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**Population Change and Australian
Living Standards**

Bruce Felmingham

and

Natalie Jackson

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Bruce Felmingham* and Natalie Jackson

Abstract

The study explores the relevance of the “population neutralism” hypothesis on Australian data. This hypothesis suggests that population growth has no significant impact on living standards, defined as real GDP per capita. The analysis is based on annual data covering the period 1960 to 2002 inclusive. The existence of cointegration suggests the presence of a long run equilibrium relationship among the variables real GDP per capita, population, investment in physical and human capital, government expenditure and the proportion of the population which is of working age. Consequently, the population neutralism hypothesis is rejected in an Australian context. Further, the estimation of a vector error correction model (VECM) indicates that reverse causation applies in the sense that population growth and changes in Australian living standards both adjust to correct for deviations from long run equilibrium.

JEL Classification:

J10 Demographic Economics – General

Key Words:

population neutralism, reverse causation, per capita income,
population growth, workforce growth

* Correspondence to: Bruce Felmingham, School of Economics, The University of Tasmania,
Private Box 85, Tasmania 7001, Australia.
Email: Bruce.Felmingham@utas.edu.au
Fax: 61-03-6226-7587 Phone: 61-03-6226-2312

1. Introduction

The debate about the nature of the relationship between demographic characteristics of particular societies and the development of their associated economies has recently moved away from the notion of population neutralism to open up the issue of cause and effect once more.¹ The stimulus for this renewed interest in the causal relationships involving population change and economic development has clearly been provided by the demographic transition from populations experiencing high birth and mortality rates to low birth and mortality rates. The natural correlate of the transition is population ageing and it is this demographic characteristic which has dominated the Australian debate about the demographic development nexus.

The contemporary Australian debate is centered on the effects of ageing on national saving and consequently on Australian living standards. This emphasis emerges from a study of optimal savings by Guest and McDonald (1998) which contradicts the arguments of a popular consensus – see Argy (2001), Wood (2001) and Fitzgerald (1993) that Australians are not sufficiently frugal in preparing for retirement and that a national policy approach is required to boost savings. In a further study Guest and McDonald (2000) also conclude that ageing will not impose a heavy burden on government social outlays in Australia. Guest and McDonald (2001) also modify their optimal savings model to incorporate ageing effects and examine the consequences of ageing for living standards generally. These are represented by consumption per capita. They find that the future growth of labour productivity dominates the effects of ageing on living standards and indicate that at best Australian living standards will rise by an average 1.2 percent per annum over the period 2001 to 2051, slightly less than two thirds of the average annual growth rate occurring over the period 1970 to 2000. Ageing accounts for 0.23 per cent of this difference. The general inference is that the ageing of the

¹ Population neutralism is identified by Bloom and Freeman (1986) as the absence of a significant relationship between population and economic growth a view that prevailed through the 1970's, 1980's and early 1990's according to Kelley and Schmidt (1995).

Australian population has only small order effects on living standards and consequently they do not recommend national policies which lead to a savings stimulus.

The result is supported in general terms by Jackson and Felmingham (2002) who find that the demographic gift associated with the post war baby boom provides an income dividend which delays the full economic consequences of ageing until at least 2011 when the first of the baby boomers enters retirement. The demographic gift is measured as the difference between the working age population and total population growth and the income dividend eventuates as the baby boomers enter the highest income earning age group.

The aim of this study is to examine the causal relationships between population change and economic growth in Australia over a longer time frame (forty years). The motivation for this study is the risk that the outcomes of the current modelling of demography and economic behaviour do not reflect the presence of reverse causation in the relationship between the two growth rates. There is no other study of long run reverse Granger causation between the variables using Australian data.

