Trade Policy and North-South Migration

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November, 1997

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ABSTRACT

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Differences in the rate of population growth between developed and developing countries have potentially important implications for patterns of trade, migration, and the distribution of the gains from economic activity, both within and between nations. This paper focuses on migration-related effects. We offer a theoretical discussion of explicit theoretical linkages between population growth, trade policy and migration. This is illustrated with numerical examples emphasizing linkages between the changes in the terms of trade and migration patterns. The numerical analysis highlights issues not immediately evident from marginal analysis, including variations in the impact of policy over different time horizons.

Keywords: trade and wages, trade and migration, population growth and migration employment

JEL categories: [F11, F12, J21]

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This paper represents the opinions of the authors. It is not meant to represent, in any way, the opinions or official positions of any institution with they may have ever been affiliated in any way, nor of staff of such institutions. It was presented at a CEPR workshop on dynamic issues in applied commercial policy analysis, which received support through a grant from the Ford Foundation. All remaining errors are our own.

NONTECHNICAL SUMMARY

Differential rates of population growth between North and South represent a phenomenon of first rate importance, with implications for patterns of trade, migration, and the distribution of the gains from economic activity both within and between nations. After similar increases in population in the first half of this century, the second half of the century has been characterized by an extraordinarily rapid increase in Southern population relative to the North, with a continuation of that trend expected through the next century. The percent increase in Northern population was 44 percent from 1950 - 1990, and is projected to increase by 24 percent from 1990 - 2100. At the same time, the Southern population increased by 143 percent in the post-war period and is projected to increase by another 150 percent over the next century. With land fixed, and under most reasonable estimates of physical and human capital creation, these data suggest a potentially rapid divergence in relative endowments between North and South. In an even moderately open world economy, relative endowment changes of this magnitude can reasonably be expected to play a substantial role in any explanations offered for change in wages, employment and welfare.

The trend in differential population growth is given added significance by its perceived connection to the emergence over the last decade and a half of increasing inequality of earnings in the United States and increasing levels of unemployment in Europe. An exploding body of literature seeks to theoretically characterize and empirically evaluate the causes of increasing inequality in advanced industrial economies. While controversial among economists, it appears to be widely believed by the public in general and their political representative in particular that the decreasing economic conditions of poorer citizens are somehow (and in some degree) transmitted from abroad. The reason for this belief is clear enough: the declining labor market performance of poorer citizens is more-or-less contemporaneous with a deteriorating trade balance for labour intensive industries, and/or perceived surges in immigration. Both of these are easily connected conceptually to differential population growth: the deteriorating sectoral trade balance for labor intensive industries via increasing comparative disadvantage in labour-intensive importables; and the migration through straightforward arbitrage. Most recent research that has sought to evaluate the contributions of trade and migration to earnings inequality has tended to separate these two channels.

In this paper we focus directly on the connection between trade and migration and its implications for trade policy in the context of a stylized dynamic general equilibrium model. The key channels we identify relate to direct factor market effects of population growth, terms-of-trade effects, and induced scale effects. Trade policy enters the analytical mix through its impact on the terms-of-trade, efficiency, and scale effects.

If protection increases home country welfare through induced terms-of-trade effects, this has the effect of increasing the relative wedge between the home and foreign country. The results is that, by boosting welfare *at the expense of trading partners*, one unintended consequence may be to induce more migration from those same trading partners.

Beggar-thy-neighbor then implies invite-thy-neighbor. The addition of scale economies may magnify this incentive effect, since protection at home can force the effective production possibility set to shrink for the foreign country by reducing economies of specialization. The other side of this effect lurks behind the arguments for a liberal EU trade regime toward Eastern Europe and the Mediterranean countries. By mitigating adverse terms-of-trade effects, such an approach may alternatively moderate underlying migration incentives. In a similar vein, protection aimed directly at propping up wages may also lead to increased incentives for migration. In particular, if such protection at home prevents the export of the abundant factor (i.e. labour) through goods from the foreign country, such labour may instead be exported directly through migration. If we have a model with a non-traded labour-intensive sector, the negative wages effects of induced migration could conceivably outweigh the positive effects of protecting labour from trade-related pressure.

We also supplement the formal analysis with simple, numeric examples. The numerical analysis highlights issues not immediately evident in the theoretical analysis, including the dominance of different effects over different time horizons. This, in turn, points to the value of CGE-based trend analysis for the study of the interaction of trade and migration policy.

I. Introduction

Differential rates of population growth between North and South represent a phenomenon of first rate importance, with implications for patterns of trade, migration, and the distribution of the gains from economic activity both within and between nations. After similar increases in population in the first half of this century, the second half of the century has been characterized by an extraordinarily rapid increase in Southern population relative to the North, with a continuation of that trend expected through the next century. (See Table 1). The percent increase in Northern population was 44 percent from 1950 - 1990, and is projected to increase by 24 percent from 1990 - 2100. At the same time, the Southern population increased by 143 percent in the post-war period and is projected to increase by another 150 percent over the next century. With land fixed, and under most reasonable estimates of physical and human capital creation, these data suggest a potentially rapid divergence in relative endowments between North and South. In an even moderately open world economy, relative endowment changes of this magnitude can reasonably be expected to play a substantial role in any explanations offered for change in wages, employment and welfare.

The trend in differential population growth is given added significance by its perceived connection to the emergence over the last decade and a half of increasing inequality of earnings in the United States and increasing levels of unemployment in Europe. An exploding body of literature seeks to theoretically characterize and empirically evaluate the causes of increasing inequality in advanced industrial economies.[1] While controversial among economists, it appears to be widely believed by the public in general and their political representative in particular that the decreasing economic conditions of poorer citizens are somehow (and in some degree) transmitted from abroad. The reason for this belief is clear enough: the declining labor market performance of poorer citizens is more-or-less contemporaneous with a deteriorating trade balance for labour intensive industries, and/or perceived surges in immigration. Both of these are easily connected conceptually to differential population growth: the deteriorating sectoral trade balance for labor intensive industries via increasing

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[1] See Francois (1996) for a theoretical overview. Levy and Murnane (1992) provide a very useful survey of the research related to the US case, also see the February 1992 *Quarterly Journal of Economics* for a number of important empirical papers addressing the problem of increasing inequality in the US. A convenient source for the European case is Alogoskoufis *et al.* (1995). The upshot of virtually all research on labor markets in industrial countries is that there has been a dramatic worsening of the distribution of benefits from participation in the labor market over the

comparative disadvantage in labour-intensive importables;[2] and the migration through straightforward arbitrage. Most recent research that has sought to evaluate the contributions of trade and migration to earnings inequality has tended to separate these two channels.[3] In this paper we focus directly on the connection between trade and migration and its implications for trade policy in the context of a stylized dynamic general equilibrium model.

Ongoing changes of the magnitude of those shown in Table 1 generate serious problems for the application of the standard qualitative models that are generally employed in the analysis of commercial policy and growth. On the one hand, these are clearly non-marginal changes, while, on the other, these differentials are not consistent with steady-states. Deardorff (1990, 1994) has emphasized the importance of non-steady state analysis for assessing the evolution of open economies with differential population growth rates. In the context of applied general equilibrium models, the application of significant underlying trends to baseline data to reflect such non-steady state processes is called projection analysis. Recent work in this area includes Hertel et al (1995) and Haaland and Norman (1996).

In this paper, we focus on migration trends and their interaction with trade and commercial policy.[4] The next section provides some background discussion of general theoretical issues, and is followed by more focused theoretical discussion of explicit theoretical linkages between trade policy and migration. The theoretical discussion is then supplemented by numerical analysis based on a stylized general equilibrium

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last 15 or so years.

[2] The key to this argument is the now well-established fact that import-competing industries use unskilled labor relatively intensively (e.g. Murphy and Welch, 1991).

