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Abstract

This paper analyses the impact of fiscal decentralisation on the Australian economy at both the aggregate and state levels. Attention is given not only to economic growth but also to a number of important macroeconomic variables which may influence growth. The results suggest that there is no straightforward impact of fiscal decentralisation on the Australian economy. At the aggregate level, when measured through expenditure shares, decentralisation is found to decrease medium-term economic growth, worsen the budget balance and increase the size of the public sector. No statistically significant effects of decentralisation are found on price stability, physical capital investment or short-term economic growth. Alternatively, revenue decentralisation is found to increase medium-term economic growth, improve the budget balance and have a stabilising effect on prices, but no relationship is found with the size of the public sector. At the state level, decentralisation is generally found to have no significant impact on the distribution of income but a weak negative effect on economic growth. In obtaining these results, special consideration is given to variable measurement, model specification, estimation technique and sample coverage. The findings highlight the importance of understanding more than just the effect of decentralisation on any one facet of an economy.

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1. Introduction

Fiscal decentralisation continues to be a controversial aspect of modern political debate and a pertinent issue amongst economic policy-makers. Relationships between Australia's Federal and State governments have been hampered by constant bickering and a general lack of cooperation over critical issues, such as health, education and infrastructure. The States complain of a lack of money and the Federal government accuses the States of being inefficient. Such controversies have created a need to understand the influence of government structure, particularly the level of fiscal decentralisation, on the performance of the Australian economy. Indeed, some suggest that a whole range of public policy issues end up depending on Federal-State relations (Garnaut, 2006: 85-6).

While much of the literature on the topic of fiscal decentralisation has focused on its impact on growth[1], there is no consensus about the effect of fiscal decentralisation on economic growth. Oates (1995), in a study of forty countries for the period 1974 to 1989, found a positive relationship, a result confirmed by Yilmaz (1999) for 17 unitary and 13 federal countries during 1971 to 1990 and by Iimi (2005) for 51 Organisation for Economic Co-operation and Development (OECD) transitional and developing countries between 1997 and 2001. Conversely, Davoodi and Zou (1998), using panel data for 46 developed and developing countries, found no relationship for developed countries but a negative relationship for developing countries, the latter result being confirmed by Woller and Phillips (1998) in a study of 23 developing countries. In a study of 52 developed and developing countries from 1972 to 1997, however, Martinez-Vazquez and McNab (2003) concluded that

[1] See Bodman and Ford (2006) for a review the existing literature.

fiscal decentralisation does not have a direct relationship with economic growth. Alternatively, Thiessen (2003), in a study of high-income OECD countries, found that the relationship between fiscal decentralisation and economic growth is positive when decentralisation is increasing from low levels, but then reaches a peak and turns negative. This suggests that a medium degree of decentralisation may be optimal, which is consistent with the findings of Eller (2004), Bodman and Ford (2006) and Campbell (2008).

Owing to the difficulties that arise when performing cross-country analyses, particularly the influence of cultural, institutional, geographical, and economic differences, single country studies have also been conducted. In an analysis of the US during the period 1948 to 1994, Xie *et al*. (1999) found that further fiscal decentralisation would be detrimental to growth. Conversely, Akai and Sakata (2002) disaggregated the US into its 50 States and concluded that fiscal decentralisation contributes to economic growth, and on the basis of an analysis of US metropolitan areas, Stansel (2005) reached the same conclusion. In an analysis of economic growth in Spain, Carrion-i-Silvestre *et al*. (2008) found that decentralisation has a negative effect at the aggregated, economy-wide level but a positive relationship for communities with a high degree of fiscal autonomy. Such a range of results highlights the lack of consensus in the literature on the relationship between fiscal decentralisation and economic growth.

The economic effects of changes in Australia's fiscal structure have yet to be thoroughly investigated, although some informal studies have been undertaken. For example, Twomey and Withers (2007), using cross-country regressions, estimated that Australians gained AU$4,507 per capita in 2006 from being a federal state. On the other hand, a report by Access Economics (2006) estimated that in 2004-05 the cost of Australia's inefficient federalism

system was approximately AU$9 billion.

Some authors have suggested that the lack of consistent evidence about the relationship between economic growth and fiscal decentralisation indicates that importance of investigating not only whether fiscal decentralisation has a direct impact on growth, but also how it might indirectly influence economic growth (Martinez-Vazquez and McNab, 2003; Thiessen, 2003) through its impact on key macroeconomic variables.

Building on this literature, the purpose of the present paper is to provide an analysis of the impact of fiscal decentralisation on the Australian economy at both the aggregate (i.e. national) and State (i.e. subnational) levels. While numerous studies have included Australia in cross-country analyses, no previous study has been conducted on the specific effect of decentralisation on Australia's economic growth. Moreover, this study is the first to consider explicitly the impact of fiscal decentralisation on five key Australian macroeconomic variables – inflation and macrostability, public sector size, budget balance, physical capital investment and income distribution – together in one single study.[2]

The analysis proceeds in two stages. First, it focuses on the implications of fiscal decentralisation for Australian economic growth and other macroeconomic variables using time-series analysis. Although Australian States are considered quite similar in fundamental characteristics, there are a number of important differences that may potentially bias any conclusions based upon a purely aggregated study into Australia's fiscal structure. Thus, secondly, the potential for state heterogeneity is accommodated by investigating the impact of

[2] One should note that Martinez-Vazquez and McNab (2003) examined the indirect effect of fiscal decentralisation on economic growth through inflation and Thiessen (2003) investigated the effect of investment. However, these were cross-country studies.

decentralisation on State-level economic growth and income distribution, utilising both cross-sectional and panel data for the six States and two major self-governing territories of the Commonwealth of Australia.

Many studies in the fiscal decentralisation literature include only the two basic measures of revenue and expenditure decentralisation.[3] However Stegarescu (2005) and OECD (2005) have proposed additional measures to account for the decentralisation of decision making, and these measures were constructed for Australia for use in the present study, giving in all a total of sixteen alternative measures of fiscal decentralisation. To take account of the uncertainty surrounding the choice of the appropriate statistical model the robustness of the results, derived from classical regression methods, is tested by utilising Bayesian Model Averaging (BMA). BMA has recently been applied in the growth regression literature to account for the model uncertainty inherent in models of economic growth (Fernandez *et al*., 2001a; Leon-Gonzalez and Montolio, 2004; Eicher *et al*., 2007; Masanjala and Papageorgiou, 2008). However, such a technique has not previously been applied to determine the influence of fiscal decentralisation on economic growth.

The results of the study suggest that fiscal decentralisation has no overall positive or negative effect on the Australian economy. Different aspects of fiscal decentralisation have different effects on Australia's key macroeconomic variables[4], which in turn affect economic growth. Moreover, different measures of fiscal decentralisation produce conflicting results. An increase in expenditure decentralisation, for example, decreases medium-term economic growth, worsens the budget balance, and increases the size of the public sector. Revenue

[3] Most studies acknowledge the shortcomings of these two measures, but do not provide any alternatives.
[4] See Table 12 for a summary of the results.

decentralisation, on the other hand, increases medium-term economic growth, improves the budget balance and has a stabilising effect on prices, but has no relationship with the size of the public sector. Such results call attention to the importance of including more than one measure of decentralisation. Collectively, the results highlight the importance of understanding the effect of fiscal decentralisation on the range of factors affecting economic growth.

The paper is structured as follows. Section 2 reviews the influence of fiscal decentralisation on economic growth and the other important macroeconomic conditions. Section 3 outlines the empirical framework and structure of the data set utilised in the study. Section 4 presents the empirical findings and Section 5 reports the conclusions and suggests implications for policy.

2. Fiscal decentralisation and macroeconomic conditions

Following previous theoretical and empirical studies, the study examines the relationship between fiscal decentralisation and the following variable: economic growth, macroeconomic stability, public sector size, budget balance, physical capital investment, and income distribution.

2.1 Economic growth

There is also much debate in the theoretical literature over the extent to which fiscal decentralisation contributes to resolving Musgrave's (1959) primary economic issues of public finance: distribution, allocation and stabilization. The advantages of fiscal decentralisation are thought to centre on three related concepts: efficient provision of output, effective decision

making, and advanced innovation. First, it is argued that the devolution of spending powers to local governments significantly increases efficiency in the supply of public goods when the output of a particular service is of 'local' interest (Oates, 1972; 1991). Second, placing budgetary power with sub-national governments allows for more effective decision making since there is more information available, fewer people involved, a greater chance of homogeneity of interests, and the decision making powers are locally held (Bahl, 1999; Groenewegen, 1990). Third, decentralisation provides for greater innovation and experimentation in the provision of public goods (Groenewegen, 1990).

On the other hand, it is argued that fiscal decentralisation leads to macro-instability, unequal income redistribution and does not account for social costs. As sub-national governments are constrained by their inability to manipulate cyclical aggregate economic movements, many argue that counter-cyclical policies are best implemented on the national level (Prud'homme, 1995; Tanzi, 1995; Ter-Minassian, 1997). The central government in a highly decentralised economy does not possess the budgetary power to control aggregate demand.[5] In addition, if a local community were to adopt a redistributive policy, the wealthy members would have a significant incentive to leave, thus ensuring that the policy would ultimately fail (Bahl, 1999; Oates, 1972). Finally, in making production decisions individual communities do not consider the externalities imposed on other communities, thus ignoring full social value (Oates, 1972).

2.2 Macroeconomic Stability and Inflation

The argument that macroeconomic policy should be administered solely by the central

[5] Thornton and Mati (2008) refute this argument and claim that the danger has been overstated.

government dates back to the important works of Musgrave (1959) and Oates (1972) who contended that any subnational policy stimulus would encounter a serious externality problem because subnational economies were predominantly 'open' with the vast majority of goods produced and consumed being exported to and imported from adjacent jurisdictions. In addition, it was argued that subnational governments were restricted in their ability to borrow thereby constraining their fiscal policy options. Furthermore, in cases where subnational governments have over-borrowed and central governments have assumed the servicing of the debt, macroeconomic stability has been compromised (Tanzi, 1995; Prud'homme, 1995).

