Income redistribution and migration

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Abstract. This paper analyses redistribution policies that transfer income between owners of immobile factors of production and workers in a given region. The menu of income distribution possibilities attainable through tax/transfer policy in the presence of labour mobility is characterized. Simple general equilibrium analysis shows that migration can lead to Pareto-inferior outcomes in the destination region if immigrants are the beneficiaries of redistributive transfers. All residents of the destination region may gain, however, if transfer payments are also paid to workers in the source region so as to reduce the level of immigration.

Redistribution des revenus et mouvements migratoires. Ce mémoire analyse les politiques de redistribution qui transfèrent le revenu entre les propriétaires de facteurs de production immobiles et les travailleurs dans une région donnée. On précise la gamme des répartitions de revenus possibles dont on peut se doter par le truchement de politiques de taxation et de transferts quand le facteur travail est mobile. Une analyse d'équilibre général simple montre que les mouvements migratoires peuvent entraîner des résultats inférieurs au sens de Pareto dans la région de destination si les immigrants sont les bénéficiaires de transferts de redistribution. Tous les résidents de la région de destination peuvent cependant faire des gains si des paiements de transfert sont aussi payés aux travailleurs dans la région d'origine de manière à réduire le niveau de migration.

I. INTRODUCTION

It is generally recognized that the mobility of households has important implications for public sector redistributive policy. Such policies, whether explicit or implicit

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in nature, give rise to a phenomenon rather like adverse selection: net beneficiaries are attracted to jurisdictions engaged in redistribution, while net contributors are repelled. This basic insight, which is found in standard references such as Stigler (1957), Oates (1968), and Musgrave (1969), has been extremely influential in the literature of fiscal federalism. For instance, it has led many writers to conclude that central governments should assume primary responsibility for the 'distribution branch' functions of the public sector. If lower-level governments instead undertake redistributive policies, then, it is commonly argued, a central government should provide fiscal assistance to the lower-level governments through a program of lump-sum or matching grants. Since lower-level governments in many countries do in fact carry out policies with significant distributional consequences, this is a matter of considerable practical importance.[1] Concern with fiscally induced migration also surfaces in discussions of international migration. For instance, many commentators express concern about the possible fiscal burden that Mexican immigrants may impose on the United States. Migrant workers or their family members may be able to take advantage of a variety of public and social services, but they may not make commensurate contributions through the tax system (see, e.g., Chiswick 1988; Borjas 1990). Analogous issues arise in the European setting. Within the EC, workers may migrate from countries with low levels of social insurance and other benefits to countries with more generous programs. This prospect will certainly be an important consideration in the disposition of Turkey's application for EC membership. The issue of migration from non-EC to EC countries is also a matter of increasing concern, and fears of east-west migration may significantly constrain the liberalization of economic relations between former Warsaw Pact countries and their neighbours to the west, with broader implications for political and national security developments in Europe.

In general, one may think of redistribution policy as a device for achieving different points along a social net income or utility-possibility frontier. In the absence of migration, society faces a menu of net income distributions that can be attained using whatever redistributive policy instruments are available. When migration is possible, these policies will affect the net income available to the residents of the society and thus the direction and extent of migration. Migration itself affects the distribution of income, since it changes factor supplies, factor productivity, and factor prices. Because of these effects, the menu of net income distributions attainable for society when migration is possible differs from the no-migration menu. Assuming that redistribution policy is aimed at affecting the distribution of net income, it becomes critically important to understand first, how migration responds to redistributive policy, and second, how migration alters the set of feasible net income distributions open to the economy. Addressing these issues is a primary task of the analysis that follows. The analysis focuses on the characterization of the *income distribution frontier*, that is, a curve showing possible net income dis-

1 See, for example, Boadway and Flatters (1982), Gramlich (1985), Peterson and Rom (1990), and Wildasin (1990, 1991, 1992) for discussion and additional references.

tributions available to the residents of a society, and on the way that this frontier changes when migration is possible.[2]

The analysis shows that a portion of the income distribution frontier with free migration can lie outside the no-migration frontier, implying that higher net incomes are attainable for all members of society. Other portions of the frontier lie below the no-migration frontier. In this case, migration must reduce net incomes for at least some households. In particular, the income distribution frontier with free migration must lie below the no-migration frontier in the important case where mobile workers are net beneficiaries from redistributive policy and thus impose a fiscal burden on society. A clear implication of the analysis in this case is that a jurisdiction might wish to limit migration. Sometimes, however, direct control over the level of migration or over the access of migrants to the benefits of redistributive policies is infeasible.[3]

Under these circumstances, it may be possible to use other policy instruments to limit migration in an indirect fashion. In the case of western Europe, there is much talk of providing aid to east European countries in order to forestall migration.[4] The German government is expending large amounts of resources partly to limit migration from the former DDR into western Germany. Could such aid ever be advantageous from the viewpoint of the *donor* country? Perhaps, surprisingly, the answer is yes. If we expand the set of redistributive policy instruments to include (direct or indirect) transfer payments to *non-resident* mobile households, some portions of the income distribution frontier with free migration dominate (lie strictly outside) the set of income distributions that are attainable when such payments are prohibited. That is, it may be possible to raise the net income of all of those residing

2 For related analysis, see Baumol (1989), who, building on Baumol and Fischer (1979), discusses how emigration by taxpayers can limit the set of attainable income distributions. A number of papers in Bhagwati and Wilson (1989) examine Mirrlees-type optimal income taxation in the presence of migration. See also Epple and Platt (1992), who develop the concept of a 'redistribution possibility frontier' (RPF) to show a set of attainable combinations of property taxes and transfer payments for local governments. The Epple-Platt RPFs differ from income distribution frontiers, however, because they describe attainable sets of fiscal instruments rather than attainable income possibilities.

3 The U.S. constitution, as interpreted by the Supreme Court in Shapiro v. Thompson (1969) and Memorial Hospital v. Maricopa County (1974) (see Tribe 1988, 1441–3 and 1455–7), the Treaty of Rome establishing the EEC (Articles 48 and 51), the provisions of the constitution of the Federal Republic of Germany conferring citizenship on all people of German origin, and Section 6 of the Canadian Charter of Rights and Freedoms embodied within the Constitution Act of 1982 (see Boadway 1992) protect the freedom of migration of U.S. citizens, citizens of EC member states, people of German ancestry, and citizens of Canada, respectively. In each of these cases, the imposition of formal legal limits on the right of people to migrate or on their access to redistributive benefits would entail changes in fundamental constitutional structures or in international treaty obligations. Admittedly, there are many means by which these de jure constraints can be circumvented de facto. However, this does not change the basic fact that de jure constraints do matter.

