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The Economics of Ageing: Generational Accounting and Regional Public Goods in Australia*

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Abstract

The ageing of Australia raises many pressing questions for policy makers, not least formulation economic policy that tackles difficult problems of equity and efficiency. Fortunately an embryonic Australian literature already exists that provides a solid basis for rational policy formulation, including the Commonwealth Government's (2002) Intergenerational Report. This paper seeks to add to this nascent literature by developing a model of generational accounting and extending it to incorporate regional public goods. The extended model can assist policy makers concerned with intergovernmental finance in approaching the problems posed by demographic change for Australian fiscal federalism.

Key Words: fiscal federalism; generational accounting, regional public goods.

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1. INTRODUCTION

Sustained media attention has ensured that the potential problems associated with an ageing population are now firmly planted in the public consciousness. Australian policy makers have already begun to explore the ramifications of these demographic trends. For example, the Commonwealth Government's *Intergenerational Report* (2002) has laid a solid foundation for future policy discourse on the economic and social implications of an ageing population. However, actual policy formulation is still in its infancy. As Sims (2003) has argued in the recent Chifley Research Centre publication *Fiscal Policy Rules in Australia,* 'just how much policy should be "optimally" adjusted in the face of these demographic and technological trends raises difficult questions relating to both efficiency and equity' that have yet to be examined in any detail. The present paper seeks to extend this nascent literature by discussing possible modifications to generational accounting to accommodate the problem of regional public goods confronting Australian fiscal federalism.

The paper itself is divided into three main parts. Section 2 outlines the theoretical framework for generational accounting and seeks to extend the original generational accounts framework developed in Auerbach *et al*. (1999). Section 3 attempts to adapt the basic model to incorporate regional public goods. The paper ends with some brief concluding remarks in section 4.

2. GENERATIONAL ACCOUNTING METHODOLOGY

Following Auerbach and Kotlikoff (1999, p. 31) the government's inter-temporal budget constraint is expressed in equation (1) as:

$$_{k=t-D}\Sigma^{t}.N_{t,k} + (1+r)^{-(k-t)}{}_{k=t+1}\Sigma^{\infty}N_{t,k} = {}_{s=t}\Sigma^{\infty}G_{s}(1+r)^{-(s-t)} - {}^{g}W_{t} \quad (1)$$

The generational account is:

$$N_{t,k} = {}_{s=z}\Sigma^{k+D}T_{s,k}P_{s,k}(1+r)^{-(s-z)} \quad (2)$$

where: $z = \max(t,k)$

The constraint requires that (on the left hand side) the present value of future tax payments net of transfers of the current and future generations be sufficient to cover (on the right hand side) the present value of future government consumption and service the government's initial net indebtedness. The constraint and the generational account are related by the term $N_{t,k}$. All items in equation (1) and (2) are real values (i.e. measured at constant prices).

On the left hand side of equation (1), the first term is an envelope expression that adds together the generational accounts of existing generations. The generational accounts are the present value of the remaining lifetime net tax payments. $N_{t,k}$ represents the present value of the average remaining net tax payments for all individuals of the generation born in year k at the base year of the analysis, time t, which for expositional purposes is set at year 2002. In this summation, k is an index, which runs from t - D to t. Thus, for those aged D, the maximum length of life, then t = 0, and there are no further net tax payments. For those age 0, the new-born, then t = D, and the remaining net tax payments run from k = 0 to D and thus are equal to total lifetime payments.

We now turn our attention to the detail of the generational account for the individual, contained in equation (2). The term $T_{s,k}$ is the projected average net tax payment to the government made in the year s from the generation born in year k, and $P_{s,k}$ is the number of surviving members of the cohort in year s who were born in year k.

Consider members of the current generation; that is, for generations born prior to year t ($k < t$). In the Σ term, $z = \max(t,k) = t$, since $k < t$. The summation begins in year t and runs for k + D periods. Each account is then discounted to year t by the real interest rate, r.