More recently, arguments have been put forward to support the capacity of fiscal decentralisation to enhance macrostability. First and foremost is the contention that the above arguments are based on the assumption that economic shocks are symmetrically distributed (Martinez-Vazquez and McNab, 2003). In circumstances in which macroeconomic shocks are actually asymmetrically distributed, subnational governments may be better situated to provide a policy response than the central government. A second argument develops from the notion that central governments in more centralised economies have relatively more responsibilities than those in decentralised economies, and that this may result in the central government being overburdened and less able to achieve efficient policy outcomes. Finally, Thornton (2007) contends that a shift in the share of revenues to subnational governments reduces the competition among subnational governments for fiscal resources. When subnational governments compete for revenue they destabilise national fiscal policy targets through the advancement of pro-cyclical fiscal policies.

Previous empirical analyses of the impact of fiscal decentralisation on macroeconomic stability have produced mixed results. King and Ma (1999; 2001), Martinez-Vazquez and McNab (2003) and Neyapti (2004) all found that decentralised countries performed better in terms of inflation levels compared to centralised economies. On the other hand, Treisman (2000), Shah (2006) and Thornton (2007) all found that fiscal decentralisation had no statistically significant impact on the levels of inflation.

2.3 Public Sector Size

In his seminal paper, Tiebout (1956) argued that greater decentralisation, increasing the number of alternative fiscal jurisdictions, in conjunction with the mobility of citizens and their ability to vote with their feet, would ensure a limit to the excessive taxing power of governments. Brennan and Buchanan (1980) extended this theory through the concept of the 'Leviathan' hypothesis: fiscal decentralisation acts as a constraint on the behaviour of monopolistic, revenue-maximising governments. Thus, it is expected that, other things being equal, the overall size of the public sector should be inversely related to the level of fiscal decentralisation.

Alternatively, Oates (1985) provides two theoretical scenarios whereby fiscal decentralisation has a positive impact on the size of the public sector. First, the decentralisation of the provision of public goods from the central government to sub-central governments may result in the loss of economies of scale thereby increasing the cost of supplying a given quantity of goods, and tending ultimately to lead to an increase in the size of the public sector. Second, when competition among political parties is present, government policies tend to conform closely to the preferences of the voting population. In a centralised

economy policies regarding public outlays would conform to the preferences of the overall median voter (the median of the entire population), whereas in a decentralised setting the policy choice would correspond to those of the median voter in each jurisdiction. Hence decentralisation provides the potential for the average level of outlays in a decentralised setting to surpass the average level in a centralised setting if the preferences of the median voters in the decentralised jurisdictions differ from those of the median voter overall.

Previous empirical studies on the effect of fiscal decentralisation on public sector size have also produced mixed results. Oates (1985) tested the 'Leviathan' model for a group of 43 countries and concluded that the hypothesis did not hold. Ebel and Yilmaz (2003), however, point out that Oates's measure of fiscal decentralisation was narrowly based on the subnational share of total government expenditure. Using a number of alternative measures of fiscal decentralisation, these authors found that increasing subnational tax autonomy decreases public sector size, increasing subnational non-tax autonomy has the opposite effect, and measures of subnational fiscal dependency and sub-national tax sharing had no significant impact.[6]

Jin and Zou (2002) disaggregated government into national and subnational components, arguing that the relationship between decentralisation and public sector size may be different at each level. Using a panel of 35 developing and industrial countries, they found that expenditure decentralisation leads to smaller national governments, but larger government in aggregate. Revenue decentralisation, on the other hand, was found to decrease national government size by more than it increased subnational government size, resulting in a smaller

[6] This sensitivity of the results to the measure of decentralisation employed was also found in Meloche *et al.* (2004).

aggregate government. Finally, they found vertical fiscal imbalance increased the size of both subnational and national governments[7].

Grossman (1992) analysed the impact of fiscal decentralisation on the size of the public sector in Australia over the period 1950 to 1984 and found it to have no significant effect. While the size of the Australian public sector as a whole grew considerably during that period, the relative size of State and Local government outlays remained almost constant, or even declined, depending on the measure of decentralisation employed. Three explanations for these Australia-specific results were proposed: the economic insignificance of local governments, the relative immobility of citizens, and the relatively small number of sub-central governments.

2.4 Budget Balance

The effect of the structure of government on an economy's fiscal budget balance is theoretically unclear. On the one hand, inter-jurisdictional competition in a decentralised economy has been argued to provide a constraint on the fiscal discipline of subnational governments (Tiebout, 1956) and would therefore produce a dampening effect on public debt (Freitag and Vatter, 2008). Alternatively, it has been argued that fiscal decentralisation involves expensive organisational and functional duplication as well as costly policy co-ordination failures (Tanzi, 1995; Ter-Minassian, 1997) which induce subnational governments to spend inefficiently and beyond their means, thereby tending to result in deficits and higher costs of borrowing (de Mello, 2000).

While empirical studies have produced varying results about the effect of fiscal

[7] A vertical fiscal imbalance arises when the sub-central government has a greater share of expenditure than revenue.

decentralisation on public debt, the majority of studies support the claim that decentralisation worsens the budget balance. However, these results are highly sensitive to the measure of fiscal decentralisation employed. Using basic measures of revenue and expenditure decentralisation, Fukasaku and de Mello (1998) and de Mello (2000) found decentralisation was associated with a bias towards deficits, as did Fornasari, Webb and Zou (2000) when measuring subnational government spending.[8] Rodden (2002) established that general government fiscal deficits are larger when subnational governments are both dependent on transfers and free to borrow. When controlling for periods of high and low economic growth, Freitag and Vatter (2008) found that in economic down-turns decentralised governments tend to implement more disciplined fiscal policy than centralised governments but, consistent with the findings of Stein (1999), found that in prosperous times the structure of the government had no significant effect on the economy's budget balance. Ebel and Yilmaz (2003) argued that de Mello (2000) did not distinguish whether subnational governments had control over the tax rate or the tax base. When the measure of decentralisation redefined to take this into account, the level of decentralisation ceased to have a statistically significant effect on the size of the deficit.

In an extension of these studies, Thornton and Mati (2008) measured the direct correlation between the fiscal balances of central and sub-central governments and found a statistically strong positive relationship, which appeared to be unrelated to the extent of fiscal decentralisation. Through the inclusion of the fiscal balance of the subnational level of government as a key explanatory variable, they found that fiscal decentralisation was not a

[8] They also found that an increase in subnational spending had a corresponding increase in national spending.

significant determinant of the fiscal balance of the central government.

2.5 Physical Capital Investment

In a dynamic context, Brueckner (1999), utilising the traditional Diamond (1965) over-lapping generations (OLG) model, showed that fiscal decentralisation affects the incentive to save by changing the time path of after-tax income. However, in a subsequent paper Brueckner (2006) incorporated OLG in an endogenous growth model including human capital investment in the form of schooling which consumers can undertake when young to improve their earning power when old. This alternative model found that when moving from a unitary system of government to a federalist system there is a decrease in the incentive to save.[9]

In an empirical study of the impact of fiscal decentralisation on the long run share of investment in the GDP of high-income OECD countries, Thiessen (2003) found that countries with a medium degree of fiscal decentralisation have, in the long run, a higher investment share in GDP than either countries with a low or a high degree of fiscal decentralisation. In a detailed study of the effect of fiscal decentralisation on the composition of public investment in Europe, Kappeler and Valila (2008) found that fiscal decentralisation increases the share of relatively more productive investment in total public investment. They argue that fiscal decentralisation will result in more public investment in spill-over goods – such as infrastructure, hospitals, and schools – particularly where the spill-over effects of these investments are internalised by capital transfers from central governments.

[9] Savings levels could be restored via a corresponding reduction in the level of human capital investment. While this may have a positive effect on the level of savings it ultimately has a negative effect on economic growth through the reduction in human capital investment.

2.6 Income Distribution

Theoretical studies have found fiscal decentralisation to have both positive and negative effects on income distribution. On the one hand, authors such as Prud'homme (1995) and Neyapti (2006) contend that a centralised government system provides a more balanced distribution of income by directing resources from relatively richer regions to poorer regions. Furthermore, Ezcurra and Pascual (2008) argue that regional disparities generate differentials in revenue raising capacities amongst regions, causing income gaps, and fiscal decentralisation weakens the ability of the central government to perform an equalisation role in fiscal policy. On the other hand, it has been argued that local governments have the specific knowledge to provide the most efficient allocation of resources (Oates, 1991). Shankar and Shah (2003) maintain that the ability of local governments to stay in power depends on their ability to realise a level of development and economic growth similar to that enjoyed by other local jurisdictions. This ensures that less advanced regions have an incentive to act competitively and offer policies, such as a more flexible labour market, to increase the overall level of development.

Qiao *et al.* (2008) developed a theoretical model to analyse the correlation between fiscal decentralisation and income inequality. This model was then employed in an empirical analysis of China and it was established that fiscal decentralisation has led to a significant increase in regional inequality. In addition, they also provided evidence to support the hypothesis that there exists a trade-off between economic growth and regional equality in China. Zhang (2006) also considered this potential trade-off in the context of China and contended that fiscal decentralisation exacerbated the high costs of tax collection in poorer

regions, particularly those with a large dependence on agriculture. Similar results were produced by Bonet (2006) in an investigation of Columbia's fiscal decentralisation experience. Neyapti (2006), however, analysed the relationship between fiscal decentralisation and income equality across 37 countries and found that when a country was governed successfully, revenue decentralisation had the potential to improve income distribution, a result consistent with the conclusions of Ezcurra and Pascual (2008).