4 The following remarks by former U.S. national security adviser Zbigniew Brzezinski are representative: 'Before too long we may have to engage in massive philanthropy, because the economic collapse of the Soviet Union is likely to produce massive migrations – hundreds of thousands, perhaps millions of people will be leaving the Soviet Union' (*World Monitor*, December 1990, 16).

within a given jurisdiction by imposing taxes on them and giving the proceeds to mobile households residing *outside* the jurisdiction.

The paper is organized as follows. Section II outlines the basic model. Section III describes the effect of migration on the income distribution frontier for one jurisdiction. Section IV explores the implications of transfers from one jurisdiction to another. Section V discusses a number of welfare and policy implications of the analysis as well as some generalizations. Section VI identifies some issues for further research.

II. THE BASIC MODEL: MARKET EQUILIBRIUM WITH MIGRATION

Let there be two regions or countries, 1 and 2. The simplest specification of the model abstracts from any market imperfections or real migration costs, allows only for one produced good, and aggregates all inputs into just two categories: an immobile resource, such as land or natural resources, and a mobile resource, homogeneous labour. The returns to the fixed input in each region accrue to immobile households that reside there (e.g., landowners), while the returns to mobile labour accrue to the workers. The number of mobile workers (natives) originally and exogenously assigned to region i is n_i, and each inelastically supplies one unit of labour. When migration is possible, the number of workers actually employed in i, l_i, may differ from n_i, hence $l_i - n_i$ represents the amount of immigration into region i. In each region, output $f_i(l_i)$ is a smoothly increasing and strictly concave function of the amount of labour employed there, $f_i' > 0 > f_i''$. Wages adjust freely, the labour market clears, and therefore the equilibrium allocation of labour must satisfy

$$l_1 + l_2 = n_1 + n_2 \equiv \bar{n}. \tag{1}$$

In the absence of government intervention, labour will flow between regions until incomes for mobile households are equalized. With competitive labour markets, this occurs where $f_1'(l_1) = f_2'(l_2)$, as shown in figure 1. In this figure, any point on the horizontal axis represents an allocation of labour between the regions. The initial allocation is n_i. If there is a political or cost barrier that prevents migration, initial wages might not be equalized because technologies differ and because relative endowments of fixed factors also differ. In figure 1, the wage is initially higher in region 1 ($w_1^0 > w_2^0$). Once the barrier to migration is removed, however, labour flows into region 1, ending with an equilibrium level of l_1^e units of labour in 1 and a uniform wage of w^e in both regions. The equilibrium return to the owners of the immobile resource in region i is $f_i(l_i) - l_i f_i'(l_i)$. In the figure, this is given by the area under the f_i' curves and above the line $w^e w^e$.

Note the role of the fixed factors in this model: they create diminishing returns to labour which serve to equilibrate migratory flows. If neither region had diminishing returns to labour, it would be necessary to rely entirely on migration costs to prevent corner solutions where all workers reside only in one region. (For this

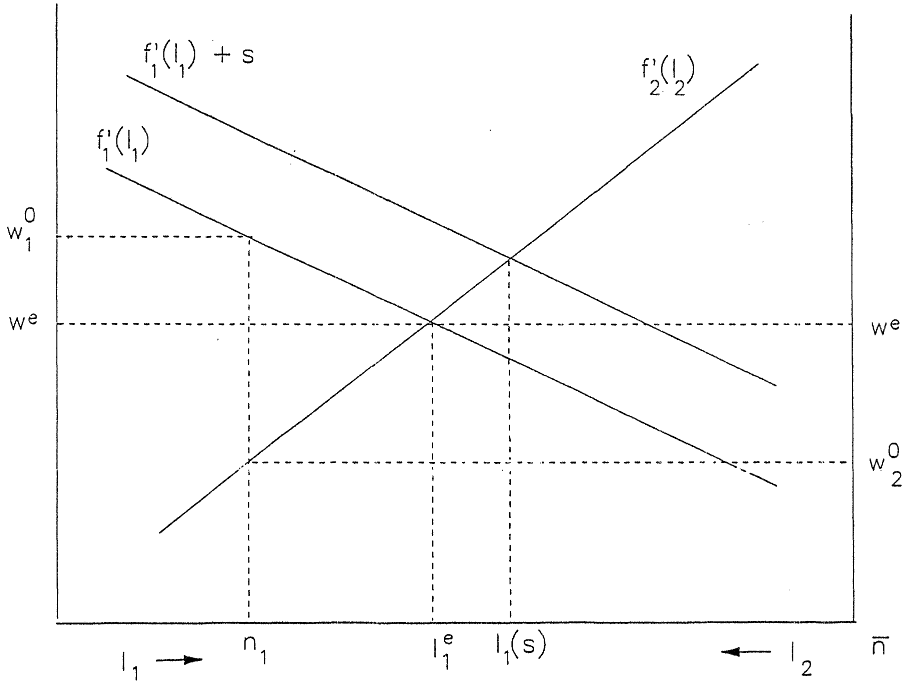

FIGURE 1

reason, models with migration and exogenously fixed factor prices generally rely on heterogeneous migration costs to generate interior, non-knife-edge equilibria.) Furthermore, through the operation of diminishing returns, the (gross) incomes of fixed factors and of labour are linked. Increases in the size of the labour force lower labour productivity but simultaneously raise returns to the fixed factor. These interrelationships cannot arise in models where gross incomes are exogenously specified.

Two important generalizations of the model are obvious. First, there could be many immobile factors in each region rather than just one. Thus, there could be a fixed number of immobile workers (e.g., high-skilled workers), in either region or in both regions, who own both their own labour and any other fixed factors, such as land or natural resources. Then $f_i(l_i) - l_i f_i'(l_i)$ is interpreted as the total income of such immobile households, including both the return to their labour and the return to other non-human fixed factors. For ease of exposition l_i will still be referred to as labour in region i, but the terms 'fixed factor' or 'immobile factor' should be interpreted to mean the totality of all factors other than the class of mobile workers denoted by l_i.

Second, it is inessential to require that *all* of the workers in this class be mobile. If, for instance, the parameters of the model are such that workers migrate from 2 to 1, then the potential mobility of workers in 1 is irrelevant to the analysis.

Similarly, the model does not require that all workers in region 2 (the region of origin) be mobile. It is necessary only that a number sufficient to equalize incomes be freely mobile.

III. TAXES, TRANSFERS, AND THE INCOME DISTRIBUTION FRONTIER

Let us now consider how redistributive transfers undertaken within region 1 can be manipulated to vary the distribution of income with and without migration. Let s be a per capita subsidy paid to all l_1 mobile residents in region 1, financed by a lump-sum tax on the owners of immobile factors in region 1.[5] Let

$$X_1 = n_1(w_1 + s) = n_1(f_1'[l_1] + s) \tag{2}$$

denote the total (subsidy-inclusive) income of the n_1 workers initially located in region 1, and let

$$Y_1 = f_1(l_1) - l_1 f_1'(l_1) - s l_1 \tag{3}$$

denote the income accruing to the owners of fixed factors in region 1 net of the taxes required to finance the subsidy to mobile workers. This net income measure subsumes the government budget constraint.

