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The Effects of Immigration on Residents' Incomes in Australia: Some Issues Reconsidered

by

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ABSTRACT

This paper outlines the standard neoclassical model (SNM) of the impact of immigration on the incomes of the resident (pre-immigration) population. We augment the SNM to allow for foreign ownership of and government equity in the capital stock. Using the expanded model, four *back-of-the-envelope* (BOTE) calculations are made. The calculations reveal that the size of the *Berry-Soligo* welfare triangle is small and is dominated by the effects of foreign ownership of capital and government equity in capital. In our preferred scenario, the BOTE calculation indicates that the 1991-92 Australian immigrant intake reduced residents' income. We believe the results of the BOTE calculations justify a more comprehensive study incorporating a range of other influential factors determining the impact of immigration on residents' income. We suggest a list of such factors and report on work done in these specific areas. Essential to a comprehensive study are the integration of results from studies in specific areas, and the devotion of resources to the tasks of further data collection and model development.

JEL classification: F22, D33, D60

Keywords: immigration, residents' income, capital mobility, government equity, Berry-Soligo effect.

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THE EFFECT OF IMMIGRATION ON RESIDENTS' INCOMES IN AUSTRALIA: SOME ISSUES RECONSIDERED

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I Introduction

In assessing the effect of immigration on living standards in Australia, most empirical studies have focused on immigration-induced changes in various measures of income per capita.[1] Society's welfare most likely depends on many more arguments than just income, such as leisure time, clean air, open spaces and other quality of life variables. However, income (or the value of goods and services represented by income payments) is an important component of the economic welfare of society and changes in it are therefore an essential input to any assessment of the impact of immigration. In this paper, we reconsider the various arguments raised in the literature on the effects of immigration on the income of (pre-immigration) Australian residents. In addition, we offer *back-of-the-envelope* (BOTE) calculations to illustrate the potential importance of the role of government equity in, and foreign ownership of, Australian assets in determining the impact of immigration on the income of the resident population.

In the next section, we define the resident population and discuss the relevance of changes to its income in assessing the economic welfare effects of immigration. In section *III,* we explain the effect of immigration on residents' income in the standard neoclassical model (SNM). In section *IV,* we outline modifications to the SNM. In section *V*, we develop a model with the facility to test the sensitivity of residents' income to additional immigration. Section *VI* presents the results of our BOTE calculations of the impact of the 1991-92 immigrant intake in Australia on residents' income. We include calculations, using the expanded model, measuring the sensitivity of the SNM to variations in government ownership and foreign ownership of Australian assets. Concluding remarks are contained in section *VII.*

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* The authors thank P.D. Adams, P.B. Dixon, M. Malakellis, J. Menon and B.R. Parmenter for helpful advice.

1 See, for example, Withers (1985 and 1988), Baker (1985), Centre for International Economics (CIE, 1988) and Nevile (1990).

II Whose Income?

A recent survey of the Australian literature on the economics of immigration concludes, on the basis of changes in aggregate income per capita of the post-immigration population, that the effects of immigration on Australian living standards are benign.[2]

Parmenter (1990) and a growing number of other authors have recognised that assessing the economic welfare effects of immigration on the basis of changes in measures of income per capita of the post-immigration population can be misleading (see Parmenter and Peter, 1991; Fel, 1992; Peter, 1993a and 1993b; and Clarke and Ng, 1993).[3] Parmenter argues that in an ex-ante sense, the immigrants reveal their preferences by the act of choosing to migrate. That is, from their choice to migrate, we can infer that immigrants are better off than had they remained in their countries of origin. It is changes in the welfare of the residents which is the missing information necessary for the assessment of the welfare effects of immigration. If the residents' welfare increases, the welfare of the post-immigration population unambiguously increases. If the residents' welfare declines, the effect of immigration on the population's welfare is ambiguous and depends on the magnitude of the decline and the relative weighting given to residents' and immigrants' welfare. A simple example can illustrate the point.

Imagine a situation where additional immigrants have lower workforce participation rates or lower skills than the residents, but where industry is subject to increasing returns. Income per capita of the post-immigration population may fall if the low productivity of immigrants dominates the effects of increasing returns. However, the residents may experience an increase in income due to the effects of increasing returns. In this example, the contribution of the immigration-induced change in income to the residents' welfare is positive. Had we used the change in income per capita of the post-immigration population as our relevant measure, we would have concluded that the immigration-induced change in income to society's welfare was negative.

The preceding discussion has assumed that the 'residents' are a well-defined group. Even if it is agreed that residents are the correct group of focus, difficulty arises in determining a universally acceptable definition of the resident population. The majority of current Australian residents are either former immigrants or offspring of immigrants. Therefore, what is the timing which results in the transition from immigrant status to resident status? One approach, is to consider the entire population existing at the point in time when a decision on additional immigration is to be made as residents, and to exclude the additional immigrants from the resident group. This is the approach implicitly assumed in the SNM and it is the definition that will be used

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2 "In summary, while not totally unequivocal, the weight of evidence leads to the conclusion that Australian living standards, measured in terms of output and income per capita, have benefited as a result of the type and scale of immigration that has been experienced to date." Wooden (1994, p.141).