3. Empirical methodology and data

Consistent with prominent previous studies, such as Xie *et al.* (1999), the impact of fiscal decentralisation on the value of the macroeconomic variable of interest is estimated by means of ordinary least squares regressions of the following form:

$$g_t = \boldsymbol{\beta}'\mathbf{x}_t + \gamma d_t + \varepsilon_t \qquad (1)$$

where g_t is the value of the macroeconomic variable of interest in period t = 1972, ..., 2005. The vector $\mathbf{x}_t$ contains a set of control variables that are useful in explaining the determinants of the macroeconomic variable, including a constant term. The variable d_t is a measure of fiscal decentralisation and ε_t is the error term, both in period t. Interest focuses upon the sign and statistical significance of the estimate of parameter γ in the regression of various macroeconomic variables g_t. against various measures of fiscal decentralisation d_t . Equation (1) is estimated for time-series data in the period 1972-2005 for the aggregate Australian economy.

The selection of the control variables to be included in the vector $\mathbf{x}_t$ is guided mainly by previous empirical studies. However, in each model potential control variables that are statistically insignificant from zero are excluded provided the validity of these exclusions is

supported by the results of a redundant-variables-F-test. Following this, the model is then tested for omitted variable bias by means of the Ramsey RESET test. Moreover, the Durbin-Watson statistic is used to test for serial correlation, and the Breusch-Godfrey Lagrange Multiplier statistic is used to test for the presence of autocorrelation.

In the case of the State-level analysis of the impact of decentralisation in Australia on State-level economic growth, both cross-sectional and panel estimation techniques were used. Cross-sectional techniques were used to analyse the effect of fiscal decentralisation on income distribution. Using the cross-sectional data, ordinary least squares regressions of the following form were estimated:

$$s_i = \boldsymbol{\delta}'\mathbf{x}_i + \theta d_i + \varepsilon_i \tag{2}$$

where s_i is either the growth of gross state product (GSP) per capita or a measure of income distribution for State $i = 1,...,8$. Again, the vector $\mathbf{x}_i$ contains a set of control variables that are useful in explaining the determinants of the growth of GSP per capita or inequity. The variable d_i is a measure of fiscal decentralisation and ε_i is the error, both in State i. Following Qiao *et al*. (2008), the income distribution in each state is calculated using the following formula:

$$\text{Inequity}_i = \left| \frac{\dfrac{\text{GSP per capita}_i}{\text{Population}_i}}{\dfrac{\sum \text{GSP per capita}_i}{\sum \text{Population}_i}} - 1 \right| \tag{3}$$

This measure uses relative GSP per capita as a proxy for the share of fiscal resources. With full income equality, a State's share of fiscal resources equals its share of the country's population and the relative share of fiscal resources assigned to each State equals one.

For the panel data, a fixed-effects model of the following form is estimated:

$$s_{it} = \alpha_i + \boldsymbol{\delta}'\mathbf{x}_{it} + \theta d_{it} + \varepsilon_{it} \quad (4)$$

where s_{it} is the growth of gross state product (GSP) per capita for State i = 1,...,8 in period t = 1990, ..., 2006. The parameters α_i represents State-fixed effects. The vector $\mathbf{x}_{it}$ contains a set of control variables that are useful in explaining State economic growth. The variable d_{it} is a measure of fiscal decentralisation and ε_{it} is the error term, both for State i in period t.

Economic theory suggests that last period's growth has an impact on current period economic growth and hence a one period lag of GSP should be included in equation (4). However, to include a lagged value of the dependent variable into the panel data analysis would make the fixed effects estimator both biased and inconsistent since the lagged dependent variable is correlated with the error term (Verbeek, 2004). Hence a dynamic panel is required. To solve the inconsistency problem, the dynamic panel begins by taking the first difference of equation (4) to remove the individual effects. However, the lagged dependent variable, $s_{i,t-1}$, and the lagged error term, $\varepsilon_{i,t-1}$ remain correlated even as the number of time periods approaches infinity, suggesting that the instrumental variable approach needs to be utilised. Often, the second lag of the dependent variable, $s_{i,t-2}$, is employed as the instrumental variable since it is correlated with $(s_{i,t-1} - s_{i,t-2})$ but not $\varepsilon_{i,t-1}$.[10] To account for the reduction in the number of observations lost in the estimation, a general method of moments (GMM) approach is often used. In the present study, the Arellano and Bond (1991) GMM method of estimating dynamic panel data models was employed. The conclusions were similar to those achieved when using the fixed effects model described above. Consequently, for simplicity and ease of understanding, the results from the fixed effects model only are

[10] That is, assuming that there is no serial correlation in the model.

reported.

The robustness of "growth regression" methods has been a particularly contentious issue in recent times (Levine and Renelt, 1992; Bleaney and Nishiyama, 2002; Sala-i-Martin *et al*., 2004). There is no consensus on what method that should be employed to determine which variables have a significant effect on economic growth.[11] Consequently, model uncertainty is arguably the most significant limitation of traditional estimation procedures. Typically individual researchers develop a single model (or small set of models) and undertake inference as if that model had generated the data. Such procedures ignore the uncertainty that surrounds the validity of the model when it is not known exactly which model is the correct one, and thus, sequential testing procedures can lead to considerably misleading inferences (Hodges, 1987; Draper, 1995). This issue can be addressed by using Bayesian Model Averaging (BMA) to test the robustness of the results. The rationale behind BMA is relatively straightforward. When there is more than one model that fits the data well, but models produce conflicting coefficient estimates and standard errors, taking a weighted average of the potential models is superior to choosing just one "best" model and discarding the remainder (Fernandez *et al*., 2001a). Distributions for the regression coefficients are calculated by averaging the posterior density of each of the models considered and using their posterior model probabilities as weights (Koop, 2003). These weights are closely related to the predictive ability of the models and, as such, provide a more formal approach to model uncertainty than the traditional approaches (Temple, 2000). It should be noted, however, that BMA is not without its critics.

[11] Growth econometrics suffers from a number of other well documented problems, including: endogeneity, parameter heterogeneity, data quality, the problems associated with pre-test estimators, and the inability to address the issue of model uncertainty. See Durlauf *et al*. (2005) for an extensive review of these issues.

Sala-i-Martin *et al*. (2004) maintain that the impact of the choice of prior on the results in BMA analyses has not been sufficiently investigated and this choice may have significant, unexplored consequences.[12] In the present study this problem is addressed by employing a benchmark prior distribution proposed by Fernandez *et al.* (2001a) that they show to have very little impact on posterior results.[13]

The selection of an appropriate measure of fiscal decentralisation is a critical difficulty encountered in empirical analysis of fiscal federalism, and there is no consensus in the literature on any one "true" measure of fiscal decentralisation. Consequently, two broad types of measures of fiscal decentralisation are considered in the present study, standard measures and corrected measures.[14]

Standard measures of fiscal decentralisation are calculated from data on government expenditure share, government revenue share and tax revenue share.[15] Whilst these standard measures do not capture the complexity of fiscal relations, they do provide a basic impression of how much authority sub-central governments possess and how this has evolved over time. Corrected measures of fiscal decentralisation seek to capture the level of autonomy – particularly tax autonomy – sub-central governments have over their own actions. OECD (2005) developed an analytical framework for classifying subnational taxes in order of fiscal autonomy by considering three principal aspects: tax administration, the attribution of tax receipts, and legislative competencies to determine the tax rate and tax base. Following this

[12] More recently, Eicher *et al.* (2007) have attempted to provide guidance on the most accurate choice of prior in economic models.
[13] The BMA equations are presented in Appendix B.
[14] See Appendix A for a description of the measures of fiscal decentralisation employed in this study.
[15] Standard measures have been used studies by Jin and Zou (2002); Triesman (2002); Martinez-Vazquez and McNab (2003); Stegarescu (2005); Neyapti, (2006); Akai *et al*. (2007); Bjornskov *et al*. (2008), amongst other.

framework, a number of measures of fiscal decentralisation have been developed. For example, Ebel and Yilmaz (2003) derived a measure of tax autonomy by summing the taxes that accrue under the top three classifications provided by OECD (2005), and weighting each tax by their corresponding share of total tax revenue. Another set of corrected measures seeks to measure the degree of centralisation. For example, Arzaghi and Henderson (2005) suggested the share of central government consumption expenditure to total government consumption expenditure would provide an indicator of expenditure centralisation.[16]

As previously mentioned the analysis is undertaken on both the aggregate and State levels. At the aggregate level, the data set covers the 33 year period of 1972 to 2005. A majority of the time-series data was taken from the World Bank's *World Development Indicators* and the *Australian Bureau of Statistics* databases.[17] It has been argued that the relationship between economic growth and fiscal decentralisation is not a short-term relationship. Davoodi and Zou (1998) asserted that the benefits and costs of fiscal decentralisation are not expected to affect year-to-year fluctuations in growth, and proposed estimating the regression on data averaged over five and ten year periods. Meloche *et al*. (2004) suggested using a centred three-year moving average (3-year MA) to smooth the fluctuations from the data. Given the small sample size and consequent restricted degrees of freedom, a three-year moving average was chosen for the present study in order to maintain a reasonable number of data points.[18] For robustness, growth results are reported when the model is estimated both on a year-by-year

[16] A further set of measures has also been utilised by past authors. These alternative measures seek to capture a 'comprehensive system' consisting not only of revenue and expenditure policies, but other aspects that consider the decision making powers at different levels of government. See Triesman (2002) and Sutherland *et al.* (2005).
[17] See Table A1 for a complete description of the data and its sources.
[18] A Hodrick-Prescott filter was also tried as a data smoothing technique. However, this implies some truncation of the data set and produced data that was too smooth and thus provided unreliable results.

basis (short-term analysis) and on a centred three-year moving average basis (medium-term analysis). At the State level, the data are arranged in both cross-section and panel structures. The cross-section data covers the post-Goods and Services Tax (GST) period of 2000 to 2005 for the six states and two major self-governing territories. In order to improve the number of observations in the data set, the panel data set covers the period 1990 to 2006, increasing the total number of observations to 136. A majority of the data was taken from the *Australian Bureau of Statistics* database. Given the differences in data coverage, care must be taken when comparing the aggregate and state level results. Summary statistics for both the aggregate and state level data are presented in Table A2 of the appendix.