An example may serve to clarify this argument: First we focus on that part of equation (1) that refers to the current generation, $_{k=t-D}\Sigma^{t} N_{t,k}$, and from equation (2), the generational account, $N_{t,k} = {}_{s=z}\Sigma^{k+D} T_{s,k} P_{s,k} (1 + r)^{-(s-z)}$, then by substitution of (2) into part of (1), we have the double summation:

$$_{k=t-D}\Sigma^{t} N_{t,k} = {}_{k=t-D}\Sigma^{t} \cdot {}_{s=z}\Sigma^{k+D} T_{s,k}\, P_{s,k}\, (1 + r)^{-(s-z)} \qquad (3)$$

Since we are dealing with the current generation, k < t, and thus z = max(t,k) becomes z = t. Equation (3) now becomes:

$$_{k=t-D}\Sigma^{t}\, N_{t,k} \;=\; {}_{k=t-D}\Sigma^{t} \cdot {}_{s=t}\Sigma^{k+D} T_{s,k}\, P_{s,k}\, (1 + r)^{-(s-t)} \qquad (4)$$

Assume that we are interested in the cohort born in 1972 (=k). This cohort is presumed to live for (D=) 85 years, and the base year of the study is (t=) 2002. Taking the inner summation first, the summation runs from the year (s = t =) 2002 to (k + D = 1972 + 85 =) 2057, which is 55 periods and represents the expected remaining lifespan of the cohort born in 1972. The net tax payments, $T_{s,1972}$, are a stream of taxes less transfers, in some years positive and in other years negative, depending on the stage in the life cycle of the cohort for 55 periods. The term $P_{s,1972}$ is the population of the cohort born in 1972, the number of which will decline according to the rate of natural attrition until the cohort reaches 85 years old when life is assumed to expire for all those remaining in the cohort at that time. For those born in 2002, the base year, this cohort has a generational account of net tax payments over the whole of their lifetime. So they will live until (k + D = 2002 + 85 =) 2087. For those born in 1917 and are thus aged 85 years in 2002, they are assumed to have reached the maximum length of life, and so there are no further transactions. In this case the index runs from t = 2002 to(k + D = 1917 + 85 =) 2002. If we now examine the outer summation, then we can extend the preceding discussion to all of the current generation. We thus have a series of generational accounts, which include the outer limits of the current generation, that is, those born in 1917 and 2002, and a middle cohort, those born in 1972, expressed as follows:

$$_{2002}\Sigma^{2002} T_{s,1917}\, P_{s,1917}\, (1 + r)^{-(s-2002)}$$

$$\vdots$$

$$_{2002}\Sigma^{2057} T_{s,1972}\, P_{s,1972}\, (1 + r)^{-(s-2002)} \qquad (5)$$

$$\vdots$$

$$_{2002}\Sigma^{2087} T_{s,2002}\, P_{s,2002}\, (1 + r)^{-(s-2002)}$$

The outer summation collects together the generational accounts for each cohort for the current generation; that is, for each of the cohorts born in 1917 through to 2002, noting that k is an index.

The second term in equation (1) is the present value of net tax payments for future generations, again with k representing the year of birth. Turning to the generational account in equation (2), for generations born after year t ($k > t$). Hence, in the Σ term, $z = \max(t,k)$ becomes $z = k$. Thus the inner summation begins in year k and runs for (D=) 85 years. The profile of the net tax payments and population for each cohort in future generations is assumed to be identical, so the model reaches a steady state. Regardless of the generation's year of birth, the discounting is always to year t. Consider the outer summation. If a member of a future generation were born in 2012, 10 years after the base year, then the summation would run from the (k = t + 1 =) 11th period to infinity. As the values are in terms of the year in which the cohort was born, the values must be brought back to the base year of the study, year t = 2002. Thus, the values are further discounted, according to r, the pre tax real discount rate.

On the right hand side of equation (1), the first term expresses the present value of the sum of government consumption (for all generations) from the base year (t=) 2002 to infinity, discounted back to the base year. Government consumption is not attributed to particular generations because this raises unnecessary complications. An implication is that the accounts do not show the full burden of any generation for government policy as a whole.

The second term is the government's net worth, ${}^{g}W_t$, in year t. Most of the conceptual literature refers to this term as net debt of the government (Cuddington, 1996, p. 3). The inter-temporal budget constraint does not assume that the government debt is ever fully repaid, merely that the debt grows less quickly than the rate of interest.

Taxes paid are net of transfers, where transfers cover payments to individuals (e.g. age pensions), health and education. All other government expenditures are treated as government consumption and remain part of the G_s term.

