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IMMIGRATION POLICY AND ECONOMIC GROWTH

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IMMIGRATION POLICY AND ECONOMIC GROWTH*

1. Introduction

There is a reasonable body of evidence which indicates that in the short term immigration to Canada increases the unemployment rate, lowers the rate of increase in real output per capita, and marginally reduces the rate of inflation.[1] Although these effects may influence the decision about the appropriate level of immigration, they are based on models in which output is demand-determined and therefore do not address the question of the long term or growth effects of immigration. Insofar as economic considerations affect the decision about the appropriate level of immigration, these growth effects have played an important role in the formulation of immigration policy in Canada, the United States, and Australia. In the 1966 White Paper on Immigration, high levels of immigration to Canada were justified on this basis, particularly on the presumption that there are economies of scale which warrant a large population.[2] But the 1975 Green Paper suggests that economies of scale are too small to matter, either because the population is already sufficiently large, or because the gains from scale may also be realized through specialization in international trade.[3]

Although the extent of economies of scale affect the desirable level of immigration, the literature and public debate have virtually ignored the fact that the net effect on economic growth also depends, even when the determination of output is neoclassical, on the age distribution of the migrating population, their labour force participation rates, the extent to which technical progress is labour- or capital-augmenting as opposed to neutral, the elasticity of substitution between capital and labour, and on parameters in the objective function. The purposes of this paper are to formulate a relatively simple economic-demographic model which takes account of the age distribution and labour force behavior of migration to Canada, and to test the extent to which the economic desirability of immigration depends on the factors enumerated. Because it is difficult to measure and separate out the effects of technical progress, economies of scale, factor substitutability, and parameters in the objective function, we experiment with different assumed values of the appropriate parameters to determine whether there is a reasonable range of values which justify a given level of immigration and thereby infer indirectly which level, or range of levels, of immigration may contribute to economic growth.

In the model, the population is formed by cohorts, but separate cohorts are specified for native-born and foreign-born persons. It is necessary to have separate cohort equations for the two groups in order to take account of the different age distribution and labour force behavior of immigrants. The economic equations are deliberately kept as simple as possible in order to be able to intuit the results: output is determined by a CES production function, savings are directly related to output, and the capital stock is reduced by depreciation and augmented by savings. Two alternative objective functions are specified. In each, utility depends on per capita consumption weighted either by the native-born population or the total population.

The general method of analysis is similar to the pioneering study by Coale and Hoover (1958) and to others which followed -- Barlow (1969), Enke and Zind (1969), Enke _et al_. (n.d.), Davies (1972), Denton and Spencer (1973, 1975), and Barlow and Davies (1974). Of these studies, the only ones which analyze the economic effects of immigration in a neoclassical framework are those by Denton and Spencer. However, their treatment of immigration is not as detailed as here and they do not specifically address some of the questions in which we are interested.

We proceed to develop the model in sections 2 - 4, present the results in sections 5 - 9, and conclude the paper with a summary discussion.

2. Population and Labour Force

The model contains 344 equations describing the formation of population cohorts. The basic cohort equation is as follows:

$$P_t^{\psi,i,c} = P_{t-1}^{\psi,i-1,c}(1 - d_{t-1}^{\psi,i-1}) + [m^{\psi,i-1}(1 - d_{t-1}^{\psi,i-1})]$$

in which $P^{\psi,i,c}$ is the number of persons of sex ψ(male or female), age i (0,1,...,84, 85+), and place of birth c (native-born or foreign-born), $d^{\psi,i}$ is the mortality rate of persons of sex ψ and age i, and $m^{\psi,i-1}$ is the number of immigrants of sex ψ and age i-1.[4] The m variable is zero for the native-born cohorts. This basic equation is varied for the infant cohorts and the open-ended cohorts of age 85 and over. The infant cohorts are related to total births which are determined by applying age-specific fertility rates to the female cohorts of childbearing age.[5]

The total labour force is determined by applying foreign and native-born, age and sex-specific labour force participation rates to the appropriate population cohorts, that is,

$$L_t = \Sigma \ell^{\psi,i,c} P_t^{\psi,i,c}$$

in which L is the total labour force, $\ell^{\psi,i,c}$ is the participation rate of persons of sex ψ, age i, and place of birth c.[6]

3. Production

Total real output is determined by a two factor CES production function with factor-augmenting and neutral technical change. The equation is

$$Y_t = \alpha(1+\rho_d)^t \, [\beta((1+\rho_k)^t K_t)^{-\gamma} + (1-\beta)((1+\rho_\ell)^t L_t)^{-\gamma}]^{\frac{\theta}{-\gamma}}$$

in which Y is total real output, K the real stock of capital, L the labour force, α the efficiency or scale parameter, ρ_d neutral technical change,

β the distribution parameter, ρ_k capital-augmenting technical change, γ the substitution parameter, ρ_ℓ labour-augmenting technical change, and θ the economies of scale parameter.

