# Immigration, International Capital Flows, and Long Run Income Distribution In Canada

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## I. Introduction

One of the most controversial issues regarding the effects of immigration and capital flows on a recipient country concerns the income distributional impacts of international factor flows. A survey of theoretical international migration issues can be found in the literature [Greenwood, 1983]. Although governments recognize that factor movement policies designed to achieve certain national objectives will raise returns to some domestic productive factors and lower returns to others, little is known about the exact pattern of induced factor reward changes.

A five sector general equilibrium model is used to derive the long-run income distributional consequences of immigration and capital flows in Canada. This is achieved through identification of factor friendship patterns. Two factors are natural friends (natural enemies) if an exogenous increase in the supply of one increases (reduces) the other's payment [Ruffin, 1981]. Factor friendship patterns will aid in identifying long run winners and losers under a variety of factor movement policies.

Canada is an ideal recipient country for this study since its immigration is carefully controlled and extremely selective. Factor movement policies are well-documented [DeVoretz and Maki, 1980, 1983; Parai, 1975; Hawkins, 1972, 1974]. Policy changes since 1967 have increasingly reflected manpower needs of the country, with immigration continuing to serve as an important source of labor skills in short supply. Immigrants are heavily concentrated in professional and technical occupations, while immigration of unskilled labor is discouraged.[1]

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## II. Model

A number of authors [Jones, 1965; Chang, 1979; Takayama, 1982] have developed the general equilibrium model utilized in this study.[2] Let $w$ represent the vector of endogenous factor payments and $v$ represent exogenous factor endowments. With constant returns to scale, non-joint production results in endogenous outputs $x$, determined by world prices $p$ which are exogenous for a price taking economy.

Firms minimize cost by adjusting unit factor inputs $a(w)$, insuring conditions of full employment and competitive pricing hold. This general equilibrium setting is summarized by the matrix expression

$$\begin{bmatrix} S & A \\ A' & O \end{bmatrix} \begin{bmatrix} dw \\ dx \end{bmatrix} = \begin{bmatrix} dv \\ dp \end{bmatrix}$$

Factor inputs are displayed in the $A$ matrix; $A'$ represents its transpose. Substitution terms in the symmetric matrix $S$ describe aggregate adjustment in factor inputs with changing factor payments. The system determinant $D$

[1]Although other major receiving nations relate immigration policy to manpower policy, the Canadian situation is unique. Canadian immigration policy is the recognized "servant" of manpower policy. Immigration programs are carried out by the Department of Manpower and Immigration [Hawkins, 1972, pp. 338-39].

[2]A comprehensive survey of research on applied general equilibrium trade models is presented by Shoven and Whalley [1984]. Models reviewed display considerable differences in dimensionality, parameter specification, other underlying assumptions, and inclusion of policy regimes. All of these studies have the goal of assessing aggregate welfare effects of trade policy. The present study uses a simple general equilibrium production model to evaluate long run comparative static results in order to arrive at policy conclusions. No assumptions regarding values of key parameters are made, as in the other studies mentioned. Since labor is disaggregated into several groups, the focus here is on distributional rather than aggregate welfare consequences of policy.

has the sign $(-1)^r$, where $r$ is the number of factors [Chang, 1979].

Comparative static effects of changing factor endowments upon factor payments, the $\partial w_h / \partial v_k$ results, are represented by $w_{hk}$. Due to symmetry, $w_{hk} = w_{kh}$. The two factors $h$ and $k$ are called natural friends if $w_{hk} > 0$, and are called natural enemies if $w_{hk} < 0$.

Labor migration or capital flow will affect factor payments, except in well-known "even" cases, where the number of factors $r$ equals the number of goods $n$. It is known that $w_{ii} < 0$ for every factor $i$, where $r > n$. Note that with prices unchanged at world levels, real income for owners of a factor moves in the same direction as the factor payment.

Consider cofactors of the $w_{hk}$ migration partial derivatives, $W_{hk} \equiv D\ w_{hk}$. Given a model with five productive sectors, utilizing six factors leads to relatively simple solutions of the $W_{hk}$'s. Substitution terms play no role in determining their values, as is always the case with one more factor than good.