[3] Borjas, Freeman and Katz (1992) is an important exception. While Borjas, Freeman and Katz do explicitly consider the effects of both trade and migration, their focus is primarily on identifying labor market effects at a fairly disaggregated level. Thus, trade and migration are treated as exogenous shocks to the labor market. Our work in this paper is interested in a different question, the interaction of trade and migration flows in general equilibrium. Borjas, Freeman and Katz' finding that both trade and migration have had a significant effect on the labor market suggests that the attempt to examine the broader general equilibrium in which the labor market is embedded is a useful task.

[4] The recent computational literature on migration has focused, for the most part, on U.S.-Mexico migration patterns. This includes Hill and Mendez (1984), Robinson et al (1993), Levy and van Wijnbergen (1994), and Burfisher et al (1994). Weyerbrock (1995) examines migration from the FSU and Eastern Europe to Western Europe, while Hamilton and Whalley (1984) have examined North-

model that emphasizes the terms-of-trade effects of commercial policy. We finish with some suggestions for further research.

II. Background

The two primary direct channels through which the economic effects of differential rates of population growth can be transmitted internationally are trade in goods and factor flows.[5] Both channels have been widely studied in standard comparative static frameworks. The basic intuition of this literature can be drawn from a simple 2 good $\times$ 2 factor $\times$ 2 country, HOS model. For obvious reasons we will call the two factors labor and capital, the countries North and South, and the goods 1 and 2. Good 1 will be assumed *K*-intensive relative to good 2 and North will be *K*-abundant relative to South. At initial prices an increase in the Southern labor force will cause the Southern offer curve to rotate outward, producing a deterioration in the Southern terms of trade (i.e. a fall in the relative price of good 2). With free trade and identical technologies, and continuing to assume nonspecialization, commodity price equalization implies factor-price equalization, and thus *L*-owning households in both countries experience a real deterioration in welfare via Stolper-Samuelson effects.[6] Of course, with factor-price equalization there is no incentive for migration, as international commodity mobility is a perfect substitute for international factor mobility.[7]

Now suppose that Northern labor is protected by a non-prohibitive tariff on

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South migration.

[5] We are well-aware that indirect effects, such as those operating on the rates of growth of population, human capital and physical capital can easily dominate the direct effects in a well-specified dynamic model. Of at least equivalent significance are indirect effects that operate through the political system. However, as is well known, both of these sources of indirect effect are extremely sensitive to the microanalytic foundations of the relevant domain of choice. Thus, in this paper, we choose to focus on the direct transmission via migration and leave the indirect mechanisms unmodeled and implicitly fixed.

[6] We are abstracting from perversities of the Metzler-Johnson sort. We should also note that aggregate Southern welfare could fall as a result of the increase in population. This is Bhagwati's (1958) immiserizing growth. As Dixit and Norman (1980, pg. 135) show, such immiserization is linked directly to the Stolper-Samuelson effects.

[7] Econometric estimates of the effect of trade on wages range from essentially zero (Lawrence and Slaughter, 1993) to conclusions that trade is the main cause of declining wages of unskilled workers (Wood, 1994; Batra, 1993). To the extent that there is a median position, it is that the effect of trade is a small but significant--on the order 10-15%--cause of the increased wage inequality that emerged in the last 15 years. Recent surveys include Baldwin (1995) and Richardson (1995).

imports of good 2. We know, from countless studies on the inter-industry incidence of protection, that labor is generally protected by both tariffs and non-tariff barriers in industrial countries. If the Northern government responds to increased Southern competitiveness through increased protection, say because the Northern government has a Corden-type conservative social welfare function, *and if this protection works as intended*, the Northern real wage will exceed the Southern real wage, inducing migration of Southern labor. If labor is costlessly mobile, and still assuming nonspecialization in the post-migration equilibrium, migration will eliminate trade, completely undoing the effect of the tariff (Mundel, 1957). That is, the downward pressure on the wage induced by the increase in the Southern labor endowment is transmitted to Northern labor, this time by migration.[8]

Recent surveys of the immigration-wages link include Borjas (1994) and Friedburg and Hunt (1994). While this analysis very nicely links differential population growth to deteriorating returns to (unskilled) labor, and thus seems to rationalize political concerns about North-South trade, there are at least three broad classes of reason to treat such a conclusion/rationalization with caution: uncertainty about the empirical magnitude of the effect; sensitivity of the static model to empirically plausible variations in the assumptions; and sensitivity to the specification of dynamics. We consider each briefly.

As with the trade-wage connection, attempts to econometrically evaluate the effect of migration on wages of unskilled native workers yield a wide range of estimates, ranging from essentially zero impact (e.g. Card, 1990; Butcher and Card, 1991; Altonji and Card, 1991; Lalonde and Topel, 1991) to something like 15-25% of the differential between skilled and unskilled wages (Borjas, Freeman, and Katz, 1992).[9] Virtually all of these attempts to quantify the effects of trade and migration on relative wages have been controversial, and this is true even in an environment with sizable

[8] As a check on the reliability of the model as an intuition generator, it is useful to note that Southern labor growth is transmitted to the North *either* by trade *or* migration, but not by both. This is just (once again) the fact that, in this model, trade and factor mobility are perfect substitutes. The fact that we observe sizable flows of both suggests caution. A very interesting recent paper by Norman and Venables (1995) incorporates international transaction costs in the standard HOS-Mundel model and generates equilibria with both commodity and factor flows.

changes in both trade flows and migration flows. Although there are a large number of factors that might interfere with attempts to empirically evaluate the effect of trade and/or migration on wages, we isolate two for particular comment: technological change, and worker heterogeneity. Substantial recent research on wage dispersion by labor economists now suggests that skill-biased technical change is a major, possibly *the* major, source of increasing wage inequality.[10] Most of the work that attempts to incorporate both trade and technological change simultaneously tends to find only a small role for trade. In a fully dynamic setting, however, the interpretation of this result is more difficult. If technological change responds to competitive pressure, Foreign population growth may induce import-competing firms to seek technologies that economized on relatively expensive unskilled workers. Thus, while the proximate cause of increasing wage inequality would appear to be skill-biased technical change, the ultimate cause would be international competitive pressure caused by Southern population growth.

Worker heterogeneity is also a fundamental problem in empirical research on both trade and migration effects. The essential point about both migration and trade is that they are ways, direct and indirect, through which Foreign factors of production compete with Home factors of production. It seems utterly uncontroversial that, if we are actually examining Home and Foreign supplies of homogeneous factors between countries linked by trade, an increase in the Foreign supply of a factor will put downward pressure on Home suppliers of the same factor. That is, under standard HOS-Mundel assumptions, trade and migration work toward reproducing the integrated equilibrium. The difficulty, of course, is identifying factors that actually are perfect substitutes for one another. The case of migration is particularly clear. Attempts to evaluate the substitutability of migrants with respect to natives find only a very weak relationship. Furthermore, the strongest effects seem to be on other immigrants with the same properties (i.e. age, experience, education, country of origin). The essential point is that people offer complex, differentiated bundles of attributes in the labor market.

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10 In addition to the useful discussion in Levy and Murnane (1992), see the widely cited papers by Davis and Haltiwanger (1991), Bound and Johnson (1992), Katz and Murphy (1992), and Berman,

Immigrants from different countries are only imperfect substitutes for one another and for Home unskilled labor. The same problem applies just as well to evaluating the effect of trade on the wage of Home workers. However, as Borjas, Freeman and Katz (1992) argue, these results of weak open economy linkages may reflect the focus on partial equilibrium models of local (i.e. urban) economies that are in fact linked by internal migration patterns that lead to underestimation. Thus, we follow Borjas, Freeman and Katz in taking a national and general equilibrium approach. (See Borjas 1987, 1992, 1994).