Savings are a fixed proportion of output, the capital stock is determined definitionally, and total real consumption is output minus savings. The three equations are

$$S_t = .178\, Y_t$$

$$K_t = K_{t-1}\,(1 - .0506) + S_{t-1}$$

and $$C_t = Y_t - S_t$$

in which S is savings and C consumption.[7]

4. Objective Function

It cannot be stated that there is any general public or academic agreement over what should be the economic objective of an immigration policy. Externally-induced population growth poses an especially difficult conceptual problem because we must decide whether to include the increase in utility of migrants in the maximand. Moreover, in a dynamic context, even if we are to take account only of those who are native born, those who migrate give birth to children who are by definition native born. This point may be emphasized by noting that approximately 98.8 percent of the Canadian population is foreign born, or descended from those who were originally foreign born.[8] This proportion must be roughly the same for other major receiving countries such as the United States and Australia. Also, we have elsewhere argued that some account should be taken of the utility gain to prior residents as a result of the improved economic conditions of immigrants, for altruistic reasons.[9] This humanitarian philosophy has in the past formed the basis for Canadian policy regarding refugee movements.

For the purposes of this study we postulate two alternative objective functions, one which takes account of the utility only of those who are native born, and one which takes account of the utility of all residents. In formal terms, everyone has the same utility function which relates individual utility to per capita consumption, which is assumed to be distributed equally among the entire (native and foreign-born) population. The function we select has found some use in time-dependent optimizing problems, for example, Kendrick and Taylor (1971). The form of the individual utility function is

$$\frac{1}{1-\mu}\left(\frac{C_t}{POP_t}\right)^{1-\mu}$$

in which μ is the elasticity of marginal utility with respect to consumption. For $0 < \mu < 1$, the form implies positive but decreasing marginal utility of consumption.

For the first maximand, utility as defined above is aggregated over the native-born population (by multiplication) in each period and then discounted back to the present. To account for using a finite time period, we also assume that the stock of capital is completely consumed by the native-born population in the terminal year. The first maximand may therefore be written as

$$W_1 = \sum_{t=1972}^{2020} \left\{ \frac{\frac{1}{1-\mu}\left(\frac{C_t}{POP_t}\right)^{1-\mu} \cdot NPOP_t}{(1+\rho_o)^t} \right\} + \frac{\frac{1}{1-\mu}\left(\frac{K_{2021}}{NPOP_{2021}}\right)^{1-\mu} \cdot NPOP_{2021}}{(1+\rho_o)^{50}}$$

where ρ_o is the discount rate.

For the alternative maximand, we take account of the utility of all residents, including those who are foreign born. In this case,

$$W_2 = \sum_{1972}^{2020} \left\{ \frac{\frac{1}{1-\mu}\left(\frac{C_t}{POP_t}\right)^{1-\mu} \cdot POP_t}{(1+\rho_o)^t} \right\} + \frac{\frac{1}{1-\mu}\left(\frac{K_{2021}}{POP_{2021}}\right)^{1-\mu} POP_{2021}}{(1+\rho_o)^{50}}$$

The maximizing solution is unfortunately not amenable to optimal control techniques because of the very large number of variables in the complete model. We therefore do not solve for an optimal time path for immigration but approximate the constant level of immigration which maximizes W_1 or W_2. The following section shows the effects on W of different assumed levels of immigration for the standard case or reference set of assumptions about parameter values.

5. Standard Case Results

To assign parameter values, we first assume that the factor shares are equal. At t=0 (1971) this implies

$$\beta = \frac{1}{\left(1 + \frac{L_o}{K_o}\right)^{\gamma}}$$

Given the 1971 values of L and K and assuming $\gamma = -.5$ (the elasticity of substitution, $\sigma = 2$), this implies $\beta = .009373$. We also initially assume that $\theta = 1.0025$. Given the 1971 value of total output, these assumptions also imply $\alpha = 1789.2$.