Notice that cofactor $W_{hk}$ will have the same sign as $w_{hk}$, since $D$ is positive. It can readily be shown using Cramer's rule that

$$W_{hk} = (-1)^{h+k+1}\ {}_hA\ {}_kA\ , \qquad (1)$$

where ${}_iA$ represents the determinant of $A$ with row $i$ deleted.[3]

Solving for factor inputs requires separating factor payments from factor shares, which is difficult for capital. Equivalent results can be obtained, however, from direct factor shares, $f \equiv w'a$. Letting $w_{-k}$ represent the product of all factor payments except $w_k$, and $F$ the matrix of factor share terms, one can show that

$$_kF = w_{-k}\ {}_kA\ . \qquad (2)$$

Solutions are expressed using (1), (2), and

$$V_{hk} \equiv w_{-h}\, w_{-k}\, w_{hk}\ . \qquad (3)$$

Results acquire more meaning when transformed into relative elasticities. Let $E_{hk}$ represent the elasticity of $w_h$ with respect to $v_k$, and $e_{hk}$ that elasticity relative to $E_{KK}$. That is, $E_{hk} \equiv (v_k / w_h) w_{hk}$ and $e_{hk} \equiv E_{hk} / E_{KK}$.[4] If factors $h$ and $k$ are friends, $e_{hk}$ will be negative, since $E_{KK} < 0$. It follows from (3) that

$$e_{hk} = (Y_k / Y_K)(V_{hk} / V_{KK})\ , \qquad (4)$$

where $Y_i$ represents total income of factor $i$, $Y_i \equiv w_i v_i$. Relative elasticities are calculated according to (4) from national income statistics.[5]

## III. Methodology and Data

Factor shares in national income are calculated from national income statistics reported in a United Nations [1982] publication. National income components include compensation of employees and net operating surplus. The latter is comprised of four property incomes: corporate profits, income of unincorporated enterprises, rental income, and net profits. Together, these components constitute claims of workers and capital owners responsible for producing each sector's output.[6]

Figures on compensation of employees by sector are reported in the United Nations [1982] publication. Total employee compensation is allocated between each sector's occupational groupings by combining data on average income from wages and salaries by

[3]See the Appendix for proofs of (1), (2), and (4). General properties of these results are developed in the literature [Thompson, 1984], where friendship is shown to be intransitive.

[4]Estimating absolute elasticities of $w_h$ with respect to $v_k$ would require a complete model specification, including substitution terms. Alternatively, an econometric estimate of only one absolute elasticity would lead to a solution of the entire matrix of solutions derived in this paper.

[5]Reported estimates will be of a comparative static nature, based on a complete general equilibrium model. This differs from the usual econometrically obtained elasticities, which involve partial equilibrium modelling.

[6]Relative friendship elasticities are calculated from 1970 Canadian factor shares. Relying upon data from one point in time does not limit usefulness of results, since relative factor shares tend to remain constant for long time periods. Examination of Canadian relative factor shares in a United Nations [1982] publication confirms this.

occupation and sector from Statistics Canada [1975], with figures on the number of workers by occupation and industry from an International Labor Organization [1980] publication. Five occupational groups are identified: professional, technical, administrative, and managerial ($L1$); clerical and sales ($L2$); service ($L3$); agriculture, forestry, fishing, and hunting ($L4$); and production and transport equipment operators ($L5$).

Net operating surplus is derived from United Nations [1982] figures on Gross Domestic Product and employee compensation by sector. Gross Domestic Product is comprised of net operating surplus, employee compensation, capital consumption allowance and indirect taxes. Since figures on capital consumption allowance and indirect taxes are not broken down by sector, it is necessary to allocate these charges to each sector on the basis of corresponding rates in the United States. Net operating surplus is then calculated as the difference between Gross Domestic Product and its remaining three components: employee compensation, capital consumption allowance, and indirect taxes.[7]

Income payments to the five labor groups and capital owners are aggregated to form five sectors: agriculture, manufacturing, construction, utilities, and other services.[8] Dividing payments to each factor by each sector's contribution to national income yields the 1970 Canadian factor share ($F$) matrix, presented in the Appendix.

[7]Natural resources play a crucial role in the Canadian economy. The present study includes these with productive capital for several reasons. First, national income statistics do not identify natural resource factor shares, and calculating these would involve arbitrary divisions of the capital stock. Second, natural resources are sector specific. Finally, natural resources as a productive factor are not mobile internationally. A discussion of these and other empirical problems associated with including natural resources as a distinct productive factor is in Posner [1975, pp. 11-2].