Another gross empirical fact that is inconsistent with the simplest versions of the standard conceptual model we have outlined is the magnitude of migration flows. That is, while the flows have been large, they have not been close to the magnitudes that the models would predict. Layard, *et al.* (1992, pg. 2) report that the average wage in dollars in Eastern Europe is about $0.90 per hour while in Western Europe it is $10.00 per hour. Similarly the average wage in Mexico remains well below the U.S. average of $13.00 per hour (even with NAFTA). Differentials of this magnitude suggest massive arbitrage opportunities, and with relatively porous borders, imperfect detection of illegal migrants and modest penalties, the costs of arbitrage would seem to be small relative to the potential gain. It seems that the only way to account for this is via some combination of informational costs and strong locational preference. In the numerical examples to follow, like others before us, we will simply assume that the international labor market adjusts to maintain a differential between wages in North and South.

Given uncertainty about the empirical magnitude of the open economy links as transmitters of differential demographic change in the standard HOS-Mundel model, it is useful to consider some plausible alternatives. Markusen (1983) presents a very useful analysis of precisely this sort. Markusen shows that, in a 2 good $\times$ 2 factor model with external economies in one sector and constant returns to scale in the other, if factors are mobile (so FPE is an equilibrium condition), the technological conditions dictate the allocation of factors between countries. Specifically, it is shown that FPE requires each country to have more of the factor used intensively in the production of its export good.

Bound and Grilliches (1994).

That is, factors move to create the basis for trade (i.e. trade and factor mobility are complements). Although Markusen is interested in a different question, the implication of his model would seem to be that an increase in the endowment of Southern labor would induce migration from South to North to reestablish the relative endowment pattern necessary to generate FPE. In a closely related paper, Panagariya (1992) develops a 2 good × 3-factor model with external economies in one sector and constant returns in the other which generates patterns of migration similar to those considered by Markusen. Helpman and Razin (1983) and Quibria (1993) also consider migration in small-country models with national IRS.

All of our comments to this point have focussed on an essentially static model, but the empirical phenomenon with which we are concerned, a substantial and ongoing divergence in endowments driven by differential rates of population growth, is inherently dynamic and does not exhibit steady-state characteristics. This is not the place to review the enormous literature on the relationship between trade and growth, but most of it emphasizes small country models or steady-state models in which both (all) countries grow at the same rate. (See Smith, 1977; and Findlay, 1984). The reason for assuming equal growth rates in long-run models is obvious -- if countries are growing at different rates, then (at some point) one country will be large (so we can analyze it as a closed economy) and one country will be small. (Khang, 1970; Kemp, 1971; Khang and Kemp, 1973). In the mean time, however, we live in a world of dramatic ongoing demographic changes. Deardorff (1990) has emphasized that these phenomenon call for non-steady-state general equilibrium analysis, which points to the usefulness of computational modeling in this regard.

III. Theoretical Considerations

The basic framework

The preceding discussion suggests that, to examine commercial policy and migration linkages, we need to construct a model that incorporates differential rates of population growth in a large-country, general equilibrium environment. To this end, we assume two regions, designated Home and Foreign. The n-dimensional vector of quantities

produced and consumed in each sector in each region is represented by *Z*. Preferences are assumed to be identical homothetic, defined over temporal consumption, and separable across time. These assumptions mean we can specify expenditure functions of the form

$$e(P, q) = \min[PZ] \text{ for } q = q(Z) \quad \textbf{(1)}$$

$$e^*(P, q^*) = \min[P Z^*] \text{ for } q^* = q^*(Z^*) \quad \textbf{(2)}$$

where *q* represents a composite that enters into the temporal preference function. *P* represents prices, a * denotes foreign country values, and time subscripts are suppressed. These expenditure functions are taken to be differentiable and can be shown to be linearly homogeneous and concave in P. National revenue functions can also be specified in terms of *P* and productive factor endowments *v*.

$$R(P,v) = \max_{z} [P Z \mid (Z,v) \text{ feasible}] \quad \textbf{(3)}$$

$$R^*(P,v) = \max_{Z^*} [P Z^* \mid (Z^*, v^*) \text{ feasible}] \quad \textbf{(4)}$$

The revenue functions are assumed to be differentiable and can be shown to be linearly homogeneous and convex in p and concave in v (Dixit and Norman, 1980; Helpman and Krugman, 1985). Assuming balanced trade and market clearing, and without intertemporal trade, we therefore also have

$$e^*(P, q^*) = R^*(P, v^*) \quad \textbf{(5)}$$

Ignoring commercial policy for the moment, and assuming identical and homothetic preferences, we can combine (5) and (6), by defining $\mathbf{e} = (e + e^*)$ and $\Gamma = (q + q^*)$.

$$\mathbf{e}(P, \Gamma) = R(P, v) + R^*(P, v^*) \qquad \textbf{(6)}$$

Continuously clearing goods markets also mean that

$$\frac{\partial \mathbf{e}}{\partial P} - \frac{\partial R}{\partial P} - \frac{\partial R^*}{\partial P} = 0 \qquad \textbf{(7)}$$

Equations (8) represent n excess demand relations, as derived from the expenditure and revenue functions via the envelope theorem. Equations (7) and (8) define a system of n + 1 equations and n unknowns. Since, by Walras' law, one of these equations is redundant, we can take one of the goods as a numeraire and drop one of the market-clearing equations in (8). The rest of the system is determined by the solution values set by these n equations. The theoretical framework developed so far is sufficient for net-trade or homogenous goods models, like the Heckscher-Ohlin or Ricardo-Viner models. However, to reflect the characteristics of stylized models of two-way trade in differentiated intermediate or final products, additional structure is required. First, we assume identical homothetic cost functions for the increasing returns sectors. Combined with the assumption of free entry and average cost pricing under symmetric monopolistic competition, this means that the cost of inputs embodied in differentiated product production in sector j is equalized across producing regions. Second, Cobb-Douglas preferences for the composite sector products, designated Y, are assumed when two-way trade is discussed. Note that in this case, we have fixed expenditure shares, with consumers behaving as if preferences were reflected through a pseudo-utility function defined in terms of inputs, where we now interpret the terms q

and q* as being Cobb-Douglas composites of homothetic factor input indexes Z, rather than as direct welfare measurements. Related to these assumptions, we also alter our interpretation of Z. The term Z still enters the above set of equations in the same way. However, it now indexes the national scale of production of differentiated products, by providing a measure of composite inputs. With Z as a measure of composite factor services allocated to production of differentiated products by sector, the revenue functions defined in equations (3) and (4) above are then defined over these indexes. With homogenous goods sectors, this is identical to output itself, since Z will map linearly into output. By assumption, the cost functions for composite factor services Z are linearly homogeneous, and pricing of Z is at average cost, set equal to P. Differentiated products in sector j, as indexed by Z_j, are assumed to be combined, either by consumers or producers, into a final composite sector product Y_j where the elements of world price vector, Py_j, can be represented in reduced form as follows:

$$P_{Y_j} = \beta_j (Z_j + Z_j^*)^{1-\eta_j} P_j = \beta_j \left(\frac{\partial R}{\partial P_j} + \frac{\partial R^*}{\partial P_j} \right)^{1-\eta_j} P_j , \qquad \textbf{(8)}$$

where β_j is a constant, η_j is industry specific, and $\eta_j > 1$. Note that P and P_Y are of an equal dimension, determined by the number of final goods. Equation (9) reflects, alternatively, reduced form pricing of the composite *Y* under models of monopolistic competition in Ethier-type models of trade in intermediates with CES final stage production functions, and common specifications of monopolistic competition in final or intermediate product markets. (i.e. the Ethier and Krugman models. See Francois 1996). In the case of differentiated consumer goods, *Y* represents a composite goods index for the differentiated products sector that enters the utility function directly. In both the case of differentiated final goods and differentiated intermediate goods, two-way trade involves trade in differentiated products. In the present context, these flows are left implicit. The implications of this implicit two-way trade are reflected in the relationship between *Z* and P_Y in equation (9).