4. Empirical Results

4.1 Aggregate Analysis

In this section, the results of the estimation of the effects of fiscal decentralisation on four macroeconomic variables and economic growth are presented. A total of 16 measures of decentralisation have been utilised in this study. To conserve space only the most noteworthy results[19] are reported. In general, to allow comparability with previous studies, the results of models including the basic revenue and expenditure share measures as well as the average of these two measures are reported.

Table 1 reports the estimated impact of fiscal decentralisation on macroeconomic stability measured via the level of inflation.[20] All measures of revenue decentralisation were found to

[19] A summary of the results are reported in Tables 12 and 13. Full results are available on request.

[20] The misery index – the sum of the rates of inflation and unemployment- was also used as a measure of macroeconomic stability and the signs and statistical significance of the decentralisation variables were consistent

have a significant negative effect on the level of inflation while expenditure decentralisation has no statistically significant effect. These results are consistent with those of King and Ma (2001), Martinez-Vazquez and McNab (2003) and Neyapti (2004). Since tax revenue has a relatively large share in total subnational revenues the significant negative sign on the coefficient of the measure of subnational governments' share of total government tax revenue (Tax share: Central total) implies that the transference of tax powers to lower levels of government is a driving force behind the dampening effect of revenue decentralisation on Australia's rate of inflation. This is particularly important given the State governments' largest source of taxation revenue is now GST, a central government controlled tax. The three measures of sub-central government fiscal autonomy are also found to have a statistically significant negative relationship with inflation.

[Table 1]

Results of the effect of fiscal decentralisation on public sector size are reported in Table 2. In contrast to Grossman's (1992) results, expenditure decentralisation was found to have a positive effect on the size of the public sector in Australia. This disparity in findings can most likely be attributed to the two alternative time periods under consideration: Grossman analysed the period 1950 to 1984 whereas the present analysis is between 1972 and 2005. A relatively high level of centralisation persisted in Australia until movements towards privatisation and microeconomic reform began in the 1970s and 1980s. The corresponding devolution of government powers generally continued until the introduction of the GST and the subsequent centralisation of government responsibilities in Australia. Thus, the evolution

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with those obtained from the inflation analysis. Results are available upon request.

of decentralisation during Grossman's time period is quite different to that of the time period analysed here.

The results of expenditure decentralisation suggest that, from a budgetary perspective, fiscal decentralisation may result in the loss of economies of scale and subsequently increase the cost of supply and thus the size of the public sector. In addition to the sub-central governments' share of total government expenditure, the measures of tax and revenue autonomy also have significant positive coefficients. These results indicate that decentralisation of decision making and responsibilities not only increases the relative size and power of the sub-central governments, it also increases the size of the Australian government as a whole.

[Table 2]

Table 3 presents the results of the effect of decentralisation on the budget balance, measured by the annual change in the fiscal balance of the central government (as a percentage of GDP). Both sub-central government revenue and expenditure shares, and consequently the average of the two, were found to have a significant relationship with Australia's budget balance. While increases in the sub-central governments' share of total government revenue was found to improve the budget balance, increases in the sub-central governments' share of total government expenditure was found to have the opposite effect. The relationship between expenditure and revenue measures and budget balance can be explained by the positive coefficient on subnational fiscal balances. This result indicates that as the subnational governments' budget balance improves there is a corresponding improvement in the central government's fiscal balance. Thus, an increase in subnational revenue and a decrease in subnational expenditure would have an indirect positive impact on the central government's

budget balance. Note that the negative and significant coefficients on growth indicate that Australian fiscal policies have been countercyclical on average.

[Table 3]

The final macroeconomic variable tested for a relationship with fiscal decentralisation was physical capital investment. The results are summarised in Table 4. The standard common measures of revenue and expenditure decentralisation were found to have no statistically significant impact on the rate of physical investment in Australia. However, a significant negative effect of decentralisation was detected when decentralisation was represented by means of autonomy measures. One possible explanation for this result is the increase in "red tape" and cross-border inconsistencies that arises when sub-central governments have a relatively larger influence on tax and regulation policies. Firms seeking to invest may well be hindered by the extra costs involved when such barriers exist. As a further point of interest, unlike the case of the three macroeconomic conditions analysed previously, the measure of vertical fiscal imbalance was found to be statistically significant in the case of investment. Vertical imbalance is a measure of centralisation and hence, its positive effect on investment is consistent with the results obtained using the decentralisation indicators.

[Table 4]

Having tested for indirect influences of fiscal decentralisation on economic performance using four important macroeconomic variables, the analysis now turns to testing for a direct impact of fiscal decentralisation on GDP growth, firstly considering short-term (year on year) economic growth. Since model specification is a central issue for growth econometrics of the sort undertaken in this study the steps employed to come to the chosen specification are

described. The base model specification is the commonly accepted Barro-type growth equations employed in previous studies (e.g. Barro, 1991). Due to the limited degrees of freedom available, the control variables included in the regression equation were determined by backward elimination. A redundant variables test was performed on regressors that did not have a significant relationship with economic growth, as determined by individual *t*-tests – namely, the lag of the dependent variable, investment, trade, and gross domestic savings. The null hypothesis that the coefficients are jointly zero was not rejected at the 1% level of significance and these potential regressors were excluded from the model.

Owing to the nature of growth regressions, endogeneity and simultaneity between the dependent and explanatory variables can be a problem. Suggestive evidence of an endogeneity problem was indicated by the rejection of correct model specification at the 1% level of significance found using a Ramsey RESET test. A Hausman test for endogeneity performed on the explanatory variables indicated that there was an endogeneity problem between consumption (expenditure share in GDP) and GDP growth. To correct this problem a one period lag of consumption was employed as simple instrumental variable on the basis of the life-cycle permanent income hypothesis which states that last period's consumption provides an accurate prediction of current consumption. An individual significance test confirmed that a one period lag of consumption had a significant relationship with economic growth but preliminary regression results indicated that this model had low explanatory power. Thus, the second lag of consumption was also included. A significance test and a Ramsey RESET test confirmed the significance of the second lag. Finally, using the Breusch-Godfrey LM test the

hypothesis of no serial correlation could not be rejected.[21] The results using the chosen model specification are presented in Table 5.

[Table 5]

Of the 16 measures of fiscal decentralisation employed, only sub-central governments' tax revenue share of total revenue produced a statistically significant (negative) coefficient. Overwhelming, the results indicate that, as argued by Davoodi and Zou (1998), fiscal decentralisation has little or no significant impact on short-term economic growth.

Next the analysis considers whether the short-term results generalise to the medium-term. In the interests of consistency and ease of interpretation, the medium-term model was specified using the same control variables as used in the short-term analysis with one exception.[22] The Ramsey RESET test on the model without the lagged consumption variable indicated that this model was well specified; suggesting that employing the 3-year moving average removed the endogeneity problem inherent in the year-to-year approach. The results are presented in Table 6.

[Table 6]

In contrast to the results obtained using the short-term measure, this model has high explanatory power with a number of decentralisation and explanatory variables producing significant coefficients. Both the standard measures of revenue decentralisation (revenue share) and expenditure decentralisation (expenditure share) exhibited significant relationships with medium-term Australian economic growth. An increase in Australian sub-central

[21] A Sargan test for instrument validity was also performed and verified the appropriateness of the instrument specification chosen).

[22] One should note, however, that the results did not change when the three-year moving average model was specified differently from the year-to-year model. These results are available upon request.

governments' share of total government expenditure was estimated to have a negative impact on economic growth, perhaps suggesting that increasing decentralisation overburdens State governments with expenditure responsibilities to the extent that they cannot perform effectively. Furthermore, potential loss of economies of scale and subsequent increases in the cost of supply can reduce the efficiency of the public sector to the detriment of economic growth. On the other hand, increasing the sub-central governments' share of total government revenue was found to increase medium-term economic growth on average. This result, in conjunction with the significant negative coefficient on the average measure, suggests that to enhance economic growth the central government needs to assume a larger share of expenditure responsibilities and the sub-central governments require larger revenue sources. The significant negative coefficient on the average measure of decentralisation indicates that merely increasing revenue proportionately to a reduction in expenditure still has a detrimental effect on medium-term economic growth. Consistent with the basic measure of revenue decentralisation, both tax autonomy and the corrected measure of revenue decentralisation are found to have positive relationships with medium-term economic growth in Australia.

The positive coefficient on non-tax share suggests that increasing sub-central governments' non-tax share of total revenue has a favourable effect on Australian economic growth. Non-tax revenue consists primarily of user charges and administrative fees and hence is considered "own source" revenue. Accordingly, the results suggest that increasing the revenues over which State and Local governments have full discretion enhances economic growth in the medium-term. Finally, it is found that increasing the local government share of total government expenditure has, on average, a positive effect on growth. The coefficient on the

States' share, however, is not statistically different from zero. This result is somewhat surprising given the negative sign on the coefficient of total sub-central government expenditure share. Nonetheless, the results imply that although State and Local governments combined have too much expenditure responsibility in a decentralised economy, increasing just grassroots, local governments' share would enhance economic growth in the medium-term.

Overall, only 7 of the 16 measures of decentralisation are found to have statistically significant effects on medium-term economic growth. Such results indicate that the view that fiscal decentralisation is growth-enhancing is not supported by the data. However, some evidence is supportive of the notion that targeted decentralisation could promote economic growth in Australia.

As a final exercise at the aggregate level, the robustness of the growth results is tested by utilising Bayesian Model Averaging.[23] The data comprise 30 potential explanatory variables of Australian economic growth over the period 1972-2005. The results reported are from 1 million recorded draws after 500,000 burn-in replications to account for the starting value of the chain. Table 7 presents the posterior means and standard deviations as well as the marginal posterior probabilities of inclusion for each explanatory variable. Masanjala and Papageorgiou (2008) contend that the absolute value of the ratio of the posterior mean to its standard deviation provides a better measure than the posterior inclusion probability to determine whether an explanatory variable achieves economic and statistical significance in a model. The results are examined using both measures to identify variable effectiveness. Fernandez *et al*.