With a closed border, $l_1 = n_1$. The curve PQ in figure 2 portrays the *income distribution frontier* for the closed-border case, showing different possible values of (X_1, Y_1) corresponding to different subsidy rates s. The total income in region 1 in this case is fixed and equal to $f_1(n_1)$, so that the incomes of workers and of owners of immobile factors trade off unit for unit. Let point A represent the income distribution when $s = 0$.[6] The endpoint P corresponds to case where the entire fixed total income $f_1(n_1)$ accrues to the owners of fixed factors, so that $s = -f'(n_1)$ is actually a tax assessed on workers. At Q, $s = [f_1(n_1) - n_1 f_1'(n_1)]/n_1$, and all income accrues to workers. Given the assumption of fixed per worker labour supply, taxes and subsidies are non-distorting and PQ has a slope of -1.

When the border between regions 1 and 2 is open, higher levels of s attract additional workers to region 1. The free-migration equilibrium condition $f_1'(l_1)+s = f_2'(l_2)$ together with (1) defines an implicit function $l_1(s)$ with $l_1' = -(f_1''+f_2'')^{-1} > 0$,

5 The subsidy could be expressed as a percentage of income rather than in per capita terms without changing the results. Note that this formulation assumes that both migrants and native residents receive equal treatment with respect to tax and transfer policy. This issue is discussed further in the conclusion. Two recent papers dealing with income redistribution and mobility, though with concerns rather different from the present analysis, should be mentioned here. Epple and Romer (1991) present a majority-voting model of property-tax-financed local redistribution in which there is a high level of redistribution when voters are not landowners but a low level when they are. In the former case, redistribution is a transfer from landowners to voters. This distinction between owners of fixed factors and other households plays a crucial role here, as well. Crane (1992) also analyses income redistribution in a model with non-traded goods. Crane focuses on the normative implications of decentralized vs. centralized redistribution.

6 That is, $X_1 = n_1 f_1'(n_1)$ and $Y_1 = f_1(n_1) - n_1 f_1'(n_1)$ at A.

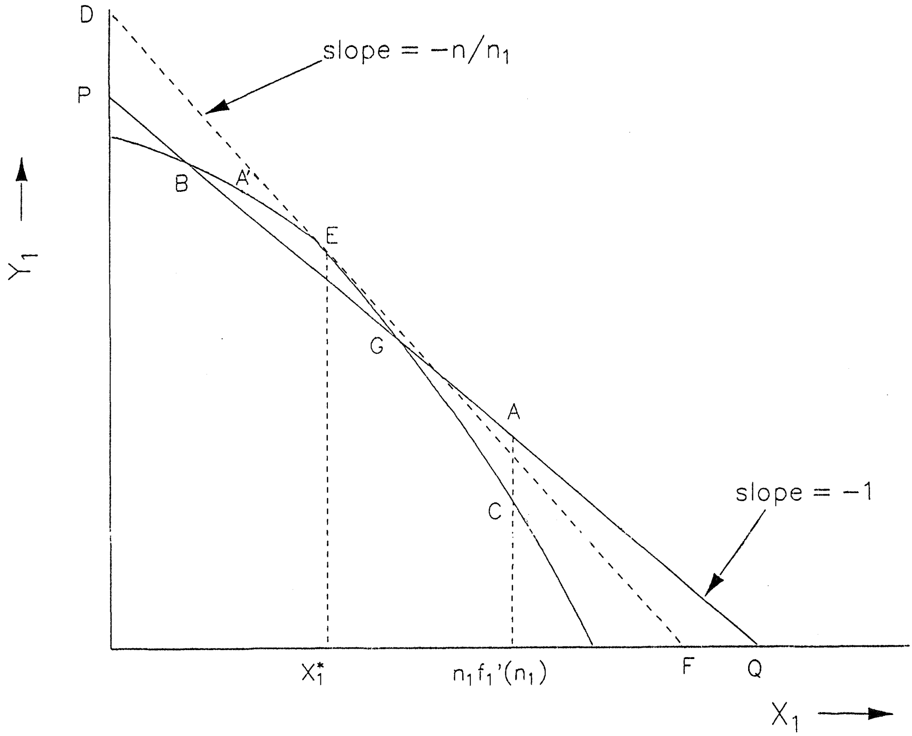

FIGURE 2

showing the equilibrium level of labour supply in 1 given s. In figure 1, with $s > 0$, the equilibrium labour allocation is shown as $l_1(s)$.

Opening up migration changes the income distribution frontier. For concreteness, suppose throughout all of the following discussion that the wage in region 1 is higher than that in 2 in the absence of migration, as portrayed in figure 1. Consider first the effect of migration when there is no redistribution, so that $s = 0$. Since $l_1(0) > n_1$, $f_1'(l_1[0]) < f_1'(n_1)$ and hence the incomes of native workers must fall relative to the pre-migration level at A. The return to the fixed factors in region 1 rises as the regional labour force rises, and indeed the increase in income to owners of fixed factors must exceed the loss in income to the native workers.[7] Thus, the income distribution with free migration and no redistribution is given by a point like A' in figure 2, lying above PQ.

7 *Proof.* Given $s = 0$, the change in $X_1 + Y_1$ due to an increase in l_1 is

$$\frac{d(n_1 f_1'[l_1] + f_1[l_1] - l_1 f_1'[l_1])}{dl_1} = (n_1 - l_1) f_1''(l_1),$$

which is positive for all $l_1 > n_1$.

Suppose now that one wanted native workers to have as much income in a free-migration equilibrium as they have at A, the no-redistribution no-migration point. This would require a subsidy, say $\tilde{s}$, implicitly defined by $f_1'(l_1[\tilde{s}]) + \tilde{s} = f_1'(n_1)$. At this subsidy rate, the income of the owner of fixed factors in region 1 is less than that corresponding to A.[8] Thus, the point C on the post-migration income distribution frontier corresponding to $s = \tilde{s}$ lies below point A.[9] One can also show that the income distribution frontier under free migration has a slope less than -1 (algebraically) for all points to the right of A'.[10] Thus, it crosses the frontier PQ only once between A' and C, and it is steeper than PQ everywhere to the right of A'.