Analysis of welfare effects requires two more expenditure functions, one defined over P_Y and actual home country welfare, and one defined over P_Y and actual foreign country welfare.

$$E(P_Y, u) = R(P, v) \tag{9}$$

$$E^*(P_Y, u^*) = R^*(P, v^*) \tag{10}$$

The additional structure imposed by equation (9) still leaves us with a rather general specification. It covers homogenous goods and net-trade models, as we can then simply assume that $\eta = 1$, so that equation (9) becomes a redundant identity. At the same time, equation (9) simply reflects average cost pricing under either specification. In cases of sectoral specialization (as may be expected when factor incomes diverge), the model collapses to one incorporating national scale economies.

We will focus on the implications of population force growth in the foreign country. Formally, we specify the time paths of the foreign country labour forces as follows:

$$v_{l^*} = e^{\lambda t} \tag{11}$$

$$\dot{v}_{l^*} = \lambda e^{\lambda t} \tag{12}$$

where a dot denotes a rate of change with respect to time, i.e. $\dot{z} = dz/dt$. Taking the total derivatives of (7) and (8) and combining, we can derive the term:

$$\dot{P} = -\left[\frac{1}{S}\right]\left[\left(\frac{\partial\left(\frac{\partial e}{\partial P}\right)}{\partial \Gamma}\right)\left(\frac{\partial e}{\partial \Gamma}\right)^{-1}\left(\frac{\partial R^*}{\partial v_l^*}\right) - \left(\frac{\partial\left(\frac{\partial R^*}{\partial P}\right)}{\partial v_l^*}\right)\right]\dot{v}_{l^*} \tag{13}$$

Where S is the matrix of derivatives of the compensated global excess demands with

respect to prices. It is negative definite. The first group of terms in brackets simply reflects uncompensated income effects on price, through demand, as a result of the evolution of changes in the foreign country's supply of labour. The second term reflects the direct output effect on price of the evolution of the foreign country's supply of labour. This effect is a function of the relevant Rybczynski derivatives.

With differentiated products and two-way trade, we also need to include the relationship between scale effects and the evolution of composite goods prices. From equation (9), we can relate changes in P_Y to changes in P by the following:

$$\frac{\dot{P}_Y}{P_Y} = \frac{\dot{P}}{P} + (1 - \theta)\frac{\dot{z}}{z} \qquad \textbf{(14)}$$

Welfare effects of population growth

We will examine both welfare- and wage-induced migration. Turning to welfare effects, from equations (10),(11), and (15) we can derive the following per-capita equivalent variation terms:

$$\left(\frac{\partial E}{\partial u}\right)\left(\frac{\dot{u}}{\Pi}\right) = \left[\left(\frac{\partial R}{\partial P}\right)\dot{P} - \left(\frac{\partial E}{\partial P_Y}\right)P_Y\frac{\dot{P}}{P} - \left(\frac{\partial E}{\partial P_Y}\right)P_Y(1 - \theta)\frac{\dot{z}}{z}\right]\Pi^{-1} \qquad \textbf{(15)}$$

$$\left(\frac{\partial E^*}{\partial u^*}\right)\left(\frac{\dot{u}^*}{\Pi^*}\right) = \left(\left(\frac{\partial R^*}{\partial P}\right)\dot{P} - \left(\frac{\partial E^*}{\partial P_Y}\right)P_Y\frac{\dot{P}}{P}\right)\Pi^{*-1}$$

$$- \left(\left(\frac{\partial E^*}{\partial P_Y}\right)P_Y(1-\theta)\frac{\dot{z}}{z} + \left(\frac{\partial R^*}{\partial v^*}\right)\dot{v}^*\right)\Pi^{*-1} \qquad \textbf{(16)}$$

$$-\left(\frac{u^*}{\Pi^{*2}}\right)\dot{v}^*$$

Here, we have defined the population base as Π, and have assumed that the change in population equals the change in the labour force.

In the home country equation, the welfare effects of population growth in the foreign region depend on three sets of effects, represented by the three sets of terms in brackets on the right side of equation (16). The first two terms, when combined, translate into terms of trade effects, which hinge on both income effects (the first term) and substitution effects (the second term). Essentially, if foreign population growth causes a secular decline in prices for goods that are more important for consumption than for income purposes (i.e. a positive terms-of-trade effect), then welfare effects will be positive. The third term in brackets reflects the potential effects of specialization / scale effects.

In the foreign country, the welfare effects are more complex. In addition to the types of effects found in equation (16), we also have both induced output effects (the fourth term in brackets) and the expansion of the consumption / population base, represented by the last term in brackets.

Wage effects of population growth

The effects on relative wage changes are similar to those driving welfare effects. For the home country, the impact is represented in equation (18).

$$\frac{\dot{w}_l\, P_Y}{w_l\, \dot{P}_Y} = \left(\frac{\partial\left(\frac{\partial R}{\partial P}\right)}{\partial v_l} \right) \left(P \left(\frac{\partial R}{\partial v_l} \right)^{-1} \right) \left(\frac{\dot{P}}{\dot{P}_j + (1 - h)(\dot{z} / z)\, P} \right)$$

$$= \left(\frac{\partial\left(\frac{\partial R}{\partial P}\right)}{\partial v_l} \right) \left(P \left(\frac{\partial R}{\partial v_l} \right)^{-1} \right) \left(\frac{1}{1 + (1 - h)(\dot{z} / z)\, P / \dot{P}} \right) \qquad \textbf{(17)}$$

We have changes in wages relative to prices being driven by Stolper-Samuelson effects (the first two terms), and by corresponding scale / variety effects (the last set of terms). Essentially, if labour force expansion in the foreign country forces a fall in the relative price of goods that are labour intensive in the home country, we expect home country

wages to fall. This hinges on scale/variety effects, which may lead to a decline in consumer prices that outweighs the fall in wages relative to producer prices. The reader can verify that a similar set of conditions holds for the foreign country.

Migration effects

How do we add migration to this framework? Working with equations (16-18), we may want to specify economic incentives for migration in terms of changes on relative per-capita welfare and/or changes in real relative wages. Consider migration based on general conditions of overall economic welfare. Formally, we may specify migration from the foreign to the home country M_t as follows:

$$M_t = M_t\left(\frac{u}{\Pi_{t-1}}, \frac{u^*}{\Pi_{t-1}^*} \right) \qquad \textbf{(18)}$$

With this lag mechanism, we then need to modify the labour force growth equations as follows:

$$\dot{v}_{l^*} = l\ e^{l\,t} - M_t \qquad \textbf{(19)}$$

$$v_l = M_t \qquad \textbf{(20)}$$

A similar mechanism can be specified for wage migration.

Formally, introduction of (20) and (21) involves some modification of equations (16)-(17), though the basic mechanisms will remain the same. Qualitatively, we have a system where the implications of population growth for welfare and migration hinge on a mix of terms-of-trade effects (the classical growth effects of Bhagwati etc.), variety scaling effects, the impact of an expanding consumption base, and the responsiveness of migration flows to changes in the arguments in equation (19). The expanding consumption base effect will depend on the type of model specified. For example, with limited land resources (i.e. specific factors), an expanding population base may more quickly lead to erosion of welfare both from declining marginal productivity within

domestic agriculture, and from worsening terms-of-trade for imported agricultural goods.

Commercial policy

Next, consider the implications of these migration mechanisms for commercial policy. The political arguments linking commercial policy to demographic trends can be quite complex. For example, in the case of NAFTA, Mexico was painted as placing wage pressure on labour in the United States both through trade and through migration. In the public debate, some members of the pro-NAFTA camp argued that migration effects tended to dominate, and that the NAFTA would help to alleviate such migration-based wage pressure, albeit with the possibility of some offset from trade-based pressure. (However, see Levy and van Wijnbergen 1994). Similar concerns underlie the EU effort to expand East into former Communist-bloc countries, and EU pursuit of agreements with certain developing Mediterranean economies.

