = 3.33 \). Here again the retirees in period zero naturally gain from migration. But in this case the highest skilled people in the generation born at period zero (i.e., when the migrants arrive) also gain. This group, which owns a larger share of the capital stock, is less affected than others by the downward pressure on wages exerted by migration. Unskilled people in all generations lose. Here again, the migrants are net contributors to the pension system as \( NB < 0 \). But their net contribution does not suffice to support the gain to the retirees in period zero and to the highest skilled people born at that time, so that all other people in all other generations are
worse off.
Conclusion

Migration has important implications for the financial soundness of the pension system which is an important pillar of any welfare state. While it is common sense to expect that young migrants, even if low-skilled, can help society pay the benefits to the current elderly, it may nevertheless be reasonable to argue that these migrants would adversely affect the current young, since the migrants are typically thought of as net beneficiaries of the welfare state which redistributes income from the rich to the poor.

In contrast to the adverse effects of migration in the static model, we employed Samuelson’s (1958) concept of the economy as an everlasting machinery, even though its human components are only finitely lived, and show that low-skill migrants may be either net beneficiaries of, or net contributors to an old-age social security system which is inherently progressive. However, regardless of whether or not the migrants are net contributors or net beneficiaries of this system, we show that migration is a Pareto-improving measure. That is, all the existing income (low and high) and age (young and old) groups living at the time of the migrants’ arrival would be better-off. This result obtains when the economy has good access to international goods and capital markets, so that migration exerts no major effect on factor prices. The effect of migration in this case is manifested entirely through the PAYG-DB pension system.

Therefore, in a dynamic model with capital mobility that freezes factor price, the political economy equilibrium will overwhelmingly support migration. Evidently, this pro-migration feature can be weakened and possibly overturned when capital inflows are not sufficient to peg factor prices, or when labor inflows change industry structure and factor
prices. In these cases, even if migrants are net contributors to the pension system, their contribution does not suffice to support the increased benefit to the old at the time of the migrants’ arrival; other people are made worse off.
APPENDIX

In this appendix we prove that $NB \geq 0$, when condition (3.17) holds. Substituting (3.2) into (3.16), we can see that:

\[
NB = \frac{1+n}{1+r} \tau w \left\{ \int_{e}^{e^*} dG - \int_{0}^{e^*} edG + (1-e^*)(1-G(e^*)) \right\} - \tau w(1-e^*). \tag{3.A1}
\]

Since

\[
e^{-} = [G(e^*)]^{-1} \int_{0}^{e^*} edG
\]

and

\[
\int_{0}^{e^*} dG = G(e^*),
\]

it follows that $NB \geq 0$, as:

\[
\frac{1+n}{1+r} \left\{ G(e^*) - G(e^*)e^- + 1 - e^* - G(e^*) + e^*G(e^*) \right\} \geq 1-e^*. \tag{3.A2}
\]

Hence,
$NB \ R \ 0$, as:

$$\frac{1+n}{1+r} [(e^* - e^-)G(e^*) + (1 - e^*)] \ R \ 1 - e^*.$$  \hspace{1cm} (3.A3)

Thus, $NB \ R \ 0$, as:

$$(e^* - e^-)G(e^*) \ R \ (1 - e^*)\left(\frac{1+r}{1+n} - 1\right),$$  \hspace{1cm} (3.A4)

which yields condition (3.17).
Table 3.1: The Effects of Migration with $\sigma = 1$.

<table>
<thead>
<tr>
<th>Period</th>
<th>$Capital\ Labor\ Ratio\ (k)$</th>
<th>$Social\ Security\ Benefit\ (b)$</th>
<th>$Welfare\ Losses\ of\ Highest\ skilled\ (%)$</th>
<th>$Welfare\ Losses\ of\ Unskilled\ (%)$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$m=0$</td>
<td>-1(m=0) 0.0096 0.0096</td>
<td>m=0.1 0.0444 0.0444</td>
<td>m=0.1 0</td>
<td>m=0.2 0</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>0</td>
<td>0.0088 0.0082</td>
<td>0.0468 0.0491</td>
<td>1.99 3.89</td>
<td>2.09 4.06</td>
</tr>
<tr>
<td>1</td>
<td>0.0091 0.0088</td>
<td>0.0438 0.0432</td>
<td>1.23 2.34</td>
<td>1.23 2.34</td>
</tr>
<tr>
<td>2</td>
<td>0.0094 0.0093</td>
<td>0.0442 0.0440</td>
<td>0.40 0.77</td>
<td>0.40 0.77</td>
</tr>
<tr>
<td>3</td>
<td>0.0095 0.0095</td>
<td>0.0443 0.0443</td>
<td>0.13 0.25</td>
<td>0.13 0.25</td>
</tr>
<tr>
<td>4</td>
<td>0.0095 0.0095</td>
<td>0.0444 0.0444</td>
<td>0.04 0.08</td>
<td>0.04 0.08</td>
</tr>
<tr>
<td>5</td>
<td>0.0095 0.0095</td>
<td>0.0444 0.0444</td>
<td>0.01 0.03</td>
<td>0.01 0.03</td>
</tr>
<tr>
<td>6</td>
<td>0.0096 0.0095</td>
<td>0.0444 0.0444</td>
<td>0     0.01</td>
<td>0     0.01</td>
</tr>
<tr>
<td>$\infty$</td>
<td>0.0096 0.0096</td>
<td>0.0444 0.0444</td>
<td>0     0</td>
<td>0     0</td>
</tr>
</tbody>
</table>

$NB = \begin{cases} 
-0.0162 & \text{for}\ m = 0.1 \\
-0.0159 & \text{for}\ m = 0.2 
\end{cases}$
Table 3.2: The Effects of Migration with $\sigma = 3.3$

<table>
<thead>
<tr>
<th>Period</th>
<th>Capital Labor Ratio ($k$)</th>
<th>Social Security Benefit ($b$)</th>
<th>Welfare Losses of Highest Skilled (%)</th>
<th>Welfare Losses of Unskilled (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>$m=0.1$</td>
<td>0.0032</td>
<td>0.0032</td>
<td>0.1595</td>
<td>0.1595</td>
</tr>
<tr>
<td>$m=0.2$</td>
<td>0.0032</td>
<td>0.0032</td>
<td>0.1595</td>
<td>0.1595</td>
</tr>
<tr>
<td>$m=0.1$</td>
<td>0.0031</td>
<td>0.0032</td>
<td>0.1594</td>
<td>0.1594</td>
</tr>
<tr>
<td>$m=0.2$</td>
<td>0.0031</td>
<td>0.0032</td>
<td>0.1594</td>
<td>0.1594</td>
</tr>
<tr>
<td>$m=0.1$</td>
<td>0.0032</td>
<td>0.0032</td>
<td>0.1595</td>
<td>0.1595</td>
</tr>
<tr>
<td>$m=0.2$</td>
<td>0.0032</td>
<td>0.0032</td>
<td>0.1595</td>
<td>0.1595</td>
</tr>
<tr>
<td>$m=0.1$</td>
<td>0.0032</td>
<td>0.0032</td>
<td>0.1595</td>
<td>0.1595</td>
</tr>
<tr>
<td>$m=0.2$</td>
<td>0.0032</td>
<td>0.0032</td>
<td>0.1595</td>
<td>0.1595</td>
</tr>
</tbody>
</table>

$NB = \begin{cases} 
-0.0173 \text{ for } m = 0.1 \\
-0.0173 \text{ for } m = 0.2 
\end{cases}$