This study involves an examination of the connections between population growth and Australia's per capita income growth in a model incorporating several of the factors which normally explain growth. Included among these are the rate of investment in physical capital, government expenditure, investment in human capital (both public and private) and the proportion of the population in the working age group. The rationale for the inclusion of these variables is provided in the following section of the paper but the distinction between the variables included here and their equivalents in related Australian studies are appropriately noted. This study generalises the existing studies of aggregate savings by testing for a direct potential link between population change and living standards where these are represented by per capita income and not the narrower measure of living standards (consumption per capita) which is the measure adopted by Guest and McDonald (2001).

2. Methodology and Data

This study is designed to fill an apparent gap in the Australian population economics literature at the highest level of economic aggregation: does population growth influence Australian living standards, or do these also impact on the growth of the Australian population? Such an aggregate study will add to the current line of research about the economic consequences of a particular demographic characteristic, namely, ageing.

The approach developed for this study may be described as a standard time series analysis of the relationship between some of the usual explanators of improved living standards, as measured by GDP per capita (Y). Included here is the rate of investment in fixed capital (I), government expenditure (G), investment in human capital (E) and two central demographic variables population (P) and the proportion of the total population of working age (WA).

The two rates of investment in physical and human capital² are acknowledged to be the major drivers of growth and development. Government expenditures are also included in this mix of variables because they constitute for many nations, particularly developing ones, the major stimulus to living standards. Governments underpin a country's infrastructure and provide welfare both of which can be expected to improve living standards.

Although a researcher may be on comparatively safe ground by assuming that causation flows from investment in physical/human capital and government expenditure to per capita income, no safe presumption of this kind can be applied to the relationship between population variables and living standards. The current literature³ about income and population growth suggests that causality can flow from population to income growth because income and markets depend on both the absolute change in the size of populations

² It is customary to model technical change as a time trend. However, the imprecise nature of this procedure leads to the view that technical change is embodied in labour and capital expenditures which are reflected in E and I.

³ A useful summary of these arguments is presented in Bloom, Canning and Maloney (2000).

which govern the size of the domestic market, but long run reverse causation can equally apply as incomes rise because high income earners place a premium on the value of their time. Childbearing is time intensive, so in the developed world higher incomes mean fewer children and an overall fertility decline. This issue of Granger causality is the one considered here and for this purpose two variables are included from the demographic side: the first is population growth itself which is the most general of the demographic measures and the second is the growth of the working age population measured as the ratio of the working age population to the total population. Following the seminal analysis by Coale and Hoover (1958) and many studies which follow it, reductions of the current rate of population growth do not lead to a corresponding reduction in the current rate of labour force growth. Given the central nature of this second demographic variable to growth in a production theory context, it is appropriate to include this second demographic characteristic in these tests for causality. The inclusion of both the working age and overall population growth rates does not appear to create any significant multicollinearity issue as the correlation coefficient between these two series is small (0.155).

The data sources which represent the variables described above are indicated at the end of this text. Attention is drawn to the fact that the data are observed annually consistent with the view that the relationship between population movements and per capita income are likely to occur over the long term and that there will be a less evident response from the variables when these are observed less frequently than annually. So the data series applied in this study dates from the first year when per capita income can be calculated (1960) to the current period (2002) inclusive. The data set then is comprised of 43 observations on six variables.

The standard time series analysis referred to in the opening lines of this sub section begin with tests for the stationarity of the individual time series. All six variables turn out to

be integrated of order 1, non-stationary in levels, but stationary in first differences⁴. The results of these tests are shown on Table 1, while a pictorial representation of each time series is included on Figure 1 in Appendix A.

Table 1: Unit Root Tests (Stationarity around a Constant)

Variable	Levels		First Differences	
	ADF ⁽¹⁾	PP ⁽²⁾	ADF ⁽¹⁾	PP ⁽²⁾
P	-0.14522	-0.14854	-3.3534*	-27.333*
G	2.3131	0.95568	-1.4880	-16.415*
I	0.64906	0.57973	-31.542*	-31.965*
WA	-0.14125	-0.14326	-3.3024*	-27.949*
Y	0.64609	0.64384	-3.9336*	-33.943*
E	0.41993	0.37024	-3.7923*	-30.149*

⁽¹⁾The critical value for the Augmented Dickey Fuller (ADF) test is -2.57 .