In the framework developed here, trade intervention will interact with incentives to migrate through traditional terms-of-trade channels, through efficiency effects, and through associated scale / variety effects. In general terms, when production in the ISE sector continues in more than one country, the national effects of trade protection involve both production efficiency and terms of trade effects. To illustrate these effects, consider a single country that taxes cross-border transactions in the *Z* sector. This requires the addition of the trade tax t directly to the revenue functions specified earlier. Such a tax has the potential, given prices, to correct for or worsen the non-tangency conditions that result from average cost pricing. In addition, prices themselves will depend, in reduced form, on the level of the trade tax, such that these rates also enter the expenditure and revenue functions indirectly through price effects.

$$e(P_Y(t), u) = R(P_Z(t), v, t) \qquad \textbf{(21)}$$

Taking derivatives with *t* and rearranging, we have

$$\frac{d\,u}{d\,t} = \left(\frac{\partial e}{\partial u}\right)^{-1}\left[-\left(\frac{\partial e}{\partial P_Y}\right)\left(\frac{\partial P_Y}{\partial t}\right)+\left(\frac{\partial R}{\partial t}\right)+\left(\frac{\partial R}{\partial P_Z}\right)\left(\frac{\partial P_Z}{\partial t}\right)\right] \qquad \textbf{(22)}$$

With reference to equations (22) and (23), the first set of terms in brackets represents the effect of a change in P_Y on welfare, through an increased cost of consumption. Efficiency and income-related terms-of-trade effects are represented by the last two terms. A trade tax will have the same qualitative effect as a production tax (a negative subsidy) on P_Y, and on efficiency, as represented by the second term in brackets. Protection reduces the extent of cross-border integration, forcing firms to use less efficient production methods biased toward the home *Z* sector and, under IIRS, weakening the base underlying external scale effects for home and foreign producers alike. Both the price and efficiency effects imply a reduction in national welfare. This is only offset if income (terms-of-trade) effects, as embodied in the last term, dominate the negative direct effects of the distortion.

Consider the impact of protection on the incentives for migration. From equation (23), if protection increases home country welfare through induced terms-of-trade effects, this would have the effect of increasing the relative wedge between the home and foreign country migration arguments in equation (19). The results is that, by boosting welfare *at the expense of trading partners*, one unintended consequence may be to induce more migration from those same trading partners. Beggar-thy-neighbor implies invite-thy-neighbor under this scenario. The addition of scale economies may magnify this incentive effect, since protection at home can force the effective production possibility set to shrink for the foreign country by reducing economies of specialization. The other side of this effect lurks behind the arguments for a liberal EU trade regime toward Eastern Europe and the Mediterranean countries. By mitigating adverse terms-of-trade effects, such an approach may alternatively moderate underlying migration incentives.

In a similar vein, protection aimed at propping up wages may also lead to increased incentives for migration. In particular, if such protection at home prevents the

export of the abundant factor (i.e. labour) through goods from the foreign country, such labour may instead be exported directly through migration, again as reflected by a variation of equation (19). If we have a model with a non-traded labour-intensive sector, the negative wages effects of induced migration could conceivably outweigh the positive effects of protecting labour from trade-related pressure.

IV. Numerical simulations

To illustrate some of the mechanisms discussed above, we next turn to a highly stylized 2 region numerical model. Our objective is to illustrate the concepts discussed above, and to highlight additional factors not immediately obvious from the marginal calculus. The basic features of the model are described in Table 2.[11]

We model migration through a variation of equation (19). We assume that, in each period, a share of the unskilled population of the South decides to migrate to the North, based on the gap between North and South per-capita welfare (or wages) relative to the benchmark ratio of these values.

$$M_t = \mu \left[\Delta \ln\left(\frac{u}{\Pi_{t-1}}\right) - \Delta \ln\left(\frac{u^*}{\Pi^*_{t-1}}\right) \right] \Pi^*_t \qquad \textbf{(23)}$$

where μ is the migration elasticity, reflecting the percentage of South population that decides to migrate for each percentage deviation in welfare (wages).

Our basic experiments are constructed as follows. We examine the impact of induced migration, starting from an initial assumption of zero migration. Migration is then induced through introduction of population growth (or identically in this model labour supply growth) in the South. This sets off a number of changes, including shifting production and wages, and changes in per-capita welfare. The levels of these variables are all solved for explicitly. These feed, through equation (24), into our migration mechanism, where we assume μ=.01. Following this migration, we then solve

[11] Copies of the model (which is spreadsheet based) are available upon request from the authors.

for a new equilibrium. The result is a sequence of equilibria involving migration flows induced by the ongoing labour supply shocks in the South. The benchmark experiment involves wage or welfare migration, without any policy response from the North. The results are contrasted with a set of equilibria involving either an assumed tariff reduction or capital transfers by the North.

Figure 1 charts the basic pattern of induced migration with no policy response and with a tariff reduction. In our example, tariff reduction leads to an initial drop in the number of migrants over the full 25 year period covered in the experiment. Similar patterns hold for capital transfers, and under specifications that include an endogenous capital stock.

The time trend for the price of unskilled and skilled labour is presented in Figures 2 and 3. A number of factors are illustrated. First, terms-of-trade effects dominate, in the medium run, when we incorporate endogenous capital stocks. Eventually, however, the underlying direct mechanism of migration comes to dominate, and real unskilled wages fall in the home in the long-run. With fixed capital stocks, terms-of-trade effects are less evident, and unskilled wage erosion is almost immediate. A second pattern illustrated in Figures 2 and 3 is that tariff reductions dominate increased tariffs as a strategy for propping up unskilled wages. This holds in both the fixed and endogenous capital specifications, and it does so because terms-of-trade gains from protection accelerate unskilled labour migration. By moderating these incentives through trade liberalization, the wage pressure of migration on home unskilled labour is moderated. Finally, skilled home labour does quite well under all scenarios. Not surprisingly, tariff reductions lead to a reduction in the increase in skilled wages. This is because it slows the inflow of unskilled labour and reduces the terms-of-trade gains, both of which act to drive up skilled wages.

The results of these numeric experiments illustrate an important point not immediately evident from marginal analysis. In particular, depending on the time frame, different effects highlighted in the theory may dominate for a given intervention. For such a policy, terms-of-trade effects may dominate over one time frame, and the direct effects of migration on factor supply may dominate over a different time frame.

In addition, the endogeneity of capital is clearly important as well.

V. Summary

Tremendous differences in the rate of population growth between North and South have important implications for patterns of trade, migration, the distribution of income, and the distribution of the gains from trade. In this paper, we focus particularly on migration-related effects. Following an overview of the literature on trade and migration-related labour market linkages, we offer a theoretical discussion of explicit theoretical linkages between population growth, trade policy and migration. The key channels we identify relate to direct factor market effects of population growth, terms-of-trade effects, and induced scale effects. Trade policy enters the analytical mix through its impact on the terms-of-trade, efficiency, and scale effects. We also supplement the formal analysis with simple, numeric examples. The numerical analysis highlights issues not immediately evident in the theoretical analysis, including the dominance of different effects (such as terms-of-trade changes) over different time horizons. This, in turn, points to the value of CGE-based projection analysis for the study of the interaction of trade and migration policy.

References

Algoskoufis, G., C. Bean, G. Bertola, D. Cohen, J. Dolado, and G. Saint-Paul (1995). *Unemployment: Choices for Europe*. London: CEPR.

Altonji, J. and D. Card (1991). "The Effects of Immigration on the Labor Market Outcomes of Less-skilled Natives". in J. Abowd and R. Freeman, eds. *Immigration, Trade and the Labor Market*. Chicago: University of Chicago Press / NBER, pp. 201-234.

Baldwin, R. (1995). "The Effect of Trade and Foreign Direct Investment on Employment and Relative Wages". *NBER Working Paper*, # 5037.