The technical change parameters ρ_d, ρ_k, and ρ_ℓ may not be separately identified. We initially assume that $\rho_d = \rho_k = \rho_\ell = .0037$, which generates a compound rate of growth in per capita output equal to the implied average annual rate from 1951 to 1971 (2.7 per cent) when net immigration is assumed to be fixed at 100 thousand per annum.

On the assumption that growth in output in Canada had been intertemporally optimal, Mera (1968) obtains estimates of μ = .094, .126, and .193 for the periods 1947-59, 1947-51, and 1952-59 respectively. The rates of time preference, ρ_o, associated with these values are .026, .034, and .019 respectively. For our standard case solution, we therefore take μ = .126 and ρ_o = .034.

Table 1 shows the values of the maximands W_1 and W_2 for seven different levels of net immigration. Higher values of both maximands result from higher levels of net immigration, but this by itself should not be construed as demonstrating the economic desirability of immigration because the standard case solution does not necessarily involve the most likely set of parameter values; rather, it is used here only as a starting point from which the effects of alternative assumptions about parameter values may be tested. The next section shows the effects of different values of the technical change parameters.

6. Factor-Augmenting Technical Change

To determine whether the above results are sensitive to the type of technical change which occurs, we first assume that neutral and capital-augmenting technical change are each one-half of the values assumed for the standard case solution and that labour-augmenting technical change is sufficient to generate a compound average growth rate in real per capita output of 2.7 per cent over the solution period when net immigration is assumed to be fixed at 100,000 per annum. The relevant values are $\rho_d = \rho_k$ = .00185 and ρ_ℓ = .0125. The results of these tests are shown in the first two columns of Table 2.

Comparable tests were completed assuming that technical change is relatively capital-augmenting. The parameter values are $\rho_d = \rho_\ell$ = .00185

Table 1

Standard Case Results

Net Immigration	W_1 (000)	W_2 (000)
zero	837.1	911.6
50,000	839.8	948.4
100,000	843.3	984.9
150,000	847.4	1,021.1
200,000	852.1	1,057.1
250,000	857.3	1,092.9
300,000	862.9	1,128.6

Table 2

Technical Change Factor-Augmenting

Net Immigration	Labour-Augmenting		Capital Augmenting	
	W_1	W_2	W_1	W_2
zero	846.2	921.6	831.1	905.1
50,000	850.5	960.5	832.9	940.7
100,000	855.5	999.2	835.6	976.0
150,000	861.1	1,037.7	839.0	1,011.0
200,000	867.2	1,075.9	843.1	1,045.8
250,000	873.7	1,114.0	847.6	1,080.4
300,000	880.6	1,151.9	852.6	1,114.8

and ρ_k = .00725. The results of these experiments are shown in the third and fourth columns of Table 2. For both variations reported in Table 2, higher values of the objective functions are associated with higher levels of immigration, so that we may conclude that the economic desirability of immigration in this model does not depend on the nature of technical progress.

7. Economies of Scale and Factor Substitutability

In the reference solution, economies of scale were assumed to be one-fourth of one per cent ($\theta = 1.0025$). Because this assumption resulted in higher values of W_1 and W_2 for higher levels of immigration, larger values of θ would *prima facie* have the same result. We therefore test only the effects of the assumption of no economies of scale ($\theta = 1.0$). This experiment also entails an adjustment in the scale factor in the production function ($\alpha = 1805.7$). The results of this experiment are shown in the first two columns of Table 3.

All of the above experiments have assumed relatively high factor substitutability ($\sigma = 2$). Assuming low factor substitutability ($\sigma = .5$) implies $\beta = .9999$ and $\alpha = 1.3326$. To maintain the implied average annual rate of growth in real per capita output for net immigration equal to 100,000 per annum, the technical change parameters are set at $\rho_d = \rho_k = \rho_\ell = .0085$. The results of these experiments for the seven different levels of immigration are shown in the last two columns of Table 3. Both of the variations shown in Table 3 indicate higher values of the objective functions as a result of higher levels of immigration.