⁽²⁾The critical value for the Phillips Perron (PP) test is -11.20 .

** Represents the 10 percent significance level.

All of the tests on Table 1 reveal that the variables are I(1). The Augmented Dickey Fuller (ADF) provides a strong basis for accepting the null for the presence of a unit root. The same argument applies to the Phillips Perron (PP) test. Therefore, it is safe to assume that tests for the cointegration of these variables are appropriate. However, before this step is taken it is appropriate to examine individual graphs of the time series involved in this study on Figure 1 in Appendix A.

The plot of the six time series included in this study (see Figure 1) all display a strong positive trend. GDP per capita displays some volatility particularly in periods of recession, namely, the years 1961, 1965, 1970, 1976, 1982 and 1990. Population, the working age population and government expenditure display a smooth trend while private investment and education expenditure display much greater volatility.

⁴ It should be noted that the augmented Dickey-Fuller test suggests that the government expenditure variable is not I(1). Nevertheless, the Phillips Perron test is generally preferred to the ADF test, as the ADF can have a low power if a lag which is too long is used to run the ADF regression. The results of the PP test are therefore used in this study.

3. Are Australian Living Standards Cointegrated with Demographic Characteristics and Growth Stimuli?

The first point to establish here is summarised in the following question: Does a long run equilibrium relationship between living standards, investment in human and physical capital, government spending and the two demographic characteristics, namely, population and the working age population exist? The results from the previous section of the paper indicate that each of the six variables featuring in this study are I(1) and stationary in first differences. The intuition applying in these circumstances is that a group of I(1) variables with a long run equilibrium relationship cannot drift very far apart in the short run because economic forces will act to correct any disequilibrium.

The technique of cointegration applied to this study is described briefly. In order to test the multivariate cointegration of the six variables simultaneously the procedure developed by Johansen and Juselius (JJ) (1990) is conducted. The JJ procedure is based on the maximum likelihood estimation of the vector autoregression (VAR) model. As demonstrated in Johansen's study, the JJ procedure involves the identification of rank of the m by m matrix Π in the specification given by

$$\Delta X_t = \delta + \sum_{i=1}^{k-1} \Gamma_i \Delta X_{t-i} + \Gamma \Pi X_{t-k} + \varepsilon_t \quad (1)$$

where X_t is a column vector of the six variables. Γ and Π represent coefficient matrices. Δ is a difference operator, k denotes the lag length, and δ is a constant. If Π has zero rank, where $r = 0$, no stationary linear combination can be identified. In other words, the variables in X_t are non-cointegrated. There will exist r possible stationary linear combinations and Π may be decomposed into two matrices α and β such that $\Pi = \alpha\beta'$ if the rank r of Π is greater than zero. In this representation β contains the coefficients of the r distinct cointegrating vectors

that render $\beta'X_t$ stationary, even that X_t is itself non-stationary, and α contains the speed-of adjustment coefficients for the equation.

Based on the estimation of (1), two statistics, the trace and maximal eigenvalue are calculated to test for the presence of r cointegrating vectors. The trace statistic tests the null hypothesis that there are at most r cointegrating vectors against the alternative of r or more cointegrating vectors. On the other hand, the maximal eigenvalue statistic tests for r cointegrating vectors against the alternative of $r+1$ cointegrating vectors.

The results of tests for the presence of cointegration in the multi-variate case are disclosed on Table 2.

Table 2: Johansen Cointegration Test Results

Number of cointegrating vectors	Trace	Max Eigenvalue
	Statistics	Statistics
$r = 0$	135.3852*	45.8632*
$r \leq 1$	89.5220*	37.1717*
$r \leq 2$	52.3503*	27.2210*
$r \leq 3$	25.1293	17.4135
$r \leq 4$	7.7158	7.4322
$r \leq 5$	0.2836	0.2836

* Represents the 5 percent significance level.