Values of $s < 0$ (negative subsidies, i.e., taxes on mobile workers) discourage migration into region 1. There exists a value of $s = \mathbf{s}$ that would reduce immigration into region 1 to 0. This value of s satisfies $l_1(\mathbf{s}) = n_1$, that is, $f_1'(n_1) + \mathbf{s} = f_2'(n_2)$. At this value of s, $Y_1 = f_1(n_1) - n_1 f_2'(n_2)$ and $X_1 = n_1 f_2'(n_2) = f_1(n_1) - Y_1$. This income distribution, therefore, lies on the curve PQ at a point such as B. Clearly, for $s < \mathbf{s}$, the income distribution frontier lies below PQ.

To summarize some of the more important implications of this analysis, let (s^0, X_1^0, Y_1^0) denote the subsidy rate and income levels in a situation where the boundary between regions 1 and 2 is closed and no migration occurs, and let (s', X_1', Y_1') represent the same variables in a free-migration equilibrium. Consider a comparative-statics change from a no-migration situation to a free-migration equilibrium.

PROPOSITION 1. *(a) Suppose that there is no redistribution in region 1 either before or after migration is permitted ($s^0 = s' = 0$). Then the income of mobile workers is lower and the income accruing to the owners of the fixed factors is higher in a free-migration equilibrium than when the border is closed (i.e., $X_1' < X_1^0$ and $Y_1' > Y_1^0$). (b) Suppose that $s^0 > 0$ in an initial no-migration situation. Then, in a free migration equilibrium, either the net income accruing to mobile workers must fall ($X_1' < X_1^0$), the net income accruing to owners of fixed factors must fall*

8 At $s = \tilde{s}$, $\tilde{l}_1 = l_1(\tilde{s}) > n_1$. $Y_1 = f_1(\tilde{l}_1) - \tilde{l}_1 f_1'(\tilde{l}_1) - \tilde{s}\tilde{l}_1 = f_1(\tilde{l}_1) - \tilde{l}_1 f_1'(n_1)$. Expanding f_1 about n_1, $f_1(\tilde{l}_1) = f_1(n_1) + (\tilde{l}_1 - n_1) f_1'(n_1) + \frac{1}{2}(\tilde{l}_1 - n_1)^2 f_1''(\lambda)$ for some $\lambda \in (n_1, \tilde{l}_1)$. By concavity of f_1, it follows that $f_1(\tilde{l}_1) - \tilde{l}_1 f_1'(n_1) < f_1(n_1) - n_1 f_1'(n_1)$.

9 Brecher and Choudhri (1990) show that in an economy with no initial distortions, opening the economy to factor migration is not Pareto-improving. The present finding that the free-migration income distribution frontier lies below the initial no-redistribution point appears to confirm the Brecher-Choudhri result.

10 To see this, note that $dY_1/ds = -l_1(1 + f_1'' l_1') - s l_1'$, while $dX_1/ds = n_1(1 + f_1'' l_1')$. Hence, along the frontier,

$$dY_1/dX_1 = -\frac{l_1}{n_1} - \frac{s l_1'}{n_1(1 + f_1'' l_1')}.$$

For $s > 0$, $l_1 > n_1$; since $l_1' > 0$ and $dX_1/ds > 0$, $dY_1/dX_1 < -1$. One can show, incidentally, that the frontier is concave in a neighbourhood of $s = 0$. It is globally concave if $f_2''' = 0$. However, concavity properties are not needed for the following analysis.

($Y_1' < Y_1^0$), or both, depending on the value of s'. In particular, holding $X_1' = X_1^0$ implies that $Y_1' < Y_1^0$ and holding $Y_1' = Y_1^0$ implies that $X_1' < X_1^0$.

Part (a) of this proposition is the observation that A' is northwest of A, and part (b) is the observation that the income distribution frontier with free migration lies below and to the left of the segment AQ of the no-migration income distribution frontier PQ.

IV. THE INCOME DISTRIBUTION FRONTIER WITH INTERREGIONAL TRANSFERS

There have been many discussions in the trade literature of the famous 'transfer problem.' The question addressed in that literature (see Bhagwati et al. 1983 for a recent treatment) is whether it might be possible for one country to gain (in a welfare sense) from transferring resources to another country. The answer is yes, for reasons that have to do with the general equilibrium terms of trade effects of such transfers. These effects cannot arise in the present model, since both regions produce the same homogeneous output whose price is invariant. However, it is still possible that one region might benefit from making transfers to another purely for fiscal reasons.

To explore this possibility, let us modify the model by now supposing that region 1 is able to offer resources to region 2 which are equivalent, in their effect, to a per capita subsidy to mobile workers residing there.[11] Cash subsidies to workers would be the most direct form of such a transfer program. In practice, in-kind transfers of food, housing, or medical supplies, provision of technical expertise or other resources that raise real wages, or provision of public goods and services may be more commonplace and, in some cases, perhaps more focused and salient instruments of policy that would achieve the same objective.

It is impossible to capture all of these policy instruments in any detailed way in a simple model. The crucial question, however, is whether expenditures by one region on behalf of mobile residents of another region can serve the donor's interests by forestalling migration or by limiting its extent. To address this question in its starkest form, let us restrict attention to pure cash transfers, where σ denotes the subsidy or expenditure per recipient paid by residents of region 1 to mobile workers in region 2. Thus, region 1 now has three policy instruments: s, σ, and the lump-sum tax imposed on owners of immobile factors in the region. The total income accruing to the original workers residing in region 1 is still given by (2). The net income received by the owners of immobile factors is reduced by the added subsidy paid to workers in region 2, that is,

$$Y_1 = f_1(l_1) - l_1 f_1'(l_1) - sl_1 - \sigma l_2 \tag{4}$$

11 It is trivial to show transfers accruing to immobile households in region 2 cannot directly benefit region 1 within the context of the model used here. They are therefore ignored.

instead of (3). The equilibrium value of l_1 is still determined by equalization of net incomes for mobile workers. However, that condition must now reflect the transfers paid to workers residing in region 2:

$$f_1'(l_1) + s = f_2'(l_2) + \sigma. \tag{5}$$

This condition together with (1) determine the equilibrium values of l_1 and l_2 as implicit functions of $s - \sigma$, such that $l_1' = -(f_1'' + f_2'')^{-1} = -l_2' > 0$.