Table 3

Economies of Scale and Factor Substitution

Net Immigration	No Economies of Scale		Low Factor Substitutability	
	W_1	W_2	W_1	W_2
zero	849.9	925.4	860.1	937.4
50,000	852.5	962.7	876.8	990.4
100,000	856.1	999.8	893.1	1,043.2
150,000	860.3	1,036.6	909.2	1,095.8
200,000	865.0	1,073.2	925.2	1,148.2
250,000	870.3	1,109.6	940.9	1,200.4
300,000	876.0	1,145.8	956.6	1,252.4

8. Participation Rate Differentials

Immigrant participation rates by age and sex, averaged over the period 1966-75, are generally higher than the corresponding rates for the native-born source population, by at most 8.5 percentage points. When immigration is set at 100,000 per annum, the calculated labour force ratio for native-born persons ranges from .38 to .43 over the solution period; for the foreign-born population, the ratio ranges from .51 to .56. (The differences between the labour force ratio for foreign- and native-born persons are also affected by the age distribution of immigrants, who are more concentrated in the working ages than the native-born population.) To determine whether the economic desirability of immigration depends on the higher participation rates displayed by the foreign-born, we performed one experiment setting the foreign-born participation rates by age and sex equal to the corresponding native-born rates. The results of this experiment are given in Table 4. Again, higher levels of immigration result in larger values of the objective functions, but the relative increases in W_1 and W_2 for higher immigration are slightly lower than in the standard case experiment, as we would expect.

9. Parameters in Objective Function

A relatively high degree of uncertainty must be attached to the values of the parameters μ and ρ in the objective function. The two alternative pairs of values suggested by Mera ($\mu = .094$ with $\rho_o = .026$ and $\mu = .193$ with $\rho_o = .019$) were used in the two final experiments, the results of which are presented in Table 5. Again, higher levels of immigration are warranted, based on the values of W_1 and W_2. In Table 5, the first pair of values gives much higher values of the objective functions, because $\mu = .094$ implies that a higher weight is given to per capita consumption and a social rate of time preference $\rho_o = .026$ means that future levels of consumption are

Table 4

Foreign-Born Participation Rates Equal to Native Born Rates

Net Immigration	W_1 (000)	W_2 (000)
zero	834.1	908.3
50,000	835.6	943.7
100,000	838.0	978.7
150,000	841.4	1,012.9
200,000	845.0	1,048.2
250,000	849.3	1,082.7
300,000	854.1	1,117.0

Table 5

Variations on Parameters in Objective Function

Net Immigration	$\mu = .094$ and $\rho_o = .026$		$\mu = .193$ and $\rho_o = .019$	
	W_1	W_2	W_1	W_2
zero	1,411.3	1,528.8	642.8	695.0
50,000	1,416.7	1,594.1	646.5	727.1
100,000	1,423.7	1,658.8	650.9	758.9
150,000	1,432.0	1,723.1	655.8	790.5
200,000	1,441.3	1,787.0	661.2	821.9
250,000	1,451.5	1,850.6	666.9	853.2
300,000	1,462.4	1,913.8	672.9	884.3

discounted at a lower rate. A comparable argument applies to the second pair of parameter values, $\mu = .193$ and $\rho_o = .019$, although the social discount rate is lower here than in any of the other cases. The result is a relative decrease in the objective function which is less than the relative increase resulting from the first pair of parameter values assumed for the purposes of this section.

10. Conclusions

We have used a realistic model describing the demographic and economic behavior of natives and immigrants to show the effects on two alternative objective functions of different assumptions regarding technical change, economies of scale, factor substitutability, participation rates, the marginal utility of consumption, and the social rate of time preference. In the use of the model it was demonstrated that, on the criterion postulated, immigration was justified for every assumed set of parameter values. This may be taken as evidence that the economic desirability of immigration to Canada at least does not depend on the existence of economies of scale in production.