The inter-temporal constraint on fiscal policy can be observed from equation (1). Holding government consumption and net worth constant, a reduction in the present value of taxes by the current generation requires an increase in the present value of taxes by future generations.

3. FISCAL FEDERALISM: EXTENDING THE MODEL TO REGIONAL PUBLIC GOODS

Long term fiscal projections could be disaggregated between the Commonwealth, the states and local government to attribute the intergenerational fiscal imbalance to each tier of government, and measure the consequent pressure to adjust intergovernmental fiscal transfers (IFTs) in the fiscal-federal gap as the long term cost drivers emerge. This analysis could be further extended using Generational Accounting by disaggregating net taxes and population structure into geographic regions (using state or local government statistical districts), which would enable an examination of the impact of demographic change on the provision of public goods at the regional (state or local) level.

A key message of the fiscal federalism literature is that a central government can design a tax and IFT scheme to channel funds to a region to enable inter-jurisdictional spillovers to be internalized and thus maximize social welfare. Cullis and Jones (1998, p. 319) present several rationales for IFTs. First, there may be external benefits for neighbouring regions as a result of any one region's expenditures. Since these are benefit spillovers, the regional government responsible for such activity takes no account of it in decision-making. A second reason is the promotion of a merit good. Third, fiscal equalization, where, even if there is overall fiscal balance, some governments may be unable to finance their programs that other authorities find easy to fund. For example, a health program for Aboriginal children to address hearing impediments due to mites is a much greater fiscal burden in the west Kimberly region than it is on Canberra. Fourth, revenue sharing, where it is efficient for central government to act as a vehicle for collection of tax, and return it to the regions. The main theme for the rationale for an IFT boils down to the funding of a fiscal burden on a region where that burden can be defined as the valuation of the regional public good (both for the residents and the non-residents of the region) in excess of the current resident population's willingness to pay for the regional public good.

Demographic change intersects with fiscal federalism in at least two ways. In the first place, the preferences for and the utilization of public goods vary across different demographic groups, which influence the cost function. For example, a region may consist of a disproportionately large number of young persons who disproportionately consume education. Second, demographics affect the degree of the spillover and the capacity of the region to fund public programs, and hence affect the socially optimal amount of the IFT. For example, demographic groups have different mobility rates, and consume goods with varying degrees of spillovers. Retirees tend to drift to coastal urban and rural regions, particularly in northern NSW, Queensland and southern WA, and about two thirds of recent immigrants locate in Sydney and Melbourne. The central issue is that the level of the public good is fixed, and the voting power of the resident regional community will determine the level or quality of the public good.

A possible mathematical representation of a regional fiscal burden from the demographic perspective is as follows. Let region i be one of many regions in Australia, where the demographic structure of this region at time t is summarized by the vector ${}^{i}x_t$ = (${}^{i}P_t$, ${}^{i}p_t$). The population size is denoted by ${}^{i}P_t$, and ${}^{i}p_t$ = (${}^{i}p_{1t}$……. ${}^{i}p_{kt}$) is the vector of shares for k different population cohorts. These cohorts could have a range of characteristics, such as gender, race, ethnicity, but in the present context we will focus on age structure. If we assume that there are three cohorts in the vector, then the share of the population that is under the working age, that is the young, is denoted by ${}^{i}Y_t$, the working age, denoted by ${}^{i}W_t$, and the elderly or retired, denoted by ${}^{i}E_t$. The vector representation is thus (${}^{i}P_t$, ${}^{i}Y_t$, ${}^{i}W_t$, ${}^{i}E_t$). A further assumption, for convenience, is that the total Australian population remains constant so that if there were six regions i = 0 to 6 then ${}^{i}\Sigma_{i=0}\ {}^{i}P_t$ = $\overline{P}_t$, which denotes the total Australian population, fixed at time t. However, local population size and age structure is determined endogenously through the location choices of individuals, while the demographic characteristics of the total population are assumed to be exogenous.