[8]An attempt was made to include as many factors and sectors in the model as possible. Divisions of occupation among labor groups and industries among sectors were dictated by the correspondence between labor and industry classifications used by the various data sources.

## IV. Results

Relative friendship elasticities ($e_{hk}$) for Canada are presented in Table 1. Each column identifies effects of a change in the endowment of one factor upon payment to each factor.[9] A positive (negative) value for an elasticity indicates that factors are enemies (friends). An increase in the supply of one factor raises (reduces) payments to its friends (enemies). Relative strengths of these relationships are reflected by magnitudes of the $e_{hk}$ terms.

**TABLE 1**

**Relative Friendship Elasticities ($e_{hk}$)***

| | | Endowment change | | | | | |
|---|---|---|---|---|---|---|---|
| | | L1 | L2 | L3 | L4 | L5 | K |
| Payment change | L1 | 1.057 | -0.657 | -0.823 | -0.303 | -0.345 | 1.069 |
| | L2 | -0.910 | 0.566 | 0.709 | 0.261 | 0.297 | -0.920 |
| | L3 | -3.309 | 2.058 | 2.578 | 0.949 | 1.080 | -3.347 |
| | L4 | -2.903 | 1.805 | 2.261 | 0.833 | 0.948 | -2.936 |
| | L5 | -0.367 | 0.228 | 0.286 | 0.105 | 0.120 | -0.371 |
| | K | 0.989 | -0.615 | -0.770 | -0.284 | -0.323 | 1 |

*Note: $L1$ = Professional, technical, managerial, and administrative
$L2$ = Clerical and sales
$L3$ = Service
$L4$ = Agricultural, forestry, fishing, and hunting
$L5$ = Production and transport equipment operators
$K$ = Physical capital

[9]Dividing the elasticity in each column by the own elasticity (each of the $e_{hk}$'s by $e_{KK}$) would standardize elasticities for each endowment change, but a comparison across columns would be impossible.

Identifying which factors gain or lose with immigration of $L1$ is of particular interest, since Canadian policy has placed heavy emphasis on encouraging immigration of this labor group.[10] Each factor, including $L1$, is its own enemy. Results show capital and $L1$ are enemies as well.[11] Both of these factors are friends of all other labor groups.

When $L1$ immigrates, its wage and the capital return fall, while payments to all other labor groups rise. A comparison of $e_{hk}$ magnitudes indicates that service workers ($L3$) and agricultural workers ($L4$) benefit most when $L1$ immigrates.[12] This tendency for $L1$ immigration to raise returns to other labor groups may help explain why the Canadian public has shown little interest in immigration policy [Hawkins, 1974, p. 142]. Among capital owners who stand to lose from $L1$ immigration is the federal government, which, through various crown corporations, has holdings in a number of industries.

These results mean that productive capital inflow would alter income distribution in the same pattern as $L1$ immigration. Recently, the Canadian government has proposed easing controls on foreign investment in order to attract the foreign capital needed to create more jobs. Proposed legislation will replace the 11-year-old Foreign Investment Review Act which limited direct foreign investments in Canada. Canadians now appear to be more receptive to foreign investments.

While results indicate that all labor groups but $L1$ will gain from this easing of controls on foreign investment, relative $e_{hk}$ magnitudes mean that service workers ($L3$) and agricultural workers ($L4$) will benefit most. Reducing the supply of a factor lowers (raises) payments to the factor's friends (enemies). Previous policy, intended to limit direct investment inflows and encourage direct investments abroad, had a favorable impact on payments to skilled $L1$ and capital owners in Canada, while lowering returns to the other labor groups.

Labor groups $L2$ through $L5$ are found to be enemies. Each of these groups is a friend of both $L1$ and capital. Increasing the supply of any one of the labor groups $L2$ through $L5$ would lower payments to each of these, but raise returns to $L1$ and capital. Group $L3$ has the largest own effect, and $L5$ the smallest. Effects of changing the supply of $L2$ and $L3$ on $L3$ and $L4$ are particularly large. Magnitudes of elasticities for $L2$ and $L3$ migration are roughly two-thirds the size of $L1$ migration and capital elasticities, and twice the size of $L4$ and $L5$ elasticities.

## V. Conclusion

This study derives long-run income distributional impacts of immigration and capital flows in a general equilibrium model of Canada. While each factor is its own enemy, results indicate that capital and skilled professional labor are enemies as well. Both of these productive inputs are friends of other labor groups, which are common enemies. Factor friendship patterns are useful in evaluating income distributional impacts of a variety of policies designed to influence the international flow of productive labor and capital.