How does the availability of the new policy instrument, σ, affect the income distribution frontier in region 1? Of course it cannot shrink the frontier, which is an envelope. However, it is not obvious that the frontier actually shifts out. To see whether it does, note that the values of s and σ corresponding to any point $(\bar{X}_1, \bar{Y}_1)$ along the frontier must be a solution to the optimization problem

$$\max_{\langle s,\sigma \rangle} \; Y_1 \text{ subject to } X_1 \geqq \bar{X}_1 \tag{P}$$

where X_1 and Y_1 are given by (2) and (4). The first-order conditions for this optimization problem imply that, along the income distribution frontier,[12]

$$\sigma = s + l_2 f_2'' \tag{6}$$

or, equivalently,

$$h(s - \sigma) \equiv s - \sigma + l_2(s - \sigma) f_2''(l_2[s - \sigma]) = 0. \tag{6$'$}$$

A second-order necessary condition for a solution to (P) is that[13]

$$h' = 1 + l_2' f_2'' + l_2 f_2''' l_2' \geqq 0 \tag{7}$$

at the optimum. Obviously it is sufficient that $h' > 0$ globally. This is a relatively weak condition, which will be assumed below in order to simplify the analysis.[14]

12 *Proof.* Form the Lagrangian $L = Y_1 - \lambda(\bar{X} - X_1)$ and derive the first-order conditions:

$$s: \; -l_1 f_1'' l_1' - (s - \sigma) l_1' - l_1 + \lambda n_1 (f_1'' l_1' + 1) = 0$$

$$\sigma: \; l_1 f_1'' l_1' + (s - \sigma) l_1' - l_2 - \lambda n_1 f_1'' l_1' = 0.$$

Eliminating λ from these equations and some algebraic manipulation yields (6). Note that maximizing Y_1 subject to $X_1 \geqq \bar{X}_1$ is equivalent to maximizing X_1 subject to $Y_1 \geqq \bar{Y}_1$. Either approach leads to (6) as a characterization of points along the income distribution frontier.

13 Details are given in the appendix.

14 Several examples illustrate the meaning of the assumption $h' > 0$. First, note that if f_2 is quadratic (i.e., $f_2(l_2) = a_2 l_2 - b_2 l_2^2$), with a_2, b_2 positive, $f_2''' = 0$ and $h' > 0$ globally. Second, if f_2 is logarithmic (i.e., $f_2(l_2) = a_2 \log(l_2)$, $a_2 > 0$, $f_2''' = -l_2^2 < 0$ and again $h' > 0$ globally. Third, if f_1 and f_2 are Cobb-Douglas and identical, that is, $f_1 = a l_1^\alpha$, $f_2 = a l_2^\alpha$, with a, α both positive), then $h' = (f_1'' + f_2'')^{-1}(f_1'' + 2f_2'' + l_2 f_2''') = (l_1^{\alpha-2} + l_2^{\alpha-2})^{-1}(l_1^{\alpha-2} + \alpha l_2^{\alpha-2}) > 0$. Relaxation of the assumption that $h' > 0$ seems to raise issues mainly of a technical nature.

The income distribution frontier for region 1 can now be characterized:

PROPOSITION 2. *Assume that $h' > 0$ globally.*
(i) Any point $(\bar{X}_1, \bar{Y}_1)$ on the income distribution frontier for region 1 is associated with values $(\bar{s}, \bar{\sigma})$ and an allocation of labour $(\bar{l}_1, \bar{l}_2) = l_1(\bar{s} - \bar{\sigma}), l_2(\bar{s} - \bar{\sigma})$ such that $\bar{s} - \bar{\sigma} = \delta^*$ and $l_i(\bar{s} - \bar{\sigma}) = l_i(\delta^*) \equiv l_i^*$ $(i = 1, 2)$ for some fixed $\delta^* > 0$, independent of $(\bar{X}_1, \bar{Y}_1)$. Further, define $X_1^* \equiv n_1(f_1'[l_1^*] - l_2^* f_2''[l_2^*])$. Then $\bar{\sigma} = (\bar{X}_1 - X_1^*)/n_1$.
(ii) The income distribution frontier for region 1 has a constant slope of $dY_1/dX_1 = -\bar{n}/n_1 < -1$.

Proof. Assuming $h' > 0$ implies that there is a unique value δ^* such that $h(\delta^*) = 0$. The equilibrium level of employment in region i is $l_i^* = l_i(\delta^*)$ whenever $s - \sigma = \delta^*$. For any point $(\bar{X}_1, \bar{Y}_1)$ on the income distribution frontier for region 1, the corresponding values of $\bar{s}$ and $\bar{\sigma}$ must satisfy (6)$'$, that is, $\bar{s} - \bar{\sigma} = \delta^* = -l_2^* f_2''([l_2^*])$. Hence, $\bar{X}_1 - X_1^* = n_1(f_1'[l_1^*] + \bar{s} - f_1'[l_1^*] + l_2^* f_2''[l_2^*]) = n_1(\bar{s} - \delta^*) = n_1\bar{\sigma}$.
Next, note that $\bar{Y}_1 = f_1(l_1^*) - (l_1^*/n_1)\bar{X}_1 - \bar{\sigma} l_2^*$. Using the fact from (i) that $\bar{\sigma} = (\bar{X}_1 - X_1^*)/n_1$ and differentiating yields (ii). QED

As noted, the fact that $s - \sigma$ is held fixed along the income distribution frontier implies that the allocation of labour is unchanged along the frontier as well. This suggests that redistributive transfer instruments are being used to achieve an allocation of labour that is, in some sense, 'optimal' from the viewpoint of jurisdiction 1. To make this intuition precise, let $Y_2 \equiv f_2(l_2) - l_2 f_2'(l_2)$ denote the income accruing to the owners of immobile factors in jurisdiction 2, and let $X = \bar{n}(f_1'(l_1) + s)$ (which is equal to $\bar{n}(f_2'(l_2) + \sigma)$ given equilibrium migration) denote the total net income accruing to the entire population of workers. The total income received by all factor owners in the two jurisdictions taken together is $X + Y_1 + Y_2 = f_1(l_1) + f_2(l_2)$ and hence

$$Y_1 = f_1(l_1) + f_2(l_2) - Y_2 - X.$$

Note that the constraint in (P) that $X_1 \geqq \bar{X}_1$ is equivalent to the constraint that $X \geqq \bar{X}$ where $\bar{X} = (\bar{n}/n_1)\bar{X}_1$. Provided that this constraint is binding, problem (P) is essentially equivalent to the unconstrained problem

$$\max_{\langle l_1 \rangle} Y_1 = f_1(l_1) + f_2(l_2) - Y_2 - \bar{X}$$

$$= f_1(l_1) + l_2 f_2'(l_2) - \bar{X}, \tag{P$'$}$$

that is, the problem of allocating population so as to maximize total ('social') income $f_1 + f_2$ (up to a constant $-\bar{X}$) minus the income accruing to immobile factor owners in region 2. Differentiating with respect to l_1 (and using the fact that $l_2 = \bar{n} - l_1$) yields the first-order condition

$$f_1'(l_1) - f_2'(l_2) - l_2 f_2''(l_2) = 0;$$

recalling that $f_1' - f_2' = -(s - \sigma)$ given free migration, this condition is identical to (6). What this illustrates is that solving problem (P) amounts to using the transfer instruments (s, σ) to allocate population across jurisdictions so that the income accruing to agents other than the immobile factor owners in region 2 is maximized. There is a unique population division between the two jurisdictions that achieves this outcome.[15]