Now suppose a regional government, i, in period t, produces a public good, the quantity and quality of which is denoted by ${}^{i}lg_t$, and faces a cost function of the form described in equation (6), as follows:

$$ {}^{i}RC_t = c({}^{i}p_t, {}^{i}lg_t,) \qquad (6) $$

For instance, ${}^{i}lg_t$ might represent health services to young Aboriginals, which is delivered through some level of spending according to the regional cost function that depends on the demographic characteristics of the regional population. A variation on this example is to consider ${}^{i}lg_t$ as a composite of a variety of public goods provided by the region. The demographic composition of the community will determine how much of the public good is provided.

The size and composition of the regional population can enter the cost function for the regional public good in various ways[1]. First, the cost of providing a given level of ${}^{i}lg_t$ depends on the size of the population, ${}^{i}P_t$, in the region. Second, to the extent that the public good is targeted to certain demographic groups, expenditure on the public good depends on the size of the population shares in each cohort; that is, ${}^{i}Y_t$, ${}^{i}W_t$ and ${}^{i}R_t$. If there were no young Aboriginals in the region, then the public health services would have per capita expenditure of zero. Third, characteristics of the regional population may create externalities within the region that cause more or less per capita spending on the public good than would otherwise be the case. For example, for a negative externality, like widespread substance abuse in the regional population, may prevent young Aboriginals from attending school, thereby causing education of a particular quality for young Aboriginals to be much more expensive in the presence of these characteristics than in other regions.

Consider an inter-temporal spillover[2]. Let income in region i at some time in the future, say period t + 1, be denoted by, ${}^{i}RI_{t+1}$, and that future income is a function of three elements. In the first place, regional income depends on demographic composition of the region, ${}^{i}x_{t+1}$. Second, regional income depends on expenditures on public goods (such as education and infrastructure) by the government of region i in a previous period. Thus current public expenditures by region i may result in future income for residents of that region. Third, if we assume that region j invests in public education at time t and that some of the beneficiaries of that education migrate to region i when they reach working age at time t + 1, then the income of region i in period t + 1 is a direct consequence of the investment of region j in period t. Overall, income of region i at a time in the future, t + 1, is a

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[1] Unless lg is a pure public good, whereby there is no rivalry in consumption. The public goods considered here have some element of rivalry and involve some congestion.

[2] There are many types of regional spillovers that could be modeled relating to investment and consumption.

function of the region's demographic composition in that period, the region's current expenditure on public goods and spillovers from current public good expenditures of region j, which is expressed in equation (7) as follows:

$$ {}^{i}RI_{t+1}. = RI({}^{i}x_{t+1}) + \alpha({}^{i}lg_{t}) + \beta({}^{j}lg_{t}) \quad (7) $$

Two inter-temporal expenditure spillovers are introduced through this regional income equation. First, for $\alpha > 0$, current public good expenditure in region i leads to higher income in region i tomorrow. This is an inter-temporal spillover. Second, for $\beta > 0$, current public good expenditure in region j leads to higher income in region i tomorrow. This is an inter-temporal interregional spillover. In both cases, the inter-temporal spillover can be interpreted to be an intergenerational transfer for suitably adjusted periods of time. For $\alpha < 0$ and $\beta < 0$, the spillovers are negative, and region i in period t+1 faces an intergenerational burden.

The implications of this model for the role of central government in the provision of IFTs are interesting. The fiscal burden on a region can be defined as the valuation of the regional public good (both for the residents and the non-residents of the region) in excess of the current resident population's willingness to pay for the regional public good. The model of intergenerational transfers (either benefit or burden) can be expressed for any region, but intergenerational fiscal benefit is easiest to specify for region i and intergenerational fiscal burden is readily defined for region j.

Accordingly, for region i, the intergeneration fiscal benefit in the future, that is period t + 1, can be represented in equation (8) as follows:

$$^{i}IFT_{t+1} = {}^{i}RI_{t+1} - {}^{i}RC_{t+1}$$

$$= RI(^{i}x_{t+1}) + \alpha(^{i}lg_{t}) + \beta(^{j}lg_{t}) - c(^{i}p_{t+1}, {}^{i}lg_{t+1}) \qquad (8)$$