[23] Full details are presented in Appendix B.

(2001a) determine a variable to be an effective determinant of GDP growth per capita if its posterior probability of inclusion is greater than 0.1. Conversely, Raftery (1995) suggests that 0.5 is an appropriate threshold. Raftery's threshold is approximately equivalent to requiring a ratio of posterior mean to standard deviation of 1. This is also the threshold applied in Masanjala and Papageorgiou (2008). Since there is no consensus in the BMA literature about the correct threshold Table 7 indicates which variables cross each threshold.

[Table 7]

Using the threshold suggested by Raftery, the results indicate that consumption expenditure, the unemployment rate, and the secondary school enrolment rate are the only explanatory variables that provide significant explanatory power in the aggregate model. Under the Fernandez *et al.* (2001a) threshold, population growth, government consumption, domestic savings, and taxation revenue can also be considered significant determinants of economic growth in Australia. Such results are consistent with the statistical significance achieved by the variables included in the model of medium-term economic growth and support the model specification used in the benchmark models estimated via classical estimation techniques.

The posterior results of the measures of fiscal decentralisation are presented in Table 8. These results suggest that no indicator of decentralisation is likely to have an important contribution to economic growth in Australia under the threshold suggested by Raftery. However, 5 of the 16 fiscal measures do satisfy the Fernandez *et al.* (2001a) threshold. The highest probability of inclusion is achieved by the tax autonomy: sub-central total measure at 34.51 percent. Only 2 of these 5 measures – revenue share: total and tax autonomy: central

total – were also estimated to have a statistical significant effect on economic growth using classical estimation. Such results reinforce the weak relationship between fiscal decentralisation and medium-term economic growth estimated above. Consequently, the results generally appear robust to the estimation techniques employed.

[Table 8]

4.2 State-Level Analysis

Since failure to take account of the cultural, institutional, demographic, and economic differences across regions could result in biased and uninformative conclusions, the analysis is broadened to examine smaller political units as recommended by Stansel (2005). Hence, in this section the effect of fiscal decentralisation on income distribution and economic growth is examined using data for Australia's 8 regions.

Per capita GDP in Australia is the most even of any democratic federation across its States (McLean, 2004). However, there is clear evidence of diverging per capita output since the mid-1970s (Cashin, 1995; Neri, 1998; Nguyen *et al*., 2003). Figure 1 highlights the inequality in income distribution across the States of Australia over the 2000 to 2005 period.[24] It can be seen that ACT has the most significant portion of fiscal resources, largely at the expense of Tasmania, Queensland, and South Australia.

Table 9 presents the results of the estimated effect of decentralisation on distribution of fiscal resources. Of the three decentralisation measures, only sub-central government investment share of total government investment was found to have a significant relationship

[24] The shorter time period and limited number of decentralisation measures compared to the aggregate analysis is owing to a lack of statistical information consistently measured in each state. Consequently, the results obtained using the basic measures employed in this study provides a solid grounding for future research. Furthermore, one should note that as the ACT does not have local governments it is given a value of zero for local decentralisation as an indication of complete centralisation.

with fiscal distribution. Given that government investment represents the most productive part of public expenditure (Carrion-i-Silvestre *et al.*, 2008) it is unsurprising that the effect of decentralisation measured via investment shares on income distribution is higher when compared to the standard measures based on expenditure or revenue shares. The positive coefficient on investment share measure suggests that as the sub-central governments' share of total government investment increases, inequity across Australian States also increases. This result arises because centralisation of fiscal resources ensures a minimum degree of horizontal fiscal balance, particularly in Australia since the main objective of the Commonwealth Grants Commission is to achieve fiscal equalisation across the States. Centralising government decision making and responsibilities provides a more balanced income distribution as the central government is able to redirect resources to relatively poorer States. Thus, decentralising fiscal resources does not allow the central government to perform an equalisation role in fiscal policy. However, overall the evidence that fiscal decentralisation leads to greater income inequality is not strong.

[Table 9]

The impact of fiscal decentralisation on State economic growth is examined by employing the data in two forms. The cross-section analysis is limited in its interpretations as it suffers from a significant lack of degrees of freedom. Hence panel data techniques are applied to the period 1990 to 2006 to provide an examination of both the individual (State) and time relationship between growth and fiscal decentralisation, while the results of the cross-sectional analysis are presented for comparison.

The cross-sectional results are presented in Table 10. To control for endogeneity, the initial

values (2000 value) of explanatory and decentralisation variables were regressed on the average of GSP over the period 2000 to 2005. Of the 6 measures of fiscal decentralisation employed, only sub-central governments' share of total government tax revenue was found to be a significant determinant of state economic growth. This result is consistent with the sign and significance on the Tax share: sub-central total measure estimated using aggregated data. However, at both the aggregate and state levels, only one significant measure of decentralisation was found. Consequently, the cross-sectional analysis indicates a very weak, if any, relationship between decentralisation and economic growth at the aggregate or state levels.

[Table 10]

The panel data results are presented in Table 11. A Hausman (1978) specification test was conducted to test the null hypothesis that the random effects model is unbiased and the null was rejected at the 1% level of significance, indicating a fixed effects model was appropriate. Furthermore, the existence of individual or time effects does not need to be addressed for a panel data model of Australian States as the interpretation of the fixed effects as State dummy variables precludes this requirement (Gujarati, 2003). The assumptions of homoskedasticity and no serial correlation were also tested to further ensure the choice of a fixed effects model specification was correct. Bhargava *et al*. (1983) developed a generalisation of the Durbin-Watson statistic to test for the presence of autocorrelation in panel data models and Verbeek (2004) derived a variant of the Breusch-Pagan test to test for heteroskedasticity in panel data models. However, Wooldridge (2002) contends that when analysing fixed effects models that are akin to including dummy variables, the idiosyncratic errors (errors across States) are

constant. This means that the fixed effects are efficient and the assumptions of heteroskedasticity and no serial correlation hold.

[Table 11]

The results indicate that three decentralisation variables have a significant relationship with state economic growth: namely the local share of tax revenue, sub-central governments' share of tax revenue, and the local governments' share of sub-central government tax revenue. Taken together, these results suggest that the negative effect of decentralisation on state growth comes from decentralisation at the local level, implying that the extent of local governments' share of power and responsibility is having a negative impact on economic growth. Unlike at the aggregate level, none of the State measures of decentralisation is found to have a positive effect on state economic growth. This is the opposite result to that found at the regional level in Spain by Carrion-i-Silvestre *et al.* (2008), suggesting that country-specific analyses, both at the aggregate and local levels, are important in determining the nature of any relationship between fiscal decentralisation and economic growth.

5. Conclusion

This paper analysed the effect of fiscal decentralisation on the Australian economy as a whole as well as at the level of the States. It argued that it was essential to study the effect of fiscal decentralisation on key macroeconomic variables which determine the economic environment within which growth occurs as well as on economic growth itself. Employing sixteen measures of fiscal decentralisation, the analysis found a number of conflicting results, summarised in Table 12, about the effects of decentralisation on these key Australian

macroeconomic variables. Overall the results suggest that decentralisation tends to enhance macroeconomic stability and increase the size of the Australian public sector. Decentralisation of expenditure and centralisation of revenue collection were found to improve Australia's vertical fiscal imbalance and stabilise central, State, and local government budgets. Increasing State and local governments' own source revenue was found to decrease investment in Australia while the relative size of State and local governments' revenue and expenditure did not appear to have significant effects. As expected, fiscal decentralisation did not appear to affect economic growth in the short-term. When analysing medium-term growth the results were mixed, but on balance suggest that, while expenditure decentralisation tends to decrease Australia's medium-term rate of economic growth, revenue decentralisation, the decentralisation of state and local governments' own source and non-tax revenue, and the decentralisation of government expenditure to the local level tend to increase the growth rate. Nine other indicators of decentralisation were found to have no relationship with economic growth.

The State level results, summarised in Table 13, suggest that, on some measures, fiscal decentralisation may tend to increase the inequity of income distribution across the States and to retard economic growth. For the majority of measures employed, however, no such relationship could be detected. Such results suggest that there are many ways in which fiscal decentralisation can affect the economy, with the outcome depending on the type of decentralisation undertaken. Now that some of these effects have been empirically identified the next step is a better theoretical understanding of why these relationships exist and what policy lessons can be learned from them.

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Tables and Figures

Table 1: Macroeconomic stability (Inflation) regressions for Australia, 1972-2005

Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Revenue share: Total	-	-16.35096 [0.0007]***	-	-	-	-	-
Expenditure share: Total	-	-	-11.5463 [0.4855]	-	-	-	-
Tax share: Central total	-	-	-	-16.75089 [0.0011]***	-	-	-
Tax autonomy: Central total	-	-	-	-	-7.332869 [0.0008]***	-	-
Tax autonomy: Sub-central total	-	-	-	-	-	-10.08613 [0.0069]***	-
Revenue decentralisation	-	-	-	-	-	-	-10.12675 [0.0005]***
Money	0.27364 [0.9199]	0.763482 [0.7305]	-0.24242 [0.9322]	0.487238 [0.8148]	-2.648546 [0.2951]	-3.87259 [0.2082]	-1.66953 [0.4823]
GDP per capita	-3.676378 [0.0005]***	-2.61953 [0.0009]***	-3.809267 [0.0002]***	-4.076715 [0.0000]***	-3.940318 [0.0000]***	-3.79535 [0.0000]***	-2.954722 [0.0002]***
Tax revenue	1.87998 [0.4782]	-2.055912 [0.3197]	1.490668 [0.5557]	-1.899763 [0.3284]	-1.468228 [0.4428]	-0.455063 [0.7988]	-1.717896 [0.3971]
Investment	-2.423461 [0.6664]	-9.171023 [0.0671]*	-3.254606 [0.5201]	-13.05881 [0.0427]**	-12.39703 [0.0333]**	-9.661798 [0.0719]*	-11.41014 [0.0261]
Δ Fiscal balance: Central gov't	0.996889 [0.0139]**	1.180532 [0.0007]***	1.030251 [0.0108]**	1.16872 [0.0009]***	1.31714 [0.0006]***	1.329806 [0.0011]***	1.280837 [0.0004]
Inflation (-1)	0.52746 [0.0000]***	0.353589 [0.0072]***	0.533513 [0.0000]***	0.340439 [0.0080]***	0.388783 [0.0033]***	0.449308 [0.0006]***	0.364647 [0.0061]
Adj-R^2	0.833085	0.867684	0.829954	0.873337	0.862526	0.848029	0.866244
Prob (F-statistic)	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000