3 Parmenter and the other authors follow a number of economists who make the point that the welfare of the residents should be distinguished from that of newly-arrived immigrants. See for example Bhagwati and Rodriguez (1975), Usher (1977) and Withers (1985).

throughout this paper. At any given point in time, it is this group, or its representatives, which must decide on the future immigrant intake. Therefore, it is reasonable to assume that this group will *inter alia* take into account changes in its income when deciding on the immigrant intake.

III The Berry-Soligo or Standard Neoclassical Model [4]

Neoclassical trade theory suggests that additional immigration can increase the factor incomes of the residents. In the neoclassical framework, firms are subject to constant-returns-to-scale (CRTS) production technology, and product and factor markets are perfectly competitive. These assumptions guarantee that factors of production are paid their marginal products. In addition, it is assumed that the variable factor and the fixed factor are homogeneous. If immigrants cause an increase in the ratio of the variable factor to fixed factor, neoclassical theory predicts an increase in resident factor income if the residents own the economy's fixed factors. In the SNM, the variable factor is assumed to be labour and the fixed factor is capital. This outcome is illustrated in Figure 1.

Figure 1. Immigration and Incomes in a Simple Economy

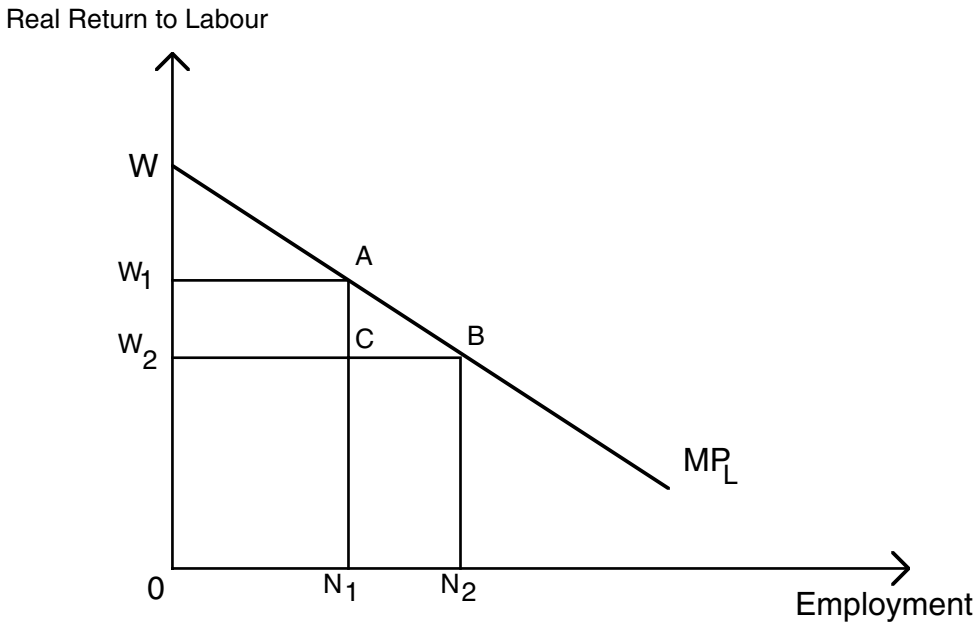

Figure 1 depicts the economy's demand curve for labour (i.e., the marginal product of labour, MP_L) and labour's pre-immigration real return (W_1) and employment (N_1). The pre-immigration real income, the area $0N_1AW$, is distributed between labour and capital (assumed to be entirely owned by the residents) with the amount $0N_1AW_1$

4 Expositions of the Berry-Soligo model (Berry and Soligo, 1969) can be found in the Australian literature in Tu (1991), Parmenter and Peter (1991) and Clarke and Ng (1993).

accruing to labour and the amount W_1AW accruing to capital. Now assume that immigration adds to the supply and employment of labour but leaves capital (and its ownership) unaffected. In Figure 1, the new employment level is N_2 resulting in a decline in the real wage to W_2. The economy's real income is increased to the area $0N_2BW$. To the immigrants goes the area N_1N_2BC, while the income of resident workers is now the area $0N_1CW_2$. From labour income, the area W_2CAW_1 is redistributed to (resident) capital owners, who also enjoy the additional area CBA. In sum, the residents experience an increase in real income equal to the area of the triangle CBA.

The above analysis is a gross simplification of the real world. For example, Parmenter and Peter (1991) show that the welfare triangle implied by an ORANI simulation conducted by the Centre for International Economics (CIE, 1988) for the Committee to Advise on Australia's Immigration Policy, is more than offset by the reduction in the terms of trade implied in the same simulation. In the same paper, Parmenter and Peter show that it is possible that an income gain to the residents, greater than that implied by the triangle, is possible if there is a redistribution of the tax burden favouring residents.