Suppose that the region can only use benefit taxes to raise revenue. Suppose further that there are many regions and that individuals sort themselves into regions based in part on their tastes for public goods. In this situation there are no spillovers, $\beta = 0$, and there is no role for central government in the provision of IFTs. For any value of α, regional finance can be used to cover the intergenerational transfer. For example, if $\alpha > 0$ then the region can issue bonds in period t to finance the public expenditure. The bonds are then repayable by future generations via benefit taxes, and no central government IFT is needed. This is thus a Tiebout equilibrium. An important assumption is that the next generation will have incomes from which benefit taxes can be paid to regional government to meet the cost regional public goods or repay loans for public expenditure for a previous period. Suppose in period t + 1 the region has managed to attract many young educated workers (like interstate migration to Brisbane). Regional income will be high and public expenditure will be low (except for infrastructure congestion). So overall, the future generation of region 1 enjoys high incomes and has a lower call on central government to finance public goods.

Consider the future generation in region j. The intergenerational fiscal burden in period t + 1 is represented by equation (9) as follows:

$$ {}^{j}IFT_{t+1} = {}^{j}RI_{t+1} - {}^{j}RC_{t+1} $$

$$ = RI({}^{j}x_{t+1}) + \alpha({}^{j}lg_{t}) + \beta({}^{i}lg_{t}) - c({}^{j}p_{t+1}, {}^{j}lg_{t+1}) \qquad (9) $$

If $\beta > 0$ for region i, then the rents to region i cannot be captured through benefit taxation in region j. Thus benefit revenue from region j is not sufficient to finance the optimal amount of public expenditure in education from the perspective of regions as a whole. In this case, there is a role for an IFT from the central government to region j. A matching IFT would cause the regional government to internalize the spillover. As in the case of region i, region j can use finance to cover any portion, α, of public good expenditure by the previous generation in period t that has benefit to the future generation. Assume that the population of region j has aged so that it comprises of entirely of elderly people; that is, ${}^{j}P_{t+1}$, = ${}^{j}E_{t+1}$. Because the elderly are assumed not to earn income, benefit taxes cannot be imposed without causing social hardship, so regional income, $RI({}^{j}x_{t+1})$, is low. On the expenditure side, there is a high demand for regional public services because the population share, ${}^{j}E_{t+1}$, of the total population is high and the elderly are intensive users of public services to the elderly. Consequently, regional public expenditure $c({}^{j}p_{t+1}, {}^{j}lg_{t+1})$ is high. This factor provides the second reason for the role of central government in the provision of IFTs to region j. The financing of the transfer can be accomplished by the central government raising income taxes from both regions and sharing the income between each region in a proportion reflecting the fiscal burden of region j.

We argued earlier that generational accounting is a model of fiscal sustainability. This concept of fiscal balance requires that each generation should raise taxes to pay for public expenditure when the expenditure is incurred. Thus generational accounting informs the policy maker about how much taxes would need to rise for current generations so that future generations do not face the fiscal burden of current generations. By extending generational accounting to the regional level, thereby introducing the relationship between demographic change and the provision of public goods, intra and inter intergenerational spillovers could be brought into the theoretical framework, thus enabling the generational accounting model to be utilized as a model of intergenerational equity. Thus, the extended model will enable the cost of public expenditures to be distributed overtime in a way that reflects the intergenerational spread of benefits generated by those expenditures.

4. CONCLUSION

Generational accounting is a method of long-term fiscal analysis based on a balance budget rule over both current and future generations and can be used to estimate the extent of fiscal burdens faced by current and future generations.

Generational accounting can be extended in several ways. In the first place, by disaggregating population shares and net taxes into various cohorts for statistical districts (at either the state of local government level), fiscal projections can be developed at the regional level. In this paper we have sought to show that the fiscal burden on a future generation in a region is a function of; (i) the projected demographic structure, which affects differentially the income earning capacity and the demand for regional public goods according to the relative weighting and characteristics of the cohorts within the region; (ii) the effect of investments in education and infrastructure by the current generation, which is an intergenerational spillover of an intra-regional type; and (iii) spillover investments by the current generation from another region, which is an intergenerational transfer of an inter-regional type. While regional public goods should be financed by benefit taxes, it was then argued that this may not maximise social welfare and there is thus a role for central government in the provision of IFTs where a region faced a fiscal burden. Furthermore, it was shown that positive (intra and inter) intergenerational spillovers enable generational accounting to be extended as a model of intergenerational equity in addition to its original purpose as a model of fiscal sustainability.

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