From Table 2, it is clear that there are as many as 3 cointegrating vectors between the variables. The Trace test statistic is significant at the 1 per cent level for 2 cointegrating vectors and at the 5 per cent level for 3 cointegrating vectors while the eigenvalue test is significant at the 5 per cent level for both 2 and 3 cointegrating vectors. The largest eigenvalue is associated with a single cointegrating vector for per capita income and the eigenvalues for this case are shown on Table 3. These are drawn from the companion matrix

of the maximum eigenvalue vector. This companion matrix has one unit eigenvalue corresponding to its common trend and all other eigenvalues are less than mod 1 in value. A significant result from Table 3 concerns the remaining eigenvalues $\beta < (1)$. These are significant in relation to population ($t = -7.116$), private investment expenditure ($t = -3.468$) and the working age population. These three variables follow a common trend.

Table 3: VECM (one lag) Results

		Dependent Variables					
		ΔY	ΔP	ΔG	ΔI	ΔWA	ΔEDU
ECT		-0.5169 (-2.5240)*	79.5414 (3.06010)*	-3612356 (-2.3111)*	-4168486 (-1.739)**	39.56040 (2.2042)*	-762030.0 (-1.900)**
Short run lagged differences	ΔY	-0.0647 (0.02324)	1.96910 (0.05571)	1471385 (0.6923)	4700330 (1.4421)	13.46730 (0.55180)	338709.6 (0.62110)
	ΔP	-0.00470 (-1.3186)	1.2876 (2.8327)*	-1.5788.85 (-0.05776)	-35163.1 (-0.8388)	0.1572 (0.5009)	-6635.042 (-0.94610)
	ΔG	0.00000 (-1.1076)	0.0000 (0.5723)	0.0323 (0.1784)	-0.8569 (-3.083)*	0.0000 (0.32900)	0.0254 (0.5471)
	ΔI	0.00000 (1.14980)	0.0000 (0.2882)	0.40220 (2.1184)*	0.2673 (0.9179)	0.0000 (0.3175)	-2.280 (-0.4687)
	ΔWA	0.006400 (1.10100)	-1.6427 (-2.2258)*	21498.18 (0.48440)	38745.03 (0.5693)	-0.04000 (-0.07850)	111545 (0.97960)
	ΔEDU	0.0000 (0.5998)	0.0000 (-0.3709)	1.9020 (2.4234)*	2.2862 (1.899)**	0.0000 (-0.1049)	0.04090 (0.2031)

Note: t-ratios are in the brackets.

* and ** represent the 5 and 10 percent levels of significance respectively.

These cointegration tests establish the existence of a long run relationship between the six variables included in the study, namely GDP per capita (the standard of living) the working age and total population growth rates and investment in human and physical capital. However, something beyond standard cointegration techniques is required if the issue of causality is to be analysed.

4. Causality

Tests for either or both short run or long run causality can be determined from a further technique described as vector error correction modelling (VECM). Cointegration among the six variables in this study implies that there is a long run error correction process working here, so that any deviation from long run equilibrium will be restored by the correction of the equilibrium error back towards its long run equilibrium. Error correction is the first notion of causality. The second is short run Granger causality in which case one of the variables in a model will lead or lag the variable treated as the independent variable. Both notions of causality are evident in the vector error correction model (VECM) developed by King et al (1991). The general form of the VECM model is written in the following manner:

$$\Delta X_t = \sum_{i=1}^n \beta_i \Delta X_{t-i} + \sum_{i=1}^r \gamma_i ECT_{t-i} + V_t \quad (2)$$

X is an nx1 (n = 6 in this case) vector of dependent variables, which are GDP per capita (Y), investment (I), education expenditure (E), percentage of the population that is working age (WA), the total population (P) and government expenditure (G). ΔX_{t-i} , β and γ are estimable parameters, while V_t is the residual. Error correction is evident in the error correction term of (2) (ECT_{t-i}). There are as many error correction terms as there are cointegrating vectors (r). In section 3 of this paper we have found that $r = 3$, so there are 3 such terms: the coefficients in expression (2) also have an interpretation: γ_i the parameter associated with the ECTs measure the proportion of the adjustment back towards equilibrium completed in a single period (in this study, one period is a year). If the estimate of γ_i in 2 is not significantly different from zero then there is no error correction mechanism. The β s in equation (1) indicate the presence of short term lags from one variable to another.