IV Three Modifications to the Standard Neoclassical Model

Our task is to calculate BOTE estimates of the SNM and to test its robustness to variations in: (i) the distribution of the ownership of the capital stock between residents and foreigners, (ii) the distribution of the returns to government-owned capital between residents and newly-arrived immigrants, and (iii) the response of the capital stock to changes in employment. We select cases (i) and (ii) for sensitivity analysis because of an *a priori* expectation that their effects may be significant for Australia. Case (iii) is selected because of the fixed-capital assumption of the SNM. Fixed capital stock is a short-run assumption, however, as immigration-induced employment growth increases capital rentals, we would expect investors to increase their rate of capital accumulation. In the remainder of this section, we elaborate on our reasons for choosing cases (i) to (iii) for sensitivity analysis.

The distribution of capital between residents and foreigners

Table 1 shows that about 30 per cent of Australia's capital stock is foreign owned. If we allow for foreign ownership of capital in the SNM, then the larger the foreign ownership, the larger the transfer of income to foreigners from resident workers. That is, part of the rectangle W_2CAW_1 in Figure 1 goes to foreigners rather than residents and this loss in resident income offsets the gain represented by triangle CBA (part of which is also captured by foreigners).

The distribution of the returns to government-owned capital between residents and immigrants

Usher (1977) highlighted that newly-arrived immigrants, on becoming citizens of the country of destination, enjoy the right to a share in the goods and services provided for the population by the government. The newly-arrived immigrants also share in the burden of debt held by the government. However, if the

Table 1. *Data for Australia, 1991-92**

1. Total Capital Stock	$1,102,124m
(a) Private assets (resident)	$455,039m
(b) Private assets (foreign)	$303,360m
(c) Public assets	$343,725m
2. Public Debt	$108,818m
3. GDP at factor cost	$342,080m
4. Population	17.5m
5. Labour force	7.78m
6. Labour share of output	0.57
7. Additional immigration	107,400

* All values are in 1991-92 current prices.

Sources:

Row 1; ABS (1993), Australian National Accounts, Capital Stock, cat. no. 5221.0.

Rows 1a and 1b; private assets is all stock owned by unincorporated enterprises, corporate trading enterprises, financial enterprises and real estate transfer expenses (ABS cat. no. 5221.0). The private sector assets were divided between resident and foreign owners at a ratio of 60:40 (ABS (1993), Australian Economic Indicators, June, cat. no. 1350.0).

Row 1c; public assets were those held by government trading enterprises, financial enterprises and government in general (ABS, cat. no. 5221.0).

Row 2; public debt is net total debt of Commonwealth, State and Local governments (ABS (1992), Public Sector Debt, cat. no. 5513.0).

Row 3; ABS (1992), Australian National Accounts National Income and Expenditure, cat. no. 5204.0.

Rows 4 and 5; ABS (1992), The Labour Force, cat. no. 6202.0.

Row 6; ABS, cat. no. 5204.0.

Row 7; Price (1993)

government's equity is positive, meaning that the value of government-owned resources is greater than the government's debt, the additional immigrants will capture a share of that equity (and the returns associated with it) at the expense of the residents.[5]

To illustrate, imagine an economy where the government has accumulated capital. The government distributes the resulting rentals to citizens on a per capita basis. Now consider two extreme cases: (i) where the government acquired the capital through past taxes on the resident population and (ii) where the government acquired the capital by borrowing from the resident population. In case (i), the government has appropriated the capital from the citizens but pays the citizens their 'lost' rentals in the form of government-provided goods and services and benefits. In this case, the government's public debt is zero and the residents' current (and future) tax liability with respect to public debt is also zero. In the second case, the government must tax the residents the value of the interest payments on the borrowings used to fund the capital either directly or by amassing an ever increasing level of debt (resulting in tax payments some time in the future). In case (ii), assuming the interest rate on the government debt and the real rate of return on capital (net of depreciation) are equal, the residents' tax liability with respect to public debt will be equal to the stream of rentals from the government-owned capital. Assuming that the time-preference discount rate is equal to the interest rate, the residents are equally well off in either case (i) or (ii). Now consider an addition to the population via immigration. Assume that the government's policy is to continue to distribute the rentals on government-owned capital to all citizens (residents and immigrants alike) on a per-capita basis. The result is a reduction in the rentals distributed to the residents from the existing government-owned capital stock as they are forced to share with the immigrants. Assume also that the government does not discriminate between residents and immigrants in its tax policy. In case (ii), the residents are no worse-off after immigration as the reduction in the rental stream from government-owned capital is just equal to the residents' reduction in their tax liability, with respect to the public debt. However, in case (i), the residents lose due to the immigration-induced addition to the population. With no future tax liability associated with public debt, there is no offsetting tax reduction for residents associated with a reduction in the debt burden as in case (ii).