Although the model and the results presented and discussed above may assist in illuminating some of the current debate surrounding immigration policy, we hesitate to assert that they confirm the economic desirability of immigration, to Canada or to other developed countries. Our principal reservation concerns the issue of the distribution of the total gains which, in the model, were illustrated to result from higher levels of immigration. Closer inspection of the expressions for the maximands W_1 and W_2 in section 4 is one way of illustrating the issue: we have implicitly assumed that per capita consumption is identical for all of those who are native-born and that this level of consumption is identical to the level for those who are foreign-born, which is also assumed to be uniform. Neither assumption is valid in a realistic sense but the implications for the results are quite unclear. Immigrants to Canada in the postwar period have generally had higher incomes than those who are native born, although immigrants may also have reduced the wages of the native-born population, but not necessarily in all occupations because some of the immigrant labour may have been complementary to native-born labour. The distributional problem is also further complicated once we acknowledge that it is a gross abstraction to assume that all individuals have the same utility functions and that all utilities may simply be aggregated by addition.

These issues are important but certainly cannot be resolved here. Other factors which may in practice influence the decision about the appropriate level of immigration are the existence of externalities, such as congestion, which may result from higher levels of immigration, changes in regional disparities in incomes, shorter term effects of immigration, and other social and political effects which may be even more difficult to quantify.

Apart from these reservations, this study may help at least to expand and clarify some of the debate surrounding the long-term or growth effects of immigration. The importance of the long-term effects of international immigration to those who move and to the sending and receiving countries, and their residents, would appear to us to warrant further investigation of the rather difficult problems.

FOOTNOTES

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[1]These results are found in several recent studies -- Davies (1972), Marr (1972), Davies (1974), Sonnen and May (1975), Grant, Nakamura, and Nakamura (n.d.), and Davies (1976).

[2]Minister of Manpower and Immigration (1966, pp. 7-17).

[3]Minister of Manpower and Immigration (1975, Volume I, p. 6).

[4]The initial values of the population cohorts by single years of age, sex, and place of birth were obtained from Statistics Canada by special tabulation from the 1971 Census of Canada. Mortality rates are assumed to be constant, uniform within each basic five-year age and sex group, the same for native and foreign born persons, and equal to the average age and sex specific rates for Canada from 1971-73. The source is Table 14, Statistics Canada (1974a, 1974b, and 1975a). The age and sex distribution of net immigration is assumed to be constant, uniform within each basic five-year age and sex group, and equal to the actual distribution of immigration to Canada over the 1951-71 period. The distribution is derived from information given in Buckley and Urquhart, eds. (1965), Brown (1965), Department of Citizenship and Immigration (1962-65), and Department of Manpower and Immigration (1966-71).

[5]The age specific fertility rates are assumed to be constant, uniform within each five-year age group, the same for native as for foreign born females, and equal to the average rates for Canada from 1971-73. The source is Table 10, Statistics Canada (1975b). The proportion of live births which are male or female is assumed to be fixed at the average for Canada from 1971-73. The source is Table 5, Statistics Canada (1975b).

[6]The disaggregated labour force participation rates are derived from a special tabulation from the February labour force survey which asks a question on place of birth. The age grouping is 14, 15-16, 17-19, 20-24, 25-34, 35-44, 45-54, 55-64, 65-69, and 70 and over. For each age, sex, and place of birth group, the rate is assumed to be constant and equal to the average February rate from 1966-75.

[7]The parameter in the savings function was derived by regressing 1961 constant dollar gross fixed capital formation (CANSIM Matrix No. 3383.2.1) on 1961 constant dollar gross domestic product (CANSIM Matrix No. 535.1 deflated by No. 529.1), for the period 1951-71 using the Cochrane-Orcutt iterative technique. The regression statistics are $t = 38.0$, and D.W. = 1.29. The depreciation rate was approximated by regressing the 1961 constant dollar, <u>net</u>, year end stock of capital (CANSIM Matrix No. 3383.2.7) minus lagged gross capital formation (above) on the lagged 1961 constant dollar, <u>gross</u>, year end stock of capital (CANSIM Matrix No. 3383.2.4) using the Cochrane-Orcutt method. The regression statistics for this equation are $t = 1159.4$ and $R^2 = .99$.

[8]As of December 30, 1970 there were 250,000 registered Indians in Canada and about 16,000 Eskimos [Department of Indian Affairs and Northern Development (1971, p. 17)]. This is 1.2 percent of the 21,568,311 people resident in Canada on June 1971. Note that these figures most likely overstate the proportion of the population descended only from natives because Indian men (but not Indian women) may marry non-Indians and remain registered Indians. On the other hand, however, Indians may voluntarily deregister and some of these may marry other pure-blooded deregistered Indians.

[9]Davies and Sharir (1976).

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