Proposition 2 has a number of important implications. First, it shows that *when it is possible to make interregional transfers to mobile workers, the interregional allocation of labour does not change as the net income distribution in region 1 is altered.* Therefore, *total production, gross factor prices, and gross factor incomes in both regions are the same at all points on the income distribution frontier for region 1.*

Allowing σ to be used as a policy instrument therefore changes matters quite dramatically. Along the curve $BA'C$ in figure 2, higher values of X_1 correspond to higher values of s and also to higher values of l_1, as higher subsidies to mobile workers attract additional workers from region 2. By contrast, when it is possible to pay subsidies to mobile workers in region 2 as well as to those in region 1, the interregional subsidy differential $s - \sigma$ is set equal to a constant (namely, δ^*) no matter which point on the income distribution frontier for region 1 is to be achieved. Thus, higher values of X_1 are achieved by increasing both s and σ in such a way that $s - \sigma$ remains constant. Simultaneous increases in s and σ do not induce mobile workers to move into region 1, and thus different levels of X_1 and Y_1 can be achieved while keeping the allocation of labour unchanged.[16]

Geometrically the income distribution frontier for region 1 when subsidies can be paid to workers in both regions is just a straight line with a slope of $-\bar{n}/n_1$. It is shown in figure 2 as the dashed line DEF. It must be tangent to $BA'C$, the income distribution frontier when transfers can be made only to mobile workers in region 1, at a point like E, lying to the right of A'. Recall that $s = 0$ at the no-redistribution point A' and that $s > 0$ to the right of A' along $BA'C$. At the value $s = \delta^* > 0$ the value of σ according to (6) is $\sigma = 0$. That is, point E corresponds to an income distribution at which it is undesirable to pay make any transfer to (or from) the mobile workers in region 2, even if it is feasible to do so. At this point, the frontiers $BA'C$ (along which σ is constrained or assumed to be zero) and DEF (along which non-zero values of σ are permissible) must coincide.

15 As an example, straighforward calculations reveal that the 'optimal' population in region 1 is given by $l_1^* = 2\bar{n}/3$ in the special case where both regions have identical quadratic production functions.

16 A referee has insightfully observed that (6) can be written as an inverse-elasticity formula:

$$\frac{s - \sigma}{w_2} = \frac{1}{-\epsilon_2},$$

where ϵ_2 is the elasticity of demand for labour in region 2. When $s > \sigma$, fiscal incentives distort the allocation of labour. This formula shows that the optimal implicit tax wedge on immigrant labour is inversely related to the supply of immigrant labour to region 1, rather like an optimal tariff formula (in this case, for an imported factor).

Points along the segment DE of the frontier DEF correspond to income distributions that are obtainable only by taxing mobile workers in region 2 (that is, by setting $\sigma < 0$), while point along EF are attained by offering positive subsidies to those workers ($\sigma > 0$). In fact, at the point E, $X_1 = X_1^* = n_1(f_1'[l_1^*] + \delta^*)$. For any $X_1 \lesseqgtr X_1^*$, $X_1 = n_1(f_1'[l_1^*] + s)$ with $s \lesseqgtr \delta^*$ and $\sigma = s - \delta^* \lesseqgtr 0$. Thus, the frontier DF must lie strictly outside the frontier $BA'C$ at all points other than E. Finally, one can show that DEF must lie below the original no-migration income distribution frontier PQ for any value of $X_1 \geqq n_1 f_1'(n_1)$. That is, the segment AQ must lie above the frontier DEF.[17]

While the entire frontier DEF is attainable if both s and σ can be freely chosen, it may be impossible in practice to for region 1 to choose negative subsidies, that is, taxes, for the mobile workers in region 2. This is certainly the case if the two regions correspond to different countries, in which case workers in region 2 would simply not be within the jurisdiction of region 1. In this case, only that part of the frontier DEF corresponding to non-negative transfers to mobile workers is relevant for policy, and the income distribution frontier for region 1 is the curve $BA'E$ for values of $X_1 < X_1^*$ and is the segment EF of DEF for $X_1 > X_1^*$.

V. CONCLUSION: IMPLICATIONS, GENERALIZATIONS, AND LIMITATIONS OF THE ANALYSIS

1. Welfare implications

The analysis so far has examined only the possible distributions of income that are attainable in a world with mobile households and different types of policy instruments. Once the income distribution possibilities are known, however, many implications of the analysis for welfare of households in region 1 are obvious, provided that one confines attention to those who are *initial* residents. The most clear-cut results emerge in the case where all factor owners are entirely self-interested, so that their welfare levels may be identified with their income levels X_1 and Y_1. The income distribution frontier in such a society is identical to its utility-possibility frontier. If instead households are altruistic, their welfare may depend on both X_1 and Y_1. A social welfare function, which represents some social procedure for trading off income across population groups, would also depend (positively) on both X_1 and Y_1.

In the case where all households are self-interested, the following conclusions can be read off immediately from figure 2. First, allowing free migration instead of no migration can result in a Pareto-improvement relative to the zero-migration situation, since parts of the income redistribution frontier with free migration (either

17 The proof is virtually identical to the proof that C in figure 2 lies below A. When no migration is allowed, $X_1 = n_1 f_1'(n_1)$ at point A. With free migration, $s = \sigma = 0$ implies $X_1 < n_1 f_1'(n_1)$. Thus, to achieve $X_1 = n_1 f_1'(n_1)$ in the presence of migration requires some $\bar{s} > 0$ and $\tilde{\sigma} \geqq 0$, $\tilde{l}_1 > n_1$, and $\tilde{l}_2 < n_2$. The corresponding value of Y_1 is $\tilde{Y}_1 = f_1(\tilde{l}_1) - \tilde{l}_1 f_1'(\tilde{l}_1) - \tilde{s}\tilde{l}_1 - \tilde{\sigma}\tilde{l}_2 = f_1(\tilde{l}_1) - \tilde{l}_1 f_1'(n_1) - \tilde{\sigma}\tilde{l}_2 \leqq f_1(\tilde{l}_1) - \tilde{l}_1 f_1'(n_1) < f_1(n_1) - n_1 f_1'(n_1)$, which is the value of Y_1 at point A. Thus the income distribution frontier with free migration lies below A. Since it has a slope less than -1, it lies below the frontier PQ for all $X_1 > n_1 f_1'(n_1)$.