Notes: Dependent variable: Inflation. In square brackets, *p*-values based on heteroscedastic-consistent (White-robust) standard errors are reported. Asterisks indicate variables that are significant at the 10% (*), 5% (**) and 1% (***) levels. Total number of observations is 33. Initial results suggested that openness to trade and government consumption were individually statistically insignificant. Before dropping these variables, a redundant variables F-test was performed to test the hypothesis that the coefficients on the two variables are jointly zero. The resulting low F-statistic led to the removal of these two explanatory variables from the model. The re-estimated model, however, exhibited signs of a potential serial correlation problem, as was indicated by a low Durbin-Watson statistic. Thus, to eradicate this problem, a lag of the dependent variable was included as an explanatory variable. An individual significance test confirmed that last period's inflation is a significant determinant of current inflation. A Ramsey RESET test was also performed to confirm the specified model was unbiased and consistent, and inferences using least squares (LS) were valid. Finally, the Breusch-Godfrey Lagrange Multiplier statistic was obtained to check for the presence of residual autocorrelation; there was insufficient evidence to reject the null of no serial correlation.

Table 2: Public sector size regressions for Australia, 1972-2005

Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Revenue share: Total	0.005153 [0.8761]	-	-	-	-	-	-
Expenditure share: Total	-	0.039000 [0.0391]**	-	-	-	-	-
Average share	-	-	-0.000608 [0.9925]	-	-	-	-
Tax share: Central total	-	-	-	0.032552 [0.4338]	-	-	-
Tax autonomy: Central total	-	-	-	-	0.065984 [0.0070]***	-	-
Tax autonomy: Sub-central total	-	-	-	-	-	0.132578 [0.0088]***	-
Revenue decentralisation	-	-	-	-	-	-	0.093821 [0.0028]***
Transfers	0.043620 [0.5033]	0.043487 [0.4503]	0.040445 [0.5313]	0.057046 [0.4041]	0.121021 [0.0411]**	0.133015 [0.0352]**	0.125478 [0.0239]**
Disposable income	0.157446 [0.0142]**	0.141491 [0.0293]**	0.155651 [0.0152]**	0.171299 [0.0083]***	0.14976 [0.0143]**	0.110509 [0.0899]*	0.145585 [0.0172]**
Population	-0.682295 [0.0286]**	-0.56017 [0.0874]*	-0.669632 [0.0313]**	-0.755206 [0.0139]**	-0.534611 [0.0767]*	-0.28088 [0.4215]	-0.573368 [0.0504]*
Gov't expenditure (-1)	0.982314 [0.0000]***	0.980664 [0.0000]***	0.984385 [0.0000]***	0.964974 [0.0000]***	0.907068 [0.0000]***	0.925747 [0.0000]***	0.909139 [0.0000]***
Gov't expenditure (-2)	-0.665933 [0.0001]***	-0.675917 [0.0001]***	-0.665471 [0.0001]***	-0.667638 [0.0001]***	-0.693235 [0.0000]***	-0.688579 [0.0000]***	-0.70161 [0.0000]***
Adj-R^2	0.786391	0.796651	0.786312	0.788561	0.816275	0.814663	0.821186
Prob (F-statistic)	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000

Notes: Dependent variable: Gov't expenditure. In square brackets, *p*-values based on heteroscedastic-consistent (White-robust) standard errors are reported. Asterisks indicate variables that are significant at the 10% (*), 5% (**) and 1% (***) levels. Total number of observations is 32. The base model employed follows the specification of Grossman (1992). Both the log-log and linear-log forms of this model did not reject the null of correct specification so the log-log model was chosen on the basis of Akaike and Schwarz criterion. The presence of autocorrelation was identified by a small Durbin-Watson statistic. Consequently, a lag of the dependent variable was included in the base equation. However, the Breusch-Godfrey LM test still detected the existence of serial correlation in the model, so a second lag of the dependent variable was incorporated. Estimation of the Ramsey RESET test and Breusch-Godfrey LM test indicated the resultant model did not show signs of omitted variables or serial correlation.

Table 3: Budget balance regressions for Australia, 1972-2005

Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Revenue share: Total	0.122002 [0.0265]**	-	-	-	-	-	-
Expenditure share: Total	-	-0.131271 [0.0205]**	-	-	-	-	-
Average share	-	-	0.209259 [0.0134]**	-	-	-	-
Tax share: Central total	-	-	-	0.161797 [0.1649]	-	-	-
Tax autonomy: Central total	-	-	-	-	-1.514178 [0.8985]	-	-
Tax autonomy: Sub-central total	-	-	-	-	-	4.506346 [0.2968]	-
Revenue decentralisation	-	-	-	-	-	-	-0.939773 [0.9426]
Δ Fiscal Balance: sub-Central gov't	0.431805 [0.0582]*	0.431721 [0.0563]*	0.472993 [0.0356]**	0.387187 [0.1095]	0.450575 [0.0856]*	0.382029 [0.1245]	0.443777 [0.0804]*
Growth	-18.36574 [0.0200]**	-16.42781 [0.0321]**	-18.56493 [0.0165]**	-17.0045 [0.0388]**	-15.34227 [0.0667]*	-14.0493 [0.0890]*	-15.29343 [0.0691]*
Inflation	-0.021508 [0.6022]	-0.020079 [0.6239]	-0.02506 [0.5335]	-0.022076 [0.6151]	-0.03143 [0.4864]	-0.032662 [0.4606]	-0.031405 [0.4874]
Debt (-1)	1.922768 [0.2093]	2.637065 [0.1017]	1.866617 [0.2103]	1.831285 [0.2626]	1.369815 [0.4266]	0.854914 [0.6057]	1.34664 [0.4419]
Adj-R^2	0.231886	0.244676	0.265596	0.140003	0.075662	0.112311	0.075276
Prob (F-statistic)	0.030606	0.025323	0.018384	0.104449	0.215552	0.144617	0.21642
DW	2.004717	1.947895	1.936576	2.108148	2.161545	2.244013	2.162722

Notes: Dependent variable: Δ Fiscal balance: Central gov't. In square brackets, *p*-values based on heteroscedastic-consistent (White-robust) standard errors are reported. Asterisks indicate variables that are significant at the 10% (*), 5% (**) and 1% (***) levels. Total number of observations is 33. DW = Durbin-Watson test statistic. The model specification was based on the specification presented in Thornton and Mati (2008).

Table 4: Physical capital investment regressions for Australia, 1972-2005

Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Revenue share: Total	-0.121954 [0.3998]	-	-	-	-	-	-
Expenditure share: Total	-	-0.184909 [0.2864]	-	-	-	-	-
Tax share: Central total	-	-	-0.231164 [0.1389]	-	-	-	-
Vertical imbalance	-	-	-	0.104177 [0.0565]*	-	-	-
Tax autonomy: Central total	-	-	-	-	-30.70232 [0.0003]***	-	-
Tax autonomy: Sub-central total	-	-	-	-	-	-11.52279 [0.0013]***	-
Revenue decentralisation	-	-	-	-	-	-	-24.68264 [0.0013]***
Fiscal balance	-0.055513 [0.8042]	0.03173 [0.8797]	-0.078633 [0.7149]	0.104219 [0.6245]	-0.146324 [0.4820]	-0.148396 [0.4848]	-0.150864 [0.4876]
GDP(-1)	0.00000302 [0.9611]	-0.000121 [0.1251]	-0.0000096 [0.8351]	-0.0000132 [0.7772]	-0.0000927 [0.0335]**	-0.00012 [0.0089]***	-0.0000469 [0.2404]
Trade	-0.119428 [0.1615]	0.065633 [0.6583]	-0.115984 [0.0438]**	-0.071508 [0.0699]*	0.005462 [0.8534]	0.016019 [0.6406]	0.004054 [0.9096]
Inflation	-0.147109 [0.2553]	-0.13282 [0.1680]	-0.147029 [0.2166]	-0.111711 [0.3040]	-0.229978 [0.0262]**	-0.227179 [0.0284]**	-0.240557 [0.0197]**
Investment (-1)	0.670978 [0.0068]***	0.662761 [0.0019]***	0.641813 [0.0087]***	0.57175 [0.0159]**	0.736004 [0.0014]***	0.902198 [0.0004]***	0.760275 [0.0011]***
Adj-R^2	0.549976	0.57193	0.572057	0.589021	0.664348	0.649836	0.640347
Prob (F-statistic)	0.000096	0.000053	0.000052	0.000032	0.000003	0.000005	0.000006

Notes: Dependent variable: Investment. In square brackets, *p*-values based on heteroscedastic-consistent (White-robust) standard errors are reported. Asterisks indicate variables that are significant at the 10% (*), 5% (**) and 1% (***) levels. Total number of observations is 33. Estimation of the base model by OLS highlighted a problem of serial correlation, as was evidenced by an analysis of the autocorrelation function and Ljung-Box *Q*-statistics. To account for this, both one and two lags of the dependent variable were included alternatively in the model. Redundant variable tests on the lags, Ramsey RESET tests and Breusch-Godfrey LM tests confirmed both were adequate models. So, in the interests of parsimony and taking into account the limited degrees of freedom available in this model, only one lag of the dependent variable was ultimately included. One should note that estimation with two lags of the dependent variable produced similar results.