The value of government equity in the capital stock in Australia can be calculated from Table 1 as the sum of public assets (row 1c) less the value of public debt (row 2). That is, the value of government equity in the capital stock in 1991-92 is $234,907 million. This gives a value for the share of net government-ownership of the economy's capital stock of 21 per cent.

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5 At this stage of the discussion, we are ignoring the possibility that many government-supplied commodities may be *public* goods in the sense that they are nonexclusive and nonrival (e.g., defence, quarantine controls). The nature of public goods is that additional consumers (e.g., additional immigrants) can be supplied with the good at zero marginal cost and without reducing the consumption level of the existing consumers (e.g., the residents). The current discussion therefore pertains to government supplied commodities that are *private* goods in the sense that they are exclusive and rival.

Movements in the capital stock

In the SNM, the capital stock is assumed to be unaffected by the immigration-induced increase in employment. With CRTS and competitive markets, the increase in employment leads to an increase in the real return to capital. In a small country such as Australia, an increase in the return to capital can be expected to lead to an increase in the level of capital formation in the long run.

V The Expanded Model

Theoretical Structure

The expanded SNM, with allowance for foreign and government ownership of capital, and variations in the capital stock, is captured in the following nine equations :

$$Y = AL^{\alpha}K^{(1-\alpha)}, \qquad 0 < \alpha < 1, \qquad (1)$$

$$w = \alpha Y/L \qquad (2)$$

$$r = (1-\alpha)Y/K \qquad (3)$$

$$K_p = (1-\theta)K \qquad (4)$$

$$K_g = \theta K \qquad (5)$$

$$K_{gi} = (1-\rho)K_g \qquad (6)$$

$$L = L_i + L_m \qquad (7)$$

$$K_{pi} = (1-\gamma)K_p \qquad (8)$$

$$Y_i = wL_i + r(K_{gi} + K_{pi}) \qquad (9)$$

Equation (1) defines the production function of the economy where output (Y) is a Cobb-Douglas function of labour (L) and capital (K). The technology coefficient (A) and the exponent (α) in equation (1) are parameters.

Equations (2) and (3) relate the real returns to labour (w) and capital (r) to their respective marginal products.

Equations (4) and (5) disaggregate the capital stock into privately-owned capital (K_p) and government-owned capital (K_g). The share of government-owned capital (θ) is a parameter.

Equation (6) defines the capital owned by the government on behalf of the residents (K_{gi}) as a share of total government-owned capital ($1-\rho$), where ρ is a parameter.

Equation (7) defines the labour force as the sum of the resident labour force (L_i) and the newly-arrived immigrant labour force.

Equation (8) defines the private-sector capital owned by residents (K_{pi}) as a share of the total private-sector-owned capital. This equation allows for foreign ownership of capital via the parameter γ.

Finally, equation (9) defines the income accruing to the residents (Y_i). The residents' income is the addition of their labour income (the first term on the right-hand side (RHS) of equation 9) and their capital income (the second term). Residents' capital income is the addition of the returns from privately-owned and government-owned capital.

The model contains 12 variables in 9 equations. To close the model we set the values of L_i, L_m, and K exogenously. We can simulate the SNM and variations in the SNM by varying the parameter settings of the expanded model and by varying the value of K.

We conduct four BOTE calculations of the change in residents' income due to additional immigrants equal to 107,400 people, which was the intake for 1991-92. We choose the 1991-92 intake as, in terms of numbers, it is representative of the annual intake of Australian immigrant intakes since 1970-71.

Of the four BOTE calculations, one covers the SNM and three cover variations to the SNM. The three variations are: the SNM with variable capital, the SNM with government and foreign ownership of capital and the SNM with variable capital and with government and foreign ownership of capital.

We can use the expanded model to move between BOTE calculations by varying the values of the model's parameters and the value of K. The relevant parameter settings for each BOTE calculation are derived from the data presented in Table 1 and are summarised in Table 2.

Table 2. Values for Parameters and Exogenous Variables

	BOTE Calculation			
	Without government or foreign ownership of pre-immigration capital stock		With government and foreign ownership of pre-immigration capital stock	
Parameter or Variable	Short run (1)	Long run (2)	Short run (3)	Long run (4)
A	0.10	0.10	0.10	0.10
α	0.57	0.57	0.57	0.57
L_i	7.78m	7.78m	7.78m	7.78m
L_m	47,747	47,747	47,747	47,747
K	1,102m	1,109m	1,102m	1,109
θ	0.00	0.00	0.213	0.212
ρ	0.00	0.00	0.006	0.006
γ	0.00	0.006	0.400	0.479

The values of A, α, L_i and L_m are common to each BOTE calculation. The values of α and L_i are taken from rows 6 and 5 respectively of Table 1. The value of the technology parameter A is determined to satisfy equation (1) given the values (from Table 1) of Y, K, L_i, and α. That is, we determine A on the basis of the pre-immigration labour force, when L_m is assumed to be zero and L equals L_i.