The VECM estimation is conducted using the S+ software and runs in the following manner: the VECM procedure is performed for each of the six variables treated as the

dependent variable; the five remaining variables are treated as independent variables. The particular interest in this study is the prospect of reverse causation. The interpretation of the ECTs in the VECM is based on the multivariate VECM analysis in Awokuse (2003). Awokuse examines the relevance of the export-led growth hypothesis for Canada. He finds that the ECT for the real GDP equation is statistically significant, while the ECT for the real exports equation is not significant. He suggests that this implies that export growth did Granger cause GDP growth (but not vice versa) in the long run. From this interpretation, the following generalisations are made to facilitate the interpretation of the VECM analysed in this study. If γ_1 (in equation 2) is significant in this equation then the dependent variable in that version of VECM adjusts back towards equilibrium when a disequilibrium occurs. Suppose γ_1 is the ECT in the VECM with the change in per capita income as the dependent variable and γ_2 is the ECT in the VECM with population change as the dependent variable then the following error correction possibilities arise:

$\gamma_1 \neq 0, \gamma_2 = 0$	Per capita income corrects to restore equilibrium
$\gamma_1 = 0, \gamma_2 \neq 0$	Population change corrects to restore equilibrium
$\gamma_1 \neq 0, \gamma_2 \neq 0$	Both of the above variables adjust

It is this last case $\gamma_1 \neq 0, \gamma_2 \neq 0$ which is referred to as reverse causation.

A further possibility is for $\gamma_1 = 0 = \gamma_2$ so there is no error correction here. However, it is possible for short run Granger causality to also apply. This arises if in the 6 estimates of (2) some of the β 's in (2) are positive, then the lagged values of one variable significantly influence another variable. Suppose, for example, that per capita income is the dependent variable and β_1 the parameter associated with the lagged value of population growth. Further, suppose β_2 is the parameter associated with per capita income when population change is the dependent variable. Again there are three possible outcomes:

$\hat{\beta}_1 \neq 0, \hat{\beta}_2 = 0$	Population growth causes (leads) per capita income growth
$\hat{\beta}_1 = 0, \hat{\beta}_2 \neq 0$	Per capita income causes (leads) population growth
$\hat{\beta}_1 \neq 0, \hat{\beta}_2 \neq 0$	Causality is bi-directional.

Clearly the first two cases are examples of unidirectional causality while the third is reverse causation.

The VECM results for this study are included on Table 4 which shows estimated parameters for each of the six versions of VECM down each column. The first row of Table 4 labelled “ECT” contains the error correction term in each equation. The estimated parameter γ_i on each ECT is shown in the first row, the standard error is shown in row 2 and the t-ratio in row 3. If the t-ratio exceeds its 5 percent level cut off score ($|1.96|$) then the conclusion is that $\gamma \neq 0$. If the absolute value of the t-ratio for each ECT is below 1.96 then the conclusion is no error correction and $\gamma = 0$. It is clear from Table 4 that the ECT in the equations for GDP per capita, ($t = -2.524$) population change ($t = 3.060$), government expenditure ($t = -2.311$) are all significant at the five percent level. The suggestion here is that there is a simultaneous feedback between these three variables and so a clear cut case of long run reverse causation exists. The remaining VECM equations reveal no evidence of reverse causality and indeed no evidence of error correction ($\gamma = 0$).