Table 5: Economic growth (short-term) regressions for Australia, 1972-2005

Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Expenditure share: Total	11.08439 [0.6018]	-	-	-	-	-	-
Revenue share: Total	-	3.830167 [0.4128]	-	-	-	-	-
Tax share: Sub-central total	-	-	-7.943197 [0.0536]*	-	-	-	-
Average share	-	-	-	8.181169 [0.3541]	-	-	-
Vertical imbalance	-	-	-	-	-1.188722 [0.6534]	-	-
Tax autonomy: Central total	-	-	-	-	-	0.835855 [0.6706]	-
Revenue decentralisation	-	-	-	-	-	-	1.375478 [0.6167]
Consumption (-1)	37.50276 [0.2075]	42.82733 [0.2305]	31.76853 [0.2800]	42.18351 [0.1804]	36.74928 [0.2541]	39.36356 [0.2184]	40.65796 [0.2312]
Consumption (-2)	44.65482 [0.0411]**	41.8847 [0.0562]*	14.23809 [0.5386]	44.15346 [0.0345]**	42.21736 [0.0579]*	39.72528 [0.0688]*	40.42492 [0.0649]*
Tax revenue	0.468789 [0.9430]	-0.786851 [0.8775]	-4.280361 [0.3995]	0.002391 [0.9997]	-1.54687 [0.7630]	-0.238392 [0.9666]	-0.809509 [0.8750]
Unemployment	0.109852 [0.6741]	-0.007672 [0.9847]	0.382304 [0.2611]	0.00041 [0.9989]	0.12458 [0.7028]	0.071189 [0.8489]	0.052169 [0.8931]
Human capital	-0.011437 [0.6966]	-0.024809 [0.3614]	0.010127 [0.6934]	-0.020992 [0.3335]	-0.020124 [0.4304]	-0.018269 [0.4182]	-0.019961 [0.4029]
GDP deflator	0.170994 [0.4970]	0.179803 [0.3970]	-0.005837 [0.9782]	0.187725 [0.4086]	0.135668 [0.5331]	0.13163 [0.5466]	0.147749 [0.4959]
Gov't consumption	-21.85999 [0.3233]	-22.93536 [0.2000]	-28.99455 [0.1026]	-21.88102 [0.2548]	-24.57954 [0.1932]	-24.22508 [0.2038]	-24.05981 [0.1979]
Adj-R^2	0.247935	0.24724	0.330372	0.250017	0.240599	0.241227	0.241579
Prob (F-statistic)	0.058603	0.05906	0.021237	0.057248	0.06358	0.063141	0.062896
DW	1.903593	1.917129	1.829221	1.917847	1.904442	1.910237	1.907253

Notes: Dependent variable: Growth (year-by-year). In square brackets, *p*-values based on heteroscedastic-consistent (White-robust) standard errors are reported. Asterisks indicate variables that are significant at the 10% (*), 5% (**) and 1% (***) levels. Total number of observations is 33. See in text for details of model specification.

Table 6: Economic growth (medium-term) regressions for Australia, 1972-2005

Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Expenditure share: Total	-6.950745 [0.0103]**	-	-	-	-	-	-
Revenue share: Total	-	11.47916 [0.0075]***	-	-	-	-	-
Non-Tax share: Sub-central total	-	-	5.109315 [0.0160]**	-	-	-	-
Average share	-	-	-	-2.081654 [0.0193]**	-	-	-
Tax autonomy: Central total	-	-	-	-	2.090535 [0.0487]**	-	-
Revenue decentralisation	-	-	-	-	-	1.647903 [0.0311]**	-
Expenditure share: State	-	-	-	-	-	-	2.686043 [0.2922]
Expenditure share: Local	-	-	-	-	-	-	8.998927 [0.0174]**
Consumption	-95.51434 [0.0000]***	-93.50613 [0.0000]***	-96.47866 [0.0000]***	-82.2266 [0.0000]***	-86.02179 [0.0000]***	-89.72158 [0.0000]***	-93.09929 [0.0000]***
Tax revenue	-2.789772 [0.1526]	-4.135154 [0.0717]*	-4.400773 [0.0325]**	-2.065937 [0.3295]	-4.875391 [0.0299]**	-4.868313 [0.0235]**	-3.691804 [0.1362]
Unemployment	0.60556 [0.0003]***	0.751333 [0.0000]***	0.490633 [0.0021]***	0.72225 [0.0000]***	0.641263 [0.0001]***	0.578952 [0.0004]***	0.687703 [0.0000]***
Human capital	0.066272 [0.0000]***	0.076498 [0.0000]***	0.064171 [0.0000]***	0.064416 [0.0000]***	0.070558 [0.0000]***	0.069054 [0.0000]***	0.072641 [0.0000]***
GDP deflator	-0.076962 [0.3614]	0.024127 [0.7312]	-0.018743 [0.7610]	-0.059149 [0.4911]	-0.011812 [0.8693]	-0.020395 [0.7656]	0.012677 [0.8560]
Gov't consumption	22.44409 [0.0004]***	17.40177 [0.0000]***	23.163 [0.0000]***	10.95051 [0.0038]***	15.85775 [0.0001]***	18.54947 [0.0000]***	20.11285 [0.0000]***
Adj-R^2	0.873686	0.857699	0.877158	0.861619	0.848284	0.859889	0.856528
Prob (F-statistic)	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
DW	1.691881	1.52743	1.749668	1.567353	1.532854	1.619691	1.645366

Notes: Dependent variable: Growth (3-year MA). In square brackets, *p*-values based on heteroscedastic-consistent (White-robust) standard errors are reported. Asterisks indicate variables that are significant at the 10% (*), 5% (**) and 1% (***) levels. Total number of observations is 31. See in text for details of model specification.

Table 7: Bayesian model averaging: Explanatory variables for Australia, 1972-2005

Explanatory Variable	Posterior Probability of	Posterior Mean	Posterior Standard	|Mean| / SD
Consumption	0.9042	-1.0609	0.5871	1.8070
Unemployment	0.6205	0.4696	0.4090	1.1480
Human capital	0.5885	0.0229	0.0214	1.0701
Population growth	0.4496	-0.9734	1.2457	0.7525
Gov't consumption	0.3790	0.6772	0.9885	0.6851
Savings	0.1833	0.0582	0.5008	0.1162
Tax revenue	0.1295	0.0354	0.1210	0.2926
Trade	0.0950	0.0148	0.0763	0.1940
Openness	0.0757	-0.0188	0.1250	0.1504
Investment	0.0650	0.0127	0.0888	0.1430
Inflation	0.0491	0.0012	0.0265	0.0453
GDP Deflator	0.0483	0.0023	0.0282	0.0816

Notes: Variables above the dotted line are considered effective under Fernandez *et al.* (2001a) threshold and variables above the continuous line are considered effective under Raftery (1995) threshold.

Table 8: Bayesian model averaging: Decentralisation measures for Australia, 1972-2005

Decentralisation Measure	Posterior Probability of Inclusion	Posterior Mean	Posterior Standard Deviation	|Mean| / SD
Tax autonomy: Sub-Central total	0.3451	-0.1869	0.3219	0.5806
Tax autonomy: Central total	0.2897	0.6428	1.2672	0.5072
Revenue share: Total	0.1671	0.0803	0.2436	0.3260
Tax share: Central total	0.1643	0.2637	1.8896	0.1396
Revenue share: Local	0.1062	0.1293	0.4962	0.2601
Non-Tax share: Sub-central total	0.0964	-0.014	0.0609	0.2299
Revenue share: State	0.0956	0.0249	0.1366	0.1823
Tax share: Sub-central total	0.0853	-0.0127	0.1131	0.1123
Average share	0.0824	0.0241	0.1523	0.1582
Revenue decentralisation	0.0747	-0.0064	0.1259	0.0508
Expenditure share: Local	0.0735	-0.1105	1.9892	0.0555
Expenditure share: State	0.0655	-0.0938	2.0009	0.0469
Expenditure centralisation	0.0643	-0.0044	0.0576	0.0764
Expenditure share: Total	0.0626	0.0839	1.9989	0.0420
Transfer share	0.0537	-0.0027	0.0304	0.0888
Vertical Imbalance	0.0498	0.0011	0.0237	0.0464

Notes: Variables above the dotted line are considered effective under Fernandez *et al.* (2001a) threshold and no variables can be considered effective under Raftery (1995) threshold.

Table 9: Income distribution regressions for the states of Australia, 2000-2005

Variable	(1)	(2)	(3)	(4)
State tax share: Local sub-central total	-	-0.000132 [0.9382]	-	-
State expenditure share: State	-	-	0.022849 [0.4323]	-
State investment share: Total	-	-	-	0.036576 [0.0181]**
GSP per capita	-0.0000034 [0.3381]	-0.0000029 [0.0627]*	-0.0000056 [0.1035]	-0.0000042 [0.0036]***
(GSP per capita)^2	1.13E-11 [0.3160]	8.22E-12 [0.1339]	-5.68E-03 [0.0036]***	9.46E-12 [0.0049]***
Inflation	-0.006601 [0.3548]	-0.004821 [0.0259]**	-0.005676 [0.0114]**	-0.005046 [0.0021]***
Aboriginal Population	0.033042 [0.8138]	-	-	-
Unemployment	0.004498 [0.8403]	-	-	-
Trade	-0.153632 [0.8376]	-	-	-
Adj-R^2	0.539784	0.751926	0.805336	0.972036
Prob (F-statistic)	0.460109	0.081137	0.057227	0.003256

Notes: Dependent variable: Inequity. In square brackets, *p*-values based on heteroscedastic-consistent (White-robust) standard errors are reported. Asterisks indicate variables that are significant at the 10% (*), 5% (**) and 1% (***) levels. Total number of observations is 8. Regression (1) presents the estimates when all 5 potential variables suggested by economic theory are included. Due to the limited degrees of freedom available with a cross-section of 8 States, the number of explanatory variables had to be reduced. Thus, regressions (2), (3), and (4) dropped those variables with the least statistical significance. The results were robust to the inclusion of other variables that were previously removed from the analysis.