In deriving a value for L_m, we maintain the SNM assumption that the immigration-induced increase in the labour force is the same proportion as the immigration-induced increase in the population. The implication is that the labour-force participation and employment rates of the immigrants are the same as those of resident labour force. A further implication is that the immigrants have the same skill profile as the residents and that immigrants and residents are paid a common wage. Of course, the labour force profile of a given immigrant intake can be expected to deviate from the average of the resident labour force. Indeed, it may be as a result of policy that the immigrants' labour force profile is different from the average of the residents, e.g., if the policy is to attract high-skilled immigrants. Evidence suggests that recent immigrant intakes have higher unemployment rates, lower participation rates and higher skill levels than the residents.[6] Also, the labour force profile varies from one intake to another. For example, it has been estimated that the 1988-89 intake had a higher participation rate than residents while the 1989-90 intake had a lower participation rate.[7]

We do not test the sensitivity of the SNM to variations in the newly-arrived immigrants' labour-force profile. However, Foster (1992) provides evidence that variations in the composition of the immigrant intake based on preferred options of the Federal government, the ACTU and Birrell, Healy and Smith (1992), have little impact on macroeconomic variables. We return to the issue of the immigrants' labour-force profile in section *VII* below.

The settings of the remaining parameters and variables, listed in Table 2, move us between BOTE calculations. The SNM is based on the assumption that the capital stock is unaffected by additional immigration and the associated change in employment and that capital rentals adjust. In a competitive economy subject to CRTS production technology, we would anticipate that, in the long run, capital mobility would return factor prices and the capital-labour (K/L) ratio to their pre-shock levels. Using the expanded model, we simulate this case holding the K/L ratio at its pre-immigration rate by increasing the capital stock in proportion with the immigration-induced increase in employment.

Another feature of the SNM is the assumption that the pre-immigration capital stock is fully owned by the residents. This assumption is captured in the expanded model by setting the parameters ρ, and γ equal to zero. We wish to test the sensitivity of the SNM to the case where the returns to government equity are divided between residents and newly-arrived immigrants, and where foreigners own some portion of the capital stock. For these calculations, the parameter setting for ρ, (giving the newly-arrived immigrants' share of returns from government-equity in the capital

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6 See Healy (1994), CIE (1992) and Foster (1992).

7 See CIE (1990 and 1992).

stock) is fixed at the proportion of the newly-arrived-immigrants in total population. That is, we assume that the returns to government equity are distributed to the population on a per capita basis. The values for θ, (the share of government equity in the capital stock), and γ, (the share of foreign ownership of total privately-owned capital), vary between the short-run and long-run experiments. In the short run, θ is given by the ratio of government equity to total capital stock. This is calculated from Table 1 by subtracting row 2 from row 1c and dividing by row 1, The short-run value of γ is calculated from Table 1 by dividing row 1b by row 1. In the long run, the immigration-induced increase in employment does not disturb factor returns from their pre-immigration levels. With no change in the returns to the factors of production, the domestic agents' (residents and government) factor incomes are unaffected by additional immigration. Unless the domestic agents' savings-to-income ratios increase after additional immigration, the domestic agents are not in a position to increase their accumulation of capital. The provision of additional capital must therefore come from foreigners (in the form of equity or debt) and/or the newly-arrived immigrants (from their funds transferred from their countries of origin to Australia). We accommodate the possibility that the expansion in the capital stock is funded by foreigners or immigrants by allowing the shares of government-owned capital and residents' privately-owned capital to vary, such that the levels of government equity and private resident ownership of capital are unaffected by the effects of additional immigration.

VI Results

Table 3 summarises the results for the four BOTE calculations. The first number in each cell (ΔY_i) reports the annual change in residents income due to the addition of 47,747 immigrants. These values, which we have been estimated in a comparative-static framework, should be capitalised as this change is permanent and, hence, ongoing through time. The second number in the cells (*PV*) is the present value of the change in residents' income.[8] To place the present values of the changes in residents' income in context, we also report the present value as a percentage of 1991-92 GDP. This is the last number reported in each column.

We begin our description of the results with the BOTE calculation (1).

BOTE (1) No Government or Foreign Ownership of Pre-immigration Capital: Short run

The parameter settings for this calculation cause the expanded model to collapse to the SNM and the value of ΔY_i reported in Table 3 is an estimate of the

8 The present value is based on a discount rate of 7.23 per cent which is the real rate of return on Australian capital, net of depreciation in 1991-92. This figure is estimated by taking the ratio of 1991-92 Gross Operating Surplus (GOS) to the asset value of the capital stock and subtracting the aggregate rate of depreciation (estimated at 6 per cent). The sources for the asset value of the capital stock and GOS are those used in Table 1 (see sources for row 1 and row 6 of Table 1 for capital stock and GOS respectively). The estimate of the rate of depreciation is based on the average of 1991-92 industry depreciation rates weighted by capital rentals. The value for the real rate of return on capital of 7.23 per cent is similar to the 1991-92 rate of interest on Commonwealth government 10 year treasury bonds (8.9 per cent, Reserve Bank of Australia, 1993) less the 1991-92 percentage change in the GDP deflator (1.5 per cent, ABS cat. no. 5206.0).