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[10] Figures on intended occupations of immigrants, contained in a Statistics Canada [1981] publication, indicate that occupational composition of immigrants remains relatively constant from year to year. Distribution of immigrants by intended occupation in 1978 is: $L1$, 35 percent; $L5$, 23 percent; $L2$, 21 percent; $L3$, 18 percent; and $L4$, 3 percent.

[11] A similar result can be found in the literature [Thompson and Clark, 1983], where capital and skilled labor are identified as enemies in a three factor model of the U.S. economy. This is true even though intuition and some applied studies suggest complementarity between the two inputs. The definition of skilled labor is somewhat broader than the present paper's $L1$.

[12] A study by Posner [1975] has shown that Canadian imports are relatively intensive in university educated labor. Immigration policy favoring highly trained labor and commodity trade appear to be substitutes. Both can be expected to have similar effects on the internal distribution of income.

## APPENDIX

1. To prove (1), consider this summary of the model's algebraic statement:

$$\begin{bmatrix} S_{6x6} & A_{6x5} \\ A'_{5x6} & O_{5x5} \end{bmatrix} \begin{bmatrix} dw \\ dx \end{bmatrix} = \begin{bmatrix} dv \\ dp \end{bmatrix} .$$

Let all exogenous differentials be zero except for one endowment change, and divide the system by that $dv_k$ to find

$$\begin{bmatrix} S & A \\ A' & O \end{bmatrix} \begin{bmatrix} \partial w/\partial v_k \\ \partial x/\partial v_k \end{bmatrix} = \begin{bmatrix} 0 \\ (1) \\ 0 \end{bmatrix} ,$$

with 1 in position $k$ of the exogenous vector.

Using Cramer's rule to solve for $W_{hk}$, the resulting cofactor has 1 in position $hk$. After deleting column $h$ and row $k$, multiply the determinant of the remaining 10x10 submatrix by $(-1)^{h+k+1}$. The result can be stated

$$W_{hk} = (-1)^{h+k+1} \begin{vmatrix} S_k^h & A_k \\ A'^h & O \end{vmatrix} ,$$

where $M_k$ ($M^h$) represents matrix $M$ with row $k$ (column $h$) deleted. Expanding along the last row of this determinant, all substitution terms disappear. What remains can be rearranged to find

$$W_{hk} = (-1)^{h+k+1} A'^h A_k = (-1)^{h+k+1}\, {}_hA\, {}_kA .$$

2. To see the relation between ${}_kF$ and ${}_kA$ in (2), remember that multiplying any row of a matrix by a constant changes the value of its determinant by its product with that constant. Row $i$ of $A_k$ is multiplied by $w_i$, for all $i$ except $k$. Hence, ${}_kF = w_{-k}\, {}_kA$.

3. In proving (4), note that by definition, $E_{hk}/E_{kK} = [(v_k/w_h)w_{hk}]/[(v_K/w_k)w_{kK}]$, which reduces readily to $(Y_k/Y_K)\,(w_K w_{hk}/w_h w_{kK})$. Also, $V_{hk}/V_{kK} = w_K w_{hk}/w_h w_{kK}$, so that $E_{hk}/E_{kK} = (Y_k/Y_K)(V_{hk}/V_{kK})$. Similarly, $E_{kK}/E_{KK} = w_K w_{kK}/w_k w_{KK} = V_{kK}/V_{KK}$. Thus, $e_{hk} = (E_{hk}/E_{kK})(E_{kK}/E_{KK}) = (Y_k/Y_K)(V_{hk}/V_{kK})(V_{kK}/V_{KK})$.

4. The calculated factor share matrix is

$F =$

| L1 | L2 | L3 | L4 | L5 | K | |
|---|---|---|---|---|---|---|
| .046 | .021 | .003 | .219 | .064 | .647 | *A* |
| .201 | .126 | .017 | .008 | .486 | .162 | *M* |
| .130 | .056 | .008 | .008 | .609 | .189 | *C* |
| .170 | .177 | .023 | .008 | .394 | .228 | *U* |
| .328 | .241 | .104 | .004 | .067 | .256 | *S* |

where $A \equiv$ agriculture, $M \equiv$ manufacturing, $C \equiv$ construction, $U \equiv$ utilities, and $S \equiv$ other services.

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