$BA'C$ or $BA'EF$) lie above the no-migration frontier PQ. However, they lie above PQ only to the left of the no-redistribution point A. Hence, *free migration* can be *Pareto-improving only if, in the no-migration situation, resident mobile workers (and non-resident mobile workers, if possible) are being taxed to provide transfer payments to owners of immobile factors*. Second, free migration can lead to Pareto-inferior outcomes. In particular, both the income distribution frontiers and migration ($BA'C$ and DF) lie below PQ to the right of the no-redistribution point A. Thus, *free migration cannot lead to Pareto-improvements, and may lead to Pareto-inferior outcomes, if, in the no-migration situation, owners of immobile factors are being taxed to provide transfer payments to mobile workers*. These two observations suggest that a country may wish to open itself to immigration by high-income 'fiscal contributors' but not to low-income (or aged, sick, etc.) 'fiscal beneficiaries.'

Third, the use of transfers from owners of immobile factors in region 1 to mobile workers in region 2 can shift out the income distribution frontier in the presence of migration, from EC to EF. Hence, given free migration, *it may be Pareto-improving for region 1 to make transfers to non-resident mobile workers in region 2*. And, recall that $l_1 = l_1^*$ along the entire segment EF. That is, *transfers to mobile workers in region 2 from owners of immobile factors in region 1 serve to limit immigration into region 1 to some maximal level. Allowing greater levels of migration can be Pareto-harmful.*

Thus, it can be advantageous, from a welfare viewpoint, for a region with an open border to make transfer payments to mobile workers in another region. The benefit from doing so comes precisely from the opportunity thus provided to limit migration to a maximum advantageous level. This argument for the 'gains from giving' differs from that given in previous discussions of the 'transfer problem.' There, the gain to a donor country from the transfer of resources to another country depends crucially on the general equilibrium change in the commodity price structure in an otherwise undistorted economy. By contrast, the potential benefits to the donor region in the present analysis are purely fiscal in nature: region 1 can benefit from subsidizing mobile workers in the other region (i.e., choosing $\sigma > 0$) only if it makes positive transfers to its own workers (i.e., if $s > 0$). There are no such gains to be had if region 1 does not engage in income redistribution in favour of mobile workers. Therefore, *the welfare gains to region 1 from transfers to region 2 cannot occur in an undistorted equilibrium; they arise only in a second-best environment with distortions of resource allocation brought about by redistributive policy in favour of mobile workers.*[18]

18 The discussion so far has focused on the welfare of the original factor owners in region 1, and the results do not depend on details of the specification of factor markets or policies in region 2. Suppose, however, that factor markets in region 2 are competitive, and that region 2 does not engage in any income redistribution. Subsidies from region 1 to the mobile workers in region 2 limit migration from 2 to 1, ceterus paribus, and raise the incomes of immobile factor owners in region 2. Thus, *transfers from region 1 to workers in region 2 can give rise to a Pareto-improving redistribution of income*, raising the welfare of immobile factor owners in both regions as well as the welfare of workers. It is noteworthy that this occurs without any utility interdependencies, which is the hallmark of standard theories of 'Pareto optimal redistribution' (e.g., Hochman and Rogers 1969).

Fourth, note that if region 1 is small relative to region 2, the ability of region 1 to change the net income of mobile workers is also small. In this case, the supply of labour from region 2 becomes very elastic, causing the income distribution frontier to become steep (recall that the slope of the income distribution frontier is $-\bar{n}/n_1$ when transfers are made from region 1 to region 2). A single small jurisdiction therefore has little to gain from making transfers to a large origin jurisdiction.

Let us now briefly consider the welfare implications of the analysis when altruism exists or when there is a social welfare function that can resolve distributional problems. A social welfare function can be represented by a function $u(X_1, Y_1)$, depending positively on the net income of both groups of factor owners. A function of this form would also represent the welfare of any households in the economy who are altruistic toward others.

Suppose, to take an idealized case, that redistributive policy in region 1 is set in such a way as to maximize social welfare, and suppose that the border of region 1 is initially closed. Initially, social welfare maximization leads to an income distribution somewhere along PQ. A revealed preference argument establishes the following. *If redistributive policy favours mobile workers in the no-migration situation (i.e., the initial social-welfare-maximizing policy lies on AQ), then welfare cannot be increased by free migration while the net incomes of mobile workers is maintained.* That is, starting at an initial optimum along AQ, it is impossible to achieve a preferred outcome along either $BA'C$ or along EF at any point to the right of A. The income distribution frontier with free migration does lie above PQ at some points to the left of A, and it is possible that the gains in net incomes to owners of immobile factors in the post-migration situation could be so large that they offset the losses to mobile workers. (For instance, A' itself could be preferred to any point along AQ for some preference structure.) Of course, as already noted above, allowing migration can actually be Pareto-improving if mobile workers are subject to taxation. In particular, *if social welfare in the no-migration situation is maximized at a point somewhere along the segment BG, revealed preference implies that welfare must rise with free migration.*

The welfare implications of migration when some (or all) households are altruistically motivated are quite similar to those just discussed. The nature of the argument in this case can be seen from one illustration. Take the case where the owners of immobile factors in region 1 (say, the rich) care about the welfare of mobile workers (the poor) and the mobile workers are self-interested. If the rich are sufficiently altruistic, their welfare in the no-migration situation would be maximized at some point along PQ to the right of A. The welfare of the poor would be maximized at Q. If the redistributive policy of region 1 is determined by a political process that responds positively to the interest of the region's residents, a policy of transfers from rich to poor will occur in the initial no-migration equilibrium, somewhere to the right of A and presumably somewhere between the optimum of the rich and point Q. It is now obvious that allowing for migration cannot be Pareto-improving. Either the new income distribution will lie to the left of the original one, in which case it hurts the native workers, or it lies to the right and below the original one, at an income distribution that has been revealed inferior with respect to the preferences of the rich.

2. Redistribution in a federal system

Suppose that region 1 does engage in redistribution in favour of mobile workers. We have seen that it might benefit by making transfers to workers in the other region. If the two regions represent different countries, such transfers could be implemented by transfers from the government of region 1 to the government of region 2. Region 1 may have very imperfect control over the use of resources that it transfers to region 2, however, and, in particular, it might be difficult to insure that such transfers are directed to the mobile workers in region 2 that are the desired beneficiaries from the donor country's viewpoint.

On the other hand, suppose that two jurisdictions form a federation and assign to the central government of the federation the task of implementing redistributive policies that transfer resources from owners of immobile factors to mobile factors. It is certainly possible that such a federation could be Pareto-improving from the viewpoint of the initial residents of the donor region, provided that that region would have undertaken redistribution in favour of mobile workers in any case and provided that migration could not be effectively limited by closing the border between the two regions. Not surprisingly, the residents of the region that receives net transfers in such a federation may also be made better off. The centralization of the redistributive function of government through establishment of a federation of jurisdictions can therefore be welfare-improving overall.