Table 3. Results

	BOTE Calculation			
	Without government or foreign ownership of pre-immigration capital stock		With government and foreign ownership of pre-immigration capital stock	
Residents Income	Short run $m, 1991-92 (1)	Long run $m, 1991-92 (2)	Short run $m, 1991-92 (3)	Long run $m, 1991-92 (4)
ΔY_i	1.57	0.00	-353.26	-192.41
PV	21.71	0.00	-4885.96	-2661.27
%GDP	0.006	0.000	-1.438	-0.780

Berry-Soligo triangle (the area CBA in Figure 1). Using Figure 1, we can intuitively compute (to a first-order approximation) the Berry-Soligo triangle. We start by noting that in Figure 1,

$$CBA = 0.5\Delta w\Delta L$$

which can be rewritten as

$$CBA = -0.5wL\eta_{w,L}(\Delta L/L)^2,$$

where the elasticity of the marginal product of labour with respect to employment ($\eta_{w,L}$) is

$$\eta_{w,L} = \frac{\Delta w/w}{\Delta L/L} = \alpha - 1.$$

The values of the various terms determining the area CBA can be derived from Table 1. The value of the real wage bill (wL) is given by multiplying the share of labour costs in GDP (α) by GDP to give 194,986 million. The values of $\eta_{w,L}$ and the proportion of newly-arrived immigrants to total population ($\Delta L/L$) are -0.43 and 0.006 respectively. These values give an estimate of CBA of $1.5 million.

BOTE (2) No Government or Foreign Ownership of Pre-immigration Capital: Long run

Given the parameter settings listed in Table 3, the post-immigration value of Y_i in the expanded model is

$$Y_i = wL_i + r(1-\gamma)K$$

where $(1-\gamma)K$ is the pre-immigration value of the residents' capital stock and w and r are unaffected by the impact of additional immigrants. Hence, the post-immigration value of Y_i is equal to its pre-immigration value and ΔY_i is zero. In Figure 1, we can see that the increase in residents' income in the SNM is dependent on the negative slope of the marginal product of labour. In the long run, the marginal product of

labour is horizontal and the increase in employment leads to additional wages, captured by the newly-arrived immigrants and additional rentals to new capital stock, captured either by immigrants (if they transfer funds) or foreigners.

BOTE (3) With Government and Foreign Ownership of Pre-immigration Capital: Short run

In contrast to the SNM, this calculation is conducted with non-zero settings for the share variables θ, ρ and γ, in recognition of newly-arrived immigrants' sharing the returns to government-owned capital with residents and foreign ownership of capital.

Given the parameter settings for this experiment, post-immigration residents' income can be written as,

$$Y_i = wL_i + r(1-\gamma)(1-\theta)K + r(1-\rho)\theta K$$

where the first term on the RHS of the above equation is the residents' wage income, the second term is their returns to privately-owned capital and the final term is their return from government equity in the capital stock. The change is residents income can therefore be written as,

$$\Delta Y_i = \Delta wL_i + \{\Delta r(1-\gamma)(1-\theta)K\} + \{\Delta r(1-\rho)\theta K - r\theta K\Delta\rho\}. \qquad (10)$$

The first term on the RHS of equation (10) is the change in residents' wage income. The second term is the change in residents' return from privately-owned capital. Within the second term, the share of capital rentals accruing to government and foreigners are netted out by the terms $(1-\gamma)$ and $(1-\theta)$. The third term on the RHS of equation (10) is the residents' return from government-owned capital. Within the third term, there are two countervailing effects. The first term within the curly brackets calculates the residents' gain from the post-immigration increase in rentals from government-owned capital. The second term calculates the loss in residents' rentals due to the sharing of the government-owned capital stock with the newly-arrived immigrants. Note that, by assumption, the term $\Delta\rho$ is equal to the newly-arrived immigrants as a proportion of the population due our definition of residents as the total pre-immigration population.

The values of the three terms in equation (10) are:

	$m
labour income	-512
return to privately-owned capital	243
return to government-owned capital	-84
Total loss to incumbents	-353

The loss in labour income is the same as in the SNM and measures the area W_2CAW_1 in Figure 1. However, the combined effects of the transfer of resident labour income to foreign owners of capital and the dilution of the resident share in returns to government-owned capital results in a net loss to residents of $353 million. The Berry-Soligo triangle is dominated by the effects of foreign ownership and the redistribution of returns to government-owned capital.