Batra, R. (1993). *The Myth of Free Trade*. New York: Scribner's.

Berman, E., J. Bound and Z. Grilliches (1994). "Changes in the Demand for Skilled Labor within US Manufacturing: Evidence from the Annual Survey of Manufactures". *Quarterly Journal of Economics*; V.109(2), pp. 367-397.

Bhagwati, J.N. (1958). "Immiserizing Growth: A Geometric Note." *Review of Economic Studies*; V.12.

Bongaarts, J. (1995). "Global and Regional Population Projections to 2025". in N. Islam, ed. *Population and Food in the Twenty-First Century*. Washington, DC: International Food Policy Research Institute, pp. 7-16.

Borjas, G. (1987). "Self-Selection and the Earnings of Immigrants". *American Economic Review*; V.77, pp. 531-553

Borjas, G. (1992). "National Origin and the Skills of Immigrants in the Postwar Period". In G. Borjas and R. Freeman, eds. *Immigration and the Work Force*. Chicago: University of Chicago Press / NBER, pp. 17-47.

Borjas, G. (1994). "The Economics of Immigration". *Journal of Economic Literature*; V.32(4), pp. 1667-1717.

Borjas, G., R. Freeman and L. Katz (1992). "On the Labor Market Effects of Immigration and Trade". In G. Borjas and L. Katz, eds. *Immigration and the Workforce: Economic Consequences for the US and Source Areas*. Chicago: University of Chicago Press / NBER, pp. 213-244.

Bos, E. M. Vu, A. Levin and R. Bulatao (1992). *World Population Projections, 1992-93 Edition*. Baltimore: Johns Hopkins University Press / World Bank.

Bound, J. and G. Johnson (1992). "Changes in the Structure of Wages in the 1980's: An

Evaluation of Alternative Explanations". *American Economic Review*; V.82(3), pp. 371-392.

Burfisher, M., S. Robinson and K. Thierfelder (1995). "Wage Changes in a US-Mexico Free Trade Area: Migration versus Stolper-Samuelson Effects". In J. Francois and C. Shiells, eds. Pp. 195-222.

Butcher, K. and D. Card (1991). "Immigration and Wages: Evidence from the 1980s". *American Economic Review*; V.81-#2, pp. 292-296.

Card, D. (1991). "The Impact of the Mariel Boatlift on the Miami Labor Market". *ILR Review*; V.43, pp. 245-257.

Davis, S. and J. Haltiwanger (1991). "Wage Dispersion between and Within U.S. Manufacturing Plants". *Brookings Papers on Economic Analysis.* 1991: Micro.

Deardorff, A. (1994). "Growth and International Investment with Diverging Populations". *Oxford Economic Papers*; V.46, pp. 477-491.

Deardorff, A. (1990). "Trade and Capital Mobility in a World of Diverging Populations". in D.G. Johnson and R. Lee, eds. *Population Growth and Economic Development: Issues and Evidence.* Madison: University of Wisconsin Press, pp. 561-588.

Dixit, A. and V. Norman (1980). *Theory of International Trade.* Cambridge: Nisbet / Cambridge University Press.

Ethier. W.J. (1982). "National and International Returns to Scale in the Modern Theory of International Trade." *American Economic Review*. vol 72: 389-405.

Findlay,R. (1984). "Growth and Development in Trade Models." in R.W. Jones and P.B. Kenen, eds., *Handbook of International Economics -- volume I.* Elsevier.

Francois, J. (1994). "Global Production and Trade: Factor Migration and Commercial Policy with International Scale Economies". *International Economic Review*; V.35, pp. 565-581.

Francois, J. (1996). "Labour Force Growth, Trade, and Wages." *Economic Journal.* forthcoming.

Francois, J. (1992). "Optimal Commercial Policy with International Returns to Scale". *Canadian Journal of Economics*; V.25, pp. 184-195.

Francois. J.F.. B. McDonald and H. Nordström (1995). "Assessing the Uruguay Round." in W. Martin and A. Winters, eds. *The Uruguay Round and the Developing Economics,* World Bank discussion paper 307.

Francois. J.F.. B. McDonald and H. Nordström (1994). "The Uruguay Round: A Global General Equilibrium Assessment." Centre for Economic Policy Research discussion paper 1067. November.

Friedberg, R. and J. Hunt (1995). "The Impact of Immigrants on Host Country Wages, Employment and Growth". *Journal of Economic Perspectives*; V.9, pp. 23-44.

Haaland and Norman (1996). "Scenarios as Tools to Assess the Effects of Trade Policy." Norwegian School of Business Administration (May).

Hamilton, B. and J. Whalley (1984). "Efficiency and Distributional Implications of Global Restrictions on Labour Mobility: Calculations and Policy Implications". *Journal of Development Economics*; V.14, pp. 61-76.

Helpman, E. and A. Razin (1983). "Increasing Returns, Monopolistic Competition, and Factor Movements: A Welfare Analysis". *Journal of International Economics*;

Helpman, E. and P. Krugman (1985). *Market Structure and Foreign Trade*. Cambridge: MIT Press.

Hertel, T. W. Martin, K. Yanagashima, and B. Dimaranan (1996). "Liberalizing Manufactures Trade in a Changing World Economy." in W. Martin and A. Winters, eds. *The Uruguay Round and the Developing Economies*. World Bank Discussion Papers 307, Washington.

Hill, J. and J. Méndez (1984). "The Effect of Commercial Policy on International Migration Flows: The Case of the US and Mexico". *Journal of International Economics*, V.17(1/2), pp. 41-53.

Katz, L. and K. Murphy (1992). "Changes in Relative Wages, 1963-1987: Supply and Demand Factors". *Quarterly Journal of Economics*; V.107(1), pp. 35-78.

Kemp, M. (1970). "International Trade between Countries with Different Natural Rates of Growth". *Economic Record*; V.46, pp. 467-481.

Khang, C. and M. Kemp (1973). "International Trade and Investment Between Countries with Different Natural Rates of Growth". *Metroeconomica*; V.25(3); pp. 214-228.

Khang, C. (1971). "Equilibrium Growth in the International Economy: The Case of Unequal Natural Rates of Growth". *International Economic Review*; V.12(2), pp. 239-249.

Lalonde, R. and R. Topel (1991). "Labor Market Adjustments to Increased Migration" in J. Abowd and R. Freeman, eds. *Immigration, Trade and the Labor Market*. Chicago: University of Chicago Press / NBER, pp. 167-199.

Lawrence, R. and M. Slaughter (1993). "Trade and US Wages: Giant Sucking Sound or Small Hiccup?". *Brookings Papers on Economic Analysis*; V.1993(2), pp. 161-210.

Layard, R., O. Blanchard, R. Dornbusch, and P. Krugman (1992). *East-West Migration: The Alternatives*. Cambridge: MIT Press.

Levy, F. and R. Murnane (1992). "US Earnings Levels and Earnings Inequality: A Review of Recent Trends and Proposed Explanations". *Journal of Economic Literature*; V.30(3), pp. 1333-1381.

Levy, S. and S. van Wijnbergen (1994). "Labor Markets, Migration and Welfare: Agriculture in the North-American Free Trade Agreement". *Journal of Development Economics*; V.43, pp. 263-278.

Markusen , J. (1983). "Factor Movements and Commodity Trade as Complements". *Journal of International Economics*; V.14, pp. 341-356.

Merrick, T. (1989). "World Population in Transition". *Population Bulletin*; V.41(2), pp.

Murphy, K. and F. Welch (1992). "The Structure of Wages". *Quarterly Journal of Economics*; V.107(1), pp. 285-326.

Murphy, K. and F. Welch (1991). "The Role of International Trade in Wage Differentials". In M. Kosters, ed. *Workers and Their Wages: Changing Patterns in the US*. Washington, DC: AEI, pp. 39-69.