What of short run Granger causality? Reading down column 1 when GDP per capita is the dependent variable there is some evidence of the significance of population growth lagged one period but only at the twenty percent level. A negative impact of population growth on per capita income is found quite frequently in research of this kind. So population growth leads per capita income growth in the Australian case, but there is no evidence of reverse causation. Reading down column (2) when population change is dependent, the

lagged value of GDP per capita is not significant ($t = 0.557$). There is no evidence of short run Granger type reverse causation linking population variables with per capita income.

5. Conclusion

In a long run error correction context, Australia's living standards and population growth are interdependent and therefore subject to reverse causation. Thus earlier studies not recognising this point may have understated the case for the impact of demography on economic welfare. On the basis of this evidence, it is appropriate to reject the "population neutralism" hypothesis on Australian data subject to certain caveats which constitute a further research agenda. The annual time series applied to this study will not capture any important within year interactions between demographic change and living standards. Further, this study is pitched at the aggregate national level which ignores the potentially diverse experiences of the Australian states and territories in relation to the nexus between demographic changes and living standards. Finally, this study is focussed on a particular doctrine, namely population neutralism and associated tests for reverse causality. Other important demographic characteristics have been put aside for further study. Not the least of these is the effects of ageing on growth or living standards.

References

- Argy, F. (2001), "Economic Rationalism in Australia – Survey of Members of the Economic Society of Australia ACT Branch", *Economic Papers*, 20(1), pp 1-14.
- Awokuse, T. (2003), "Is the Export-led Growth Hypothesis Valid for Canada?" *Canadian Journal of Economics*, 36(1), pp 126-136.
- Bloom, D. & Freeman, R. (1986), "The Effects of Rapid Population Growth on Labour Supply and Employment in Developing Countries", *Population and Development Review*, 12(3), pp 381-414.
- Bloom, D. Canning, D. & Maloney, P. (2000), "Population Dynamics and Economic Growth in Asia", *Population and Development Review Supplement*, 26, pp 257-290.
- Coale, A. & Hoover, E.M. (1958), *Population Growth and Economic Development in Low-Income Countries*, Princeton NJ: Princeton University Press.
- Fitzgerald, V. (1993), *National Saving: A Report to the Treasurer*, Canberra: AJPS.
- Guest, R. & McDonald, I. (1998), "The Socially Optimal Level of Saving in Australia", *Australian Economic Papers*, 37(2), pp 211-229.
- Guest, R. & McDonald, I. (2000), "Population Ageing and Projections of Social Government Outlays", *Australian Economic Papers*, 33(1), pp 49-64.
- Guest, R. & McDonald, I. (2001), "Ageing, Optimal National Saving and Future Living Standards in Australia", *Economic Record*, 77(257), pp 117-134.
- Jackson, N. & Felmingham, B. (2003), "The Demographic Gift in Australia", *Agenda*, forthcoming.
- Johansen, S. & Juselius, K. (1990), "Maximum Likelihood Estimation and Inference on Cointegration, with Applications to the Demand for Money", *Oxford Bulletin of Economics and Statistics*, 52, pp 169-210.
- Kelley, A. & Schmidt, R. (1995), "Aggregate Population and Economic Growth Correlations: The Role of the Components of Demographic Change", *Demography*, 32(4), pp 543-555.
- Wood, A. (2001), "Raising the Levy is Not a Super Idea in Election Years", *The Australian*, April 10.

Data Sources

Per capita GDP is the ratio of real GDP to the Australian population. Real GDP is sourced from ABS 5206.0 *Australian National Accounts: National Income, Expenditure and Product: Table 3 Chain Volume Measures*, and the population variable from ABS 3101.0 *Australian Demographic Statistics Table 4*.

Investment in physical capital is also sourced from ABS 5206.0 and its precedent publications.

Government expenditure is sourced from ABS 5206.0.

The working age population (15-65 years of age) is derived from ABS 3101.0 and its precedent publications.

Investment in human capital from 1976/77 is drawn from ABS 4230.0 *Education and Training Indicators, Table 6: Total Expenditure on Education*. The data is sourced from the ABS Year Books over the period 1959/60 to 1975/76.

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