BOTE (4) With Government and Foreign Ownership of Pre-immigration Capital: Long run

In this calculation, factor prices are unaffected by the impact of immigration. Therefore, with resident employment and private ownership of capital stock fixed, the residents' wage bill and rentals from privately-owned capital are unaffected. Government ownership of capital is also assumed to be unaffected by immigration, however, residents must share the returns from government-owned capital with the newly-arrived immigrants. With the post-immigration value of capital rentals from government-owned capital unchanged, residents' income form this source must fall in proportion to the decline in the share of the resident population in the post-immigration population. We can calculate this number by multiplying the pre-immigration value of rentals to government-owned capital by the share of the newly-arrived immigrants in the post-immigration population. This gives a loss of $192 million.

VII Concluding Remarks

Standard neoclassical theory suggests that immigration-induced employment growth leads to an increase in residents' income when the economy's fixed factors are entirely owned by residents. The standard neoclassical case abstracts from a range of economic phenomenon that are potentially quite influential in determining the effect of immigration on residents' income. Of the many possible influences, the effect of foreign ownership of and government equity in the capital stock are likely to be quantitatively significant in the Australian context.

To gauge orders of magnitude, we undertake four BOTE calculations which test the sensitivity of residents' incomes to four scenarios; (1) the standard neoclassical model (SNM), (2) the SNM with a fixed capital-labour (K/L) ratio, (3) the SNM modified to allow for the existence of foreign ownership of and government equity in the capital stock, and (4) a long-run case where additional immigration does not disturb the K/L ratio, but where foreign and government ownership of the capital stock is allowed. Our calculations are calibrated to Australian data for the year 1991-92 when the immigration intake was 107,400 representing an addition to the Australian population of about 0.6 per cent.

In the SNM calculation we find that the impact of additional immigration causes a relatively small increase in residents' income of about $1.6 million. This is an estimate of the Berry-Soligo triangle. We calculate the present value of the residents' gain to be $22 million or about 0.006 per cent of 1991-92 GDP.

When we allow for foreign and government ownership of the capital stock, we find that immigration results in a decline in residents' income. Two mechanisms explain this result. First, in the SNM the additional employment generated by immigration causes a fall in the real wage and a rise in the rentals to capital. Residents who derive their income from labour experience a fall in income, but their loss is transferred as a gain to the owners of capital who, in the SNM, are assumed to be residents. When we allow for foreign ownership of the capital stock, part of the transfer of income from resident workers to capital owners is captured by foreigners resulting in a net decline in resident income. Second, with government equity in the

capital stock, the residents now share the returns to government-owned capital with the newly-arrived immigrants thereby reducing residents' incomes compared to the SNM. That is, the transfers of income from residents to foreigners and newly-arrived immigrants, swamp the value of the Berry-Soligo triangle. In the calculation with fixed capital stock, the net effect is a reduction in residents' income of $353 million. The present value of this loss is $4,886 million which is about 1.44 per cent of 1991-92 GDP. In the calculation with the K/L ratio fixed, only the second mechanism operates (i.e., the transfer of some government rentals to newly-arrived immigrants) and residents' income loss is $192 million, which has a present value of $2661 million and is 0.78 per cent of 1991-92 GDP.

In summary, our BOTE calculations show a change in residents' income ranging from a small positive amount, in the SNM calculation, to a relatively large negative amount in the SNM calculation modified to allow for foreign and government ownership of the capital stock. Our opinion is that of the four calculations, the most realistic is the case which allows for foreign and government ownership, but which keeps the K/L ratio rather than the capital stock fixed.

However, we do not claim that our BOTE calculations provide any more than a first pass at quantifying the impact of immigration on residents' income. The BOTE calculations are based on a very simple model which abstracts from a multitude of economic phenomena of potential significance in determining the effect of immigration on residents' incomes. Given that our preferred BOTE calculation indicates a relatively significant negative impact on residents' income, we believe a more comprehensive study into the effect of immigration on residents' income is justified. In such a study, we believe the following issues to be of critical importance.

Dynamic adjustment in the capital market. Our BOTE calculations indicate that residents' income is sensitive to changes in the K/L ratio. We model only stylised short-run and long-run scenarios. In reality, there is a time path which the K/L ratio follows in moving from the short run to the long run. There are at least three important issues in modelling the adjustment process of the capital stock.

First, what is the response of investors to the immigration-induced shock over time? To answer this question we need a model that recognises the technological relationship between capital formation and investment, and the extent to which investors use all information (past, present and future) in formulating their current investment decisions.

Second, does the timing of the shock, with respect to the business cycle, affect the outcome? For example, if we increase the size of the labour force through immigration during a downturn in economic activity, will it add to employment or to unemployment? Available statistical evidence suggests that the unemployment rate is unaffected by the level of immigration in the short run and even during recessions (see Ackland and Williams 1992, Pope and Withers 1989, and Withers and Pope 1985). These studies are based on the application of Granger causality. Scope remains for the confirmation of these results from models built on more convincing theoretical foundations.