Of course, the formation of federations is a very complex process that entails many benefits and costs other than those associated with income redistribution. In any federation, however, some decision must be reached about the extent of redistributive activity to be undertaken by different levels of government. In the United States, for example, all levels of government – federal, state, and local – engage in policies that redistribute income. Greater centralization of the redistributive function inevitably entails net redistributions among regions, since some make net contributions and others receive net benefits from the redistributive policies of higher-level governments. This system corresponds loosely with interregional transfers of the type analysed above. The fiscal equalization system and Established Programs Financing in Canada obviously transfer resources from some provinces to others, as do other centralized redistributive policies (Boadway 1992). Within this policy context, the foregoing results suggest that regions that provide net contributions to a federation may actually benefit from this aspect of membership in the federation, or at least might not lose as much as would otherwise appear to be the case. Such gains would result from reductions in the level of fiscally induced migration that would otherwise result from redistributive activities undertaken by the individual regions.[19]

19 Results somewhat similar to those presented here appear in Myers (1990). In Myers's model, individual jurisdictions voluntarily transfer resources to others because all households in the entire

3. Generalizations and limitations

Some of the assumptions underlying the preceding analysis can be relaxed without changing the results. Since the analysis focuses on the income distribution possibilities in region 1, it is not extremely sensitive to the precise specification of factor market conditions in region 2. Although marginal productivity factor pricing has been assumed in region 2, one main role of this assumption is simply to generate an upward-sloping supply of mobile workers from region 2 to region 1. For those parts of the analysis and results that pertain to migration from region 2 to region 1, one could simply assume the existence of such a supply curve without postulating a competitive labour market in region 2. It is also straightforward to accommodate migration costs in the model without much change in the analysis or results, provided that the migration costs are not prohibitively high. Suppose that migration from region 2 to 1 entails some cost c per migrant. Then the effective supply of labour from region 1 is given by the curve $f_2'(l_2) - c$, that is, the original supply curve shifted down by the amount c. For those parts of the analysis concerning migration from region 2 to region 1, the fact that the supply curve has shifted down changes nothing essential and the previous results go through. For issues involving migration from region 2 to 1, the two really critical assumptions for the analysis are that there is an upward-sloping supply of mobile labourers, and that this supply curve can be shifted downward by subsidies paid by region 1 directly or indirectly to workers in region 2; any specification of labour markets in region 2 that preserves these properties will be consistent with the model developed above.

The model used above has been deliberately simplified, and it is useful to conclude by highlighting some of its limitations. First, the model assumes that all factors of production can be aggregated into two groups and that households can own only one or the other of these factors. These stylized assumptions suppress many possible general-equilibrium interactions in factor pricing and oversimplify the effect of migration and policy on the personal distribution of income. Second, the model abstracts from the effects of migration and public policy on the general equilibrium structure of production, prices, and trade. As shown in previous literature, migration can change factor supplies in both the origin and the destination regions which, according to well-known trade theorems, will cause some industries to expand and others to contract. Such considerations are precluded here by the assumption of homogeneous production, but they might be important in practice.

economy are identical and freely mobile. Any transfers that can raise the *common* level of welfare for all households will therefore be undertaken. (Boadway (1982) showed that regions choose efficient public expenditure policies in such a setting, and Wellisch (1992) extends this idea to a model with environmental spillovers and free migration.) The gains from voluntary transfers in the present analysis, however, occur despite the fact that not all households are identical. Hercowitz and Pines (1991) develop a model where households are ex ante identical but then receive random draws from an earnings distribution for each of two regions; depending on these draws and migration costs, household may relocate from one region to another. Hercowitz and Pines also allow for resource rents in one of the regions and show that it may be advantageous in some cases for one jurisdiction to share its rent with the other. This model incorporates ex post heterogeneity; in contrast to much of the literature, however, wages and rents are not generated as the marginal products from an underlying production technology, and redistributive policy therefore does not give rise to general equilibrium factor price responses.

Third, since the model is static, it cannot explicitly capture the dynamics of immigrant assimilation. As pointed out by Chiswick (1988) and Borjas (1990), among others, the status of immigrants, including illegals, changes over time. Immigrants who initially make net contributions to public pension programs may become benefit recipients later; young male migrants may initially place little burden on social medical care or educational institutions, but family members who join them later, or the original migrants themselves, may become net fiscal beneficiaries at a later stage. The static analysis presented above is not really designed to address these issues directly, but they should be borne in mind in interpreting the results. In particular, present-value interpretations of wages, subsidies, etc. might be necessary in order to avoid misleading conclusions.

APPENDIX

1. Second-order condition for (P)

It is convenient to convert (P) to an unconstrained problem. For notational convenience, let δ denote $s-\sigma$. From the definition (2) and the fact that l_i is a function of δ,

$$s = \frac{X_1}{n_1} - f_1'(l_1[\delta]).$$

Substituting into (4) and simplifying (noting that $l_2(\delta) = \bar{n} - l_1(\delta)$),

$$\begin{aligned} Y_1 &= f_1(l_1[\delta]) - l_1(\delta)f_1'(l_1[\delta]) - \delta l_1(\delta) - (s-\delta)\bar{n} \\ &= f_1(l_1[\delta]) - l_1(\delta)f_1'(l_1[\delta]) - \delta l_1(\delta) - \frac{\bar{n}}{n_1}X_1 + \delta\bar{n} + \bar{n}f_1'(l_1[\delta]). \end{aligned} \tag{A1}$$

Given any value of $X_1 = \bar{X}_1$, δ must be chosen to maximize Y_1 as given by (A1); that is, a problem with two instruments (s and σ) and one side constraint ($X_1 \geqq \bar{X}_1$) has been converted to an unconstrained problem with one instrument (δ). The first-order condition for a maximum of Y_1 with respect to δ is

$$\begin{aligned} \frac{dY_1}{d\delta} &= (-l_1 f_1'' - \delta + \bar{n}f_1'')l_1' + \bar{n} - l_1 \\ &= l_2(f_1'' l_1' + 1) - \delta l_1' \\ &= \frac{l_2 f_2'' + \delta}{f_1'' + f_2''} = 0, \end{aligned}$$

which is equivalent to (6).

The second-order condition is that $d^2Y_1/d\delta^2 \leqq 0$ at the maximum. Using the above first-order condition, the second-order condition is

$$\frac{d^2Y_1}{d\delta^2} = \frac{1 + l_2' f_2'' + l_2 f_2''' l_2'}{f_1'' + f_2''} \leqq 0,$$

which is equivalent to (7) in the text.

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