Panagariya, A. (1992). "Factor Mobility, Trade and Welfare--A North-South Analysis with Economies of Scale". *Journal of Development Economics*; V.39, pp. 229-245.

Quibria, M. (1993). "International Migration, Increasing Returns and Real Wages". *Canadian Journal of Economics*; V.26(2), pp. 456-468.

Richardson, J.D. (1995). "Income Inequality and Trade: How to Think, What to Conclude". *Journal of Economic Perspectives*, V.9(3), pp. 33-55.

Robinson, S., M. Burfisher, R. Hinojosa-Ojeda and K. Thierfelder (1993). "Agricultural Policies and Migration in a US Mexico Free Trade Area". *Journal of Policy Modelling*; V.15(5/6), pp. 673-701.

Smith. M.A.M.. (1977). "Capital Accumulation in the Open Two-Sector Economy." *Economic Journal* 87. (November): 273-282.

Weyerbrock, S. (1995). "Can the European Community Absorb More Immigrants? A General Equilibrium Analysis of the Labor Market and Macroeconomic Effects of East-West Migration in Europe". *Journal of Policy Modeling*; V.17(2), pp. 85-120.

Wood, A. (1994). *North-South Trade, Employment and Inequality: Changing Fortunes in a Skill-Driven World*. New York: Oxford University Press.

Table 1: Population, Historical and Projected (in billions)

	1900	1950	1990	2025	2100
Developing Countries	1.07	1.68	4.08	7.07	10.20
Developed Countries	0.56	0.84	1.21	1.40	1.50
World	1.63	2.52	5.30	8.47	11.70

Source: Bongaarts (1995). These data are originally from Merrick (1989) and Bos, *et al*. (1992).

Table 2: Migration and trade policy: numeric examples

Model description:

The model includes two regions -- the home region (a stylized North economy) and a foreign region (a stylized South economy). The benchmark data are summarized below.

	home (North)	foreign (South)
GDP	130.34	27.15
population	200.00	550.00
per-capita income	0.65	0.05
unskilled wages	0.43	0.02
labour force growth	0.00%	3.00%
savings rates	5.00%	15.00%
initial tariffs	20.00%	0.00%

The GDP function in both regions is Cobb-Douglas, and is defined over a supply of skilled labour, unskilled labour, and capital.
Preferences are also Cobb-Douglas with respect to the goods of both regions, so that trade takes place in Armington-fashion. Preferences are identical, and are weighted toward the goods produced by the North.
The benchmark data include a tariff imposed by the North on imports from the South. The basic migration mechanism is very simple. Based on divergence between real unskilled labour wages in the North and South, the share of the foreign(South) region's unskilled labour force that chooses to migrate is determined by a migration elasticitiy. The only factor that adjusts in model 1 is labour. In model 2, capital accumulates at a rate of 5 percent of GDP in the North, and 15 percent in the South. Here, the Cobb-Douglas utility composite is assumed to be a good that is used in consumption or investment.

Experiments:

1. no policy -- fixed capital
2. tariff reduction, fixed capital
3. capital transfer, fixed capital
4. no policy -- capital accumulation
5. tariff reduction, capital accumulation
6. capital transfer, capital accumulation

Figure 1

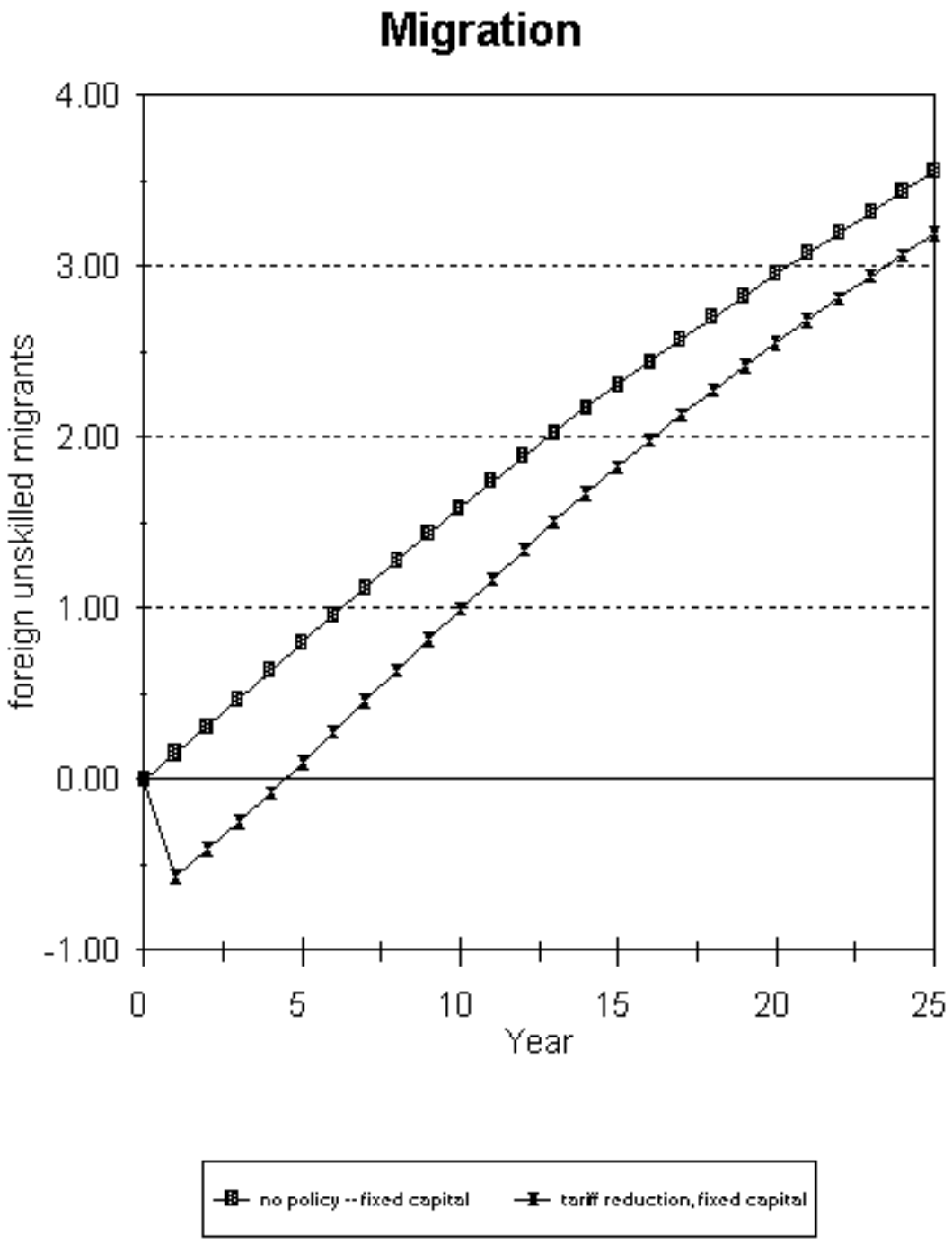

Migration
4.00
3.00
2.00
1.00
0.00
-1.00
foreign unskilled migrants
0
5
10
15
20
25
Year
no policy -- fixed capital
tariff reduction, fixed capital