Third, how sensitive is the K/L ratio to the amount of advance warning given by government on its immigration policy? If policy was announced in advance, investors could be expected to make decisions which affect the capital stock and factor prices in periods prior to the arrival of immigrants. Depending on the amount of advance notice and the degree of foresight assumed on behalf of investors, full adjustment to capital stock and factor prices may already occur prior to the arrival of immigrants.

Two applied models of the Australian economy with dynamic specifications which have been used to address questions of the impact of immigration are the Murphy model and ORANI-F. The Bureau of Immigration, Multicultural and Population Research (BIMPR) commissioned Access Economics to develop a demographic module to accompany the Access-Economics-Murphy-model for the specific purpose of modelling the impact of immigration. Recently, the Centre of Policy Studies (COPS) at Monash University has extended ORANI-F, in the form of the MONASH model, to include a more sophisticated specification of the dynamic process of capital formation. These models could be exploited to provide quantitative estimates of the relationship over time of changes in residents' incomes due to immigration.

Taxes paid and revenues received by immigrants. Our results showed residents' income to be sensitive to the degree of government equity in the capital stock. However, if the newly-arrived immigrants' tax bill was greater than their total receipt of government benefits, then residents' income could rise even in the presence of positive government equity in the capital stock. Whether or not newly-arrived immigrants' tax payments exceed their benefit receipts is an empirical question. A recent study by Mathews (1992) commissioned by the BIMPR, estimated that in the long run, immigrants per capita benefits exceeded their per-capita tax payments by $222 in 1989-90 prices. However, Mathews is sceptical of the reliability of the data available to make such caluculations. Accuruately estimating the net benefits received by immigrants would appear to be an important area of future research.

Government provision of pure public goods. In our BOTE calculations we assumed that all government-provided goods and services had 'private goods' characteristics in that they are excludable and rival in consumption. Many goods and services provided by the government are *prima facie* pure public goods, in that they are nonexcludable and nonrival in consumption. Classic examples are defence and the provision of dams. Other government provided goods and services, while not conforming to the textbook definition of pure public goods can probably be treated as such in that additions to the population due to the immigrant intake can be serviced out of the existing stock of these goods. Examples of these types of government-provided goods are roads and law enforcement. To the extent that immigrants needs can be serviced from the existing stock of these goods without reducing the services provided to residents, our BOTE calculations overstate the loss in residents' incomes.

Economies of scale and the production process. A related issue to the existence of pure public goods is the extent to which an immigration-induced increase in the size of the economy facilitates the exploitation of economies of scale in the production process. Our BOTE calculations are based on a CRTS production process. If we allowed for increasing-returns-to-scale production technology the immigration-induced increase in output would be higher than in our BOTE calculations, and the possibility of residents capturing some of the surplus would exist. Few empirical

studies on the extent of scale economies in Australian industries exist. In a study commissioned by the BIMPR Perkins, Brain, Manning and Klingender (1990), report a scale elasticity for Australian manufacturing industries of 1.15, and for the economy as a whole of 1.28. In a study commissioned for the National Population Council, Peter (1992), using results from a survey by Pratten (1989), reports a scale elasticity for Australian manufacturing and public utilities of 1.06. Not surprisingly Perkins et al conclude significant output gains via immigration-induced increases to the size of the economy, while Peter concludes that only modest gains are made. Given the paucity of empirical work in this area scope exists for more comprehensive studies of the extent of scale economies in Australian industries.

Complementarity between immigrant and resident labour. Our BOTE calculations assumed a homogeneous labour force. To the extent that the labour force is not homogeneous, some types of labour may be in scarce supply at a given point in time. If the type of labour in scarce supply is a complement to other types of labour, then a shortage can be said to have arisen if workers of the abundant types are unemployed or underemployed. Note that this is a different situation to where the types of labour are substitutes and scarcity of one type manifests itself in the relative wages paid to the various types of labour rather than unemployment. In times of labour shortage, targeting the immigrant intake to include labour of the scarce type reduces unemployment amongst the abundant type. As we are assuming that all labour prior to immigration is classified as resident, residents' income will rise as immigration reduces unemployment. In the case where labour types are substitutes an increase in the supply of the scarce labour type will increase the marginal product of the abundant labour types and reduce the marginal product of the scarce labour types including the marginal product of the existing scarce workers. If the production technology is CRTS and markets are competitive, the result is a transfer of income from resident workers of the scarce type to resident workers of the abundant type analogous to the transfer of income from resident workers to resident capital owners in the SNM. In this case any change to residents income relies upon the existence of a Berry-Soligo triangle being captured by residents.

Many factors are important in determining the relationship between immigration and residents' income. We find evidence that the degree of foreign ownership of the capital stock and the extent of government equity in the capital stock may be quantitatively important in determining the relationship in the Australian context. In this paper we also flag a range of other factors important in a comprehensive modelling exercise which we hope to undertake in the near future.

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