Figure 2

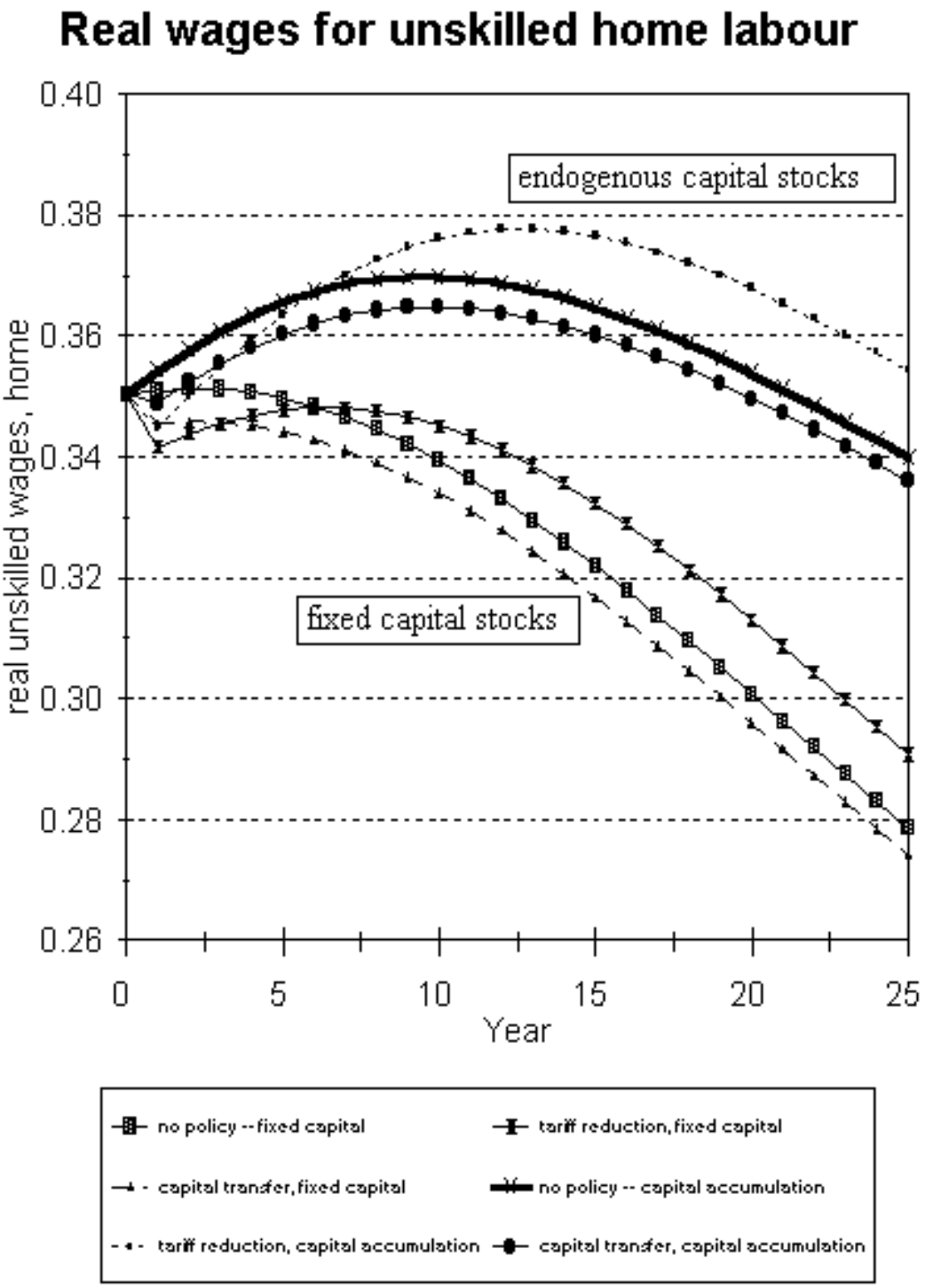
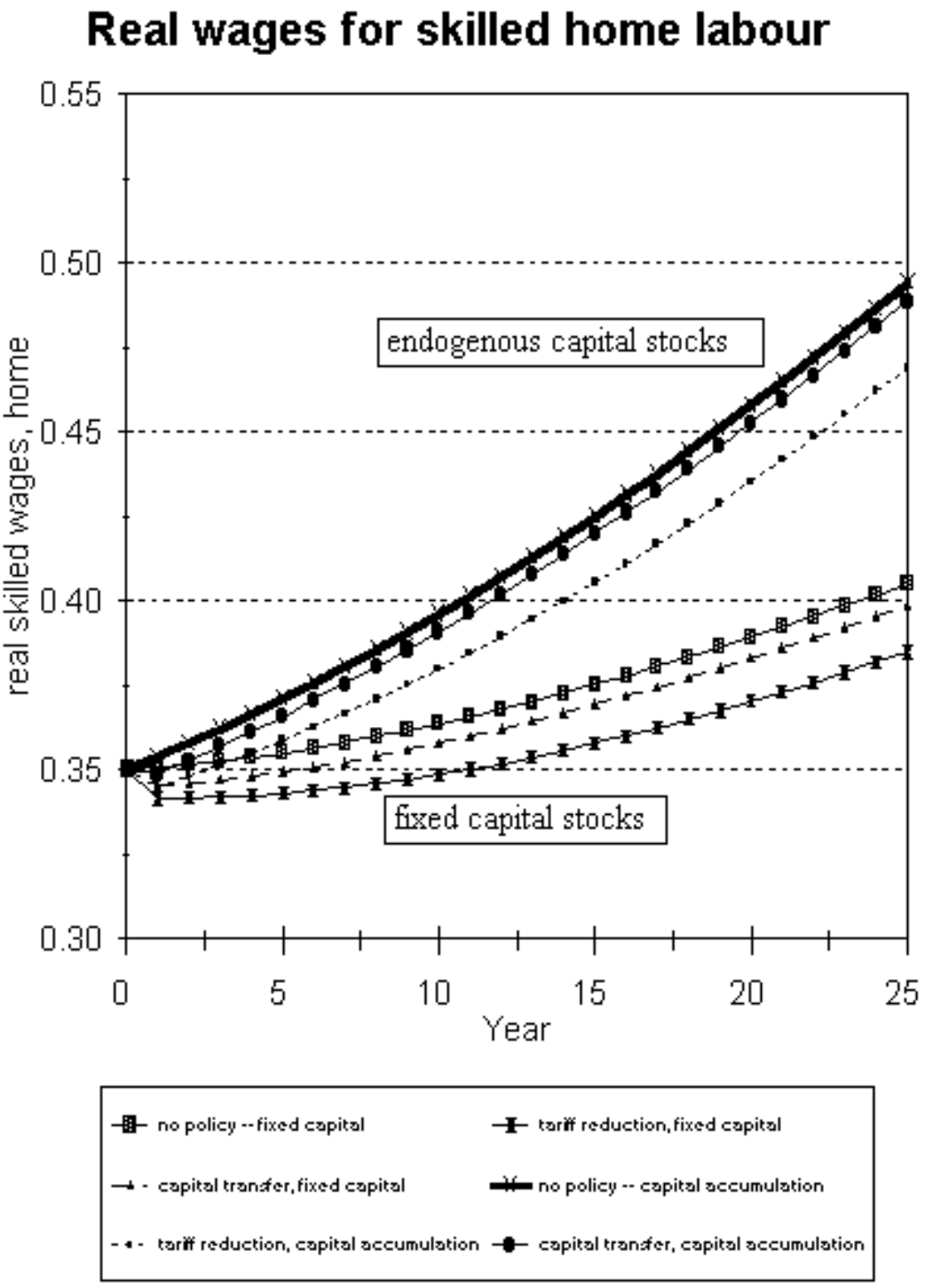

Real wages for unskilled home labour
real unskilled wages, home
0.40
0.38
0.36
0.34
0.32
0.30
0.28
0.26
endogenous capital stocks
fixed capital stocks
0
5
10
15
20
25
Year
no policy -- fixed capital
tariff reduction, fixed capital
capital transfer, fixed capital
no policy -- capital accumulation
tariff reduction, capital accumulation
capital transfer, capital accumulation

Figure 3


Real wages for skilled home labour
real skilled wages, home
0.55
0.50
0.45
0.40
0.35
0.30
0
5
10
15
20
25
Year
endogenous capital stocks
fixed capital stocks
no policy -- fixed capital
tariff reduction, fixed capital
capital transfer, fixed capital
no policy -- capital accumulation
tariff reduction, capital accumulation
capital transfer, capital accumulation