Table 10: State economic growth cross-sectional regressions for Australia, 2000-2005

Variable	(1)	(2)	(3)	(4)	(5)	(6)
State tax share: Local	-	0.147234 [0.5019]	-	-	-	-
State tax share: State	-	-0.649151 [0.1673]	-	-	-	-
State tax share: Central total	-	-	-0.840258 [0.0178]**	-	-	-
State tax share: Local Sub-central total	-	-	-	-0.929761 [0.6402]	-	-
State expenditure share: Total	-	-	-	-	0.19374 [0.4129]	-
State investment share: Total	-	-	-	-	-	0.154277 [0.2030]
Population	-0.066812 [0.0331]**	0.472069 [0.3828]	0.817581 [0.0184]**	-0.102558 [0.5503]	-0.220102 [0.3746]	-0.223675 [0.1578]
Unemployment	-0.056398 [0.0031]***	-0.089313 [0.1512]	-0.096799 [0.0033]***	0.066051 [0.8001]	-0.054401 [0.1128]	-0.058942 [0.0276]**
Inflation: Capital cities	-0.926986 [0.0401]**	-0.168499 [0.9459]	-1.843302 [0.0222]**	6.880552 [0.6451]	-0.776693 [0.5186]	-0.300488 [0.4794]
Gov't consumption	-0.045801 [0.1303]	-0.318372 [0.4425]	-0.128645 [0.0339]**	-1.580691 [0.6290]	-0.055781 [0.7639]	-0.186937 [0.1729]
Adj-R^2	0.973097	0.990322	0.977473	0.698936	0.759181	0.883473
Prob (F-statistic)	0.019106	0.069653	0.016013	0.201373	0.16324	0.081167

Notes: Dependent variable: State growth. In square brackets, *p*-values based on heteroscedastic-consistent (White-robust) standard errors are reported. Asterisks indicate variables that are significant at the 10% (*), 5% (**) and 1% (***) levels. Total number of observations is 8. The model specification was based on the specification presented by Xie *et al*. (1999). Due to the very limited degrees of freedom not all potential explanatory variables were included in the model. Accordingly, redundant variable tests were performed on regressors with particularly low t-statistics: trade, human capital and mining revenue. Tests on these variables did not reject the null hypothesis of insignificance and were consequently deleted from the model. A Ramsey RESET test was performed to ensure the model was adequate and it failed to reject the null hypothesis of correct specification.

Table 11: State economic growth panel regressions for Australia, 1990-2005

Variable	(1)	(2)	(3)	(4)	(5)	(6)
State tax share: Local	-	-0.358238 [0.0000]***	-	-	-	-
State tax share: State	-	0.009287 [0.7094]	-	-	-	-
State tax share: Central total	-	-	-0.029698 [0.0794]*	-	-	-
State tax share: Local sub-central total	-	-	-	-0.066076 [0.0735]*	-	-
State expenditure share: Total	-	-	-	-	0.018441 [0.6744]	-
State investment share: Total	-	-	-	-	-	0.016469 [0.1261]
Population	-0.860053 [0.0000]***	-0.794134 [0.0000]***	-0.757747 [0.0000]***	-0.881628 [0.0000]***	-0.889132 [0.0000]***	-0.891675 [0.0000]***
Unemployment	-0.006958 [0.0501]*	-0.002316 [0.4968]	-0.006772 [0.0545]*	-0.006806 [0.0531]*	-0.007062 [0.0481]**	-0.008549 [0.0207]**
Investment	-0.09158 [0.0041]***	-0.077287 [0.0089]***	-0.088383 [0.0052]***	-0.090522 [0.0042]***	-0.093139 [0.0038]***	-0.10071 [0.0019]***
Consumption	0.81179 [0.0000]***	0.78429 [0.0000]***	0.779095 [0.0000]***	0.819143 [0.0000]***	0.816282 [0.0000]***	0.824448 [0.0000]***
Gov't consumption	-0.465275 [0.0000]***	-0.52709 [0.0000]***	-0.461735 [0.0000]***	-0.4761 [0.0000]***	-0.470245 [0.0000]***	-0.467111 [0.0000]***
Trade	-0.010852 [0.0854]*	-0.009254 [0.1147]	-0.010292 [0.1001]	-0.009104 [0.1494]	-0.010811 [0.0877]*	-0.009053 [0.1553]
Inflation: Capital cities	0.435706 [0.0004]***	0.375700 [0.0010]***	0.425055 [0.0005]***	0.430682 [0.0004]***	0.455389 [0.0006]***	0.436469 [0.0004]***
Adj-R^2	0.986988	0.988914	0.987213	0.987227	0.986899	0.987134
Prob (F-statistic)	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000

Notes: Dependent variable: State growth. In square brackets, *p*-values are reported. Asterisks indicate variables that are significant at the 10% (*), 5% (**) and 1% (***) levels. Total number of observations is 136. The model specification was based on the specification presented by Xie *et al*. (1999). See in text for further details of model specification.

Table 12: Summary of Results: Australia as a Whole

Measure of Fiscal Decentralisation	Inflation and Misery Index	Public Sector Size	Budget Balance	Investment	Short-Term Economic Growth	Medium-Term Economic Growth
Expenditure share: Total	not sig	+	-	not sig	not sig	-
Revenue share: Total	-	not sig	+	not sig	not sig	+
Tax share: Central total	-	not sig	not sig	not sig	not sig	not sig
Tax autonomy: Sub-central total	-	+	not sig	-	not sig	not sig
Tax autonomy: Central total	-	+	not sig	-	not sig	+
Revenue decentralisation	-	+	not sig	-	not sig	+
Average share		not sig	+		not sig	-
Transfer share		+			not sig	not sig
Vertical Imbalance				+	not sig	not sig
Tax share: Sub-Central total					-	not sig
Non-Tax share: Sub-Central total					not sig	+
Expenditure centralisation					not sig	not sig
Expenditure share: State					not sig	not sig
Expenditure share: Local					not sig	+
Revenue share: State					not sig	not sig
Revenue share: Local					not sig	not sig

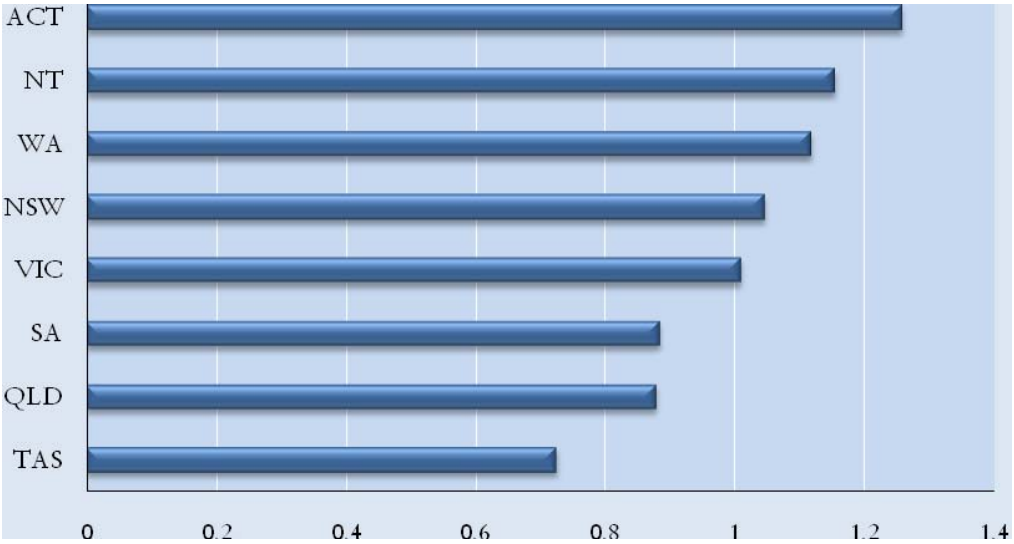
Notes: "not sig" indicates the variable is not statistically significant, "+" indicates a statistically significant positive relationship and "-" indicates a statistically significant negative relationship.

Table 13: Summary of Results: State Level

Measure of Fiscal Decentralisation	Income Distribution *Inequity*	Economic Growth *Cross-Section*	Economic Growth *Panel Data*
State tax share: Local		not sig	-
State tax share: State		not sig	not sig
State tax share: Central total		-	-
State tax share: Local sub-central total	not sig	not sig	-
State expenditure share: Total		not sig	not sig
State expenditure share: State	not sig		
State investment share: Total	+	not sig	not sig

Notes: "not sig" indicates the variable is not statistically significant, "+" indicates a statistically significant positive relationship and "-" indicates a statistically significant negative relationship.

Figure 1: State shares of fiscal resources, 2000-2005



Source: ABS Australian National Accounts: State Accounts Cat 5220.0, author's calculations.

Notes: States with a share greater than one have a relatively larger share of fiscal resources than those States with a share less than one. Furthermore, as the absolute difference from one increases the level of State income inequality in Australia also increases.

Appendix A

Measures of Fiscal Decentralisation

Aggregate Measure:

Standard Measures:

Expenditure share: Total: Total sub-central government (SCG) expenditure to total consolidated general government (GG) expenditure, net of transfers from sub-central governments to the central government.

Expenditure share: State: Total state government expenditure to total consolidated general government (GG) expenditure.

Expenditure share: Local: Total local government expenditure to total consolidated general government (GG) expenditure.

Revenue share: total: Total sub-central government (SCG) revenue to total consolidated general government (GG) Revenue, net of transfers from sub-central governments to the central government.

Revenue share: State: Total state government revenue to total consolidated general government (GG) Revenue.

Revenue share: Local: Total local government revenue to total consolidated general government (GG) revenue.

Tax share: Central total: Total sub-central government (SCG) taxation revenue to total general government (GG) taxation revenue.

Tax share: Sub-central total: Total sub-central government (SCG) taxation revenue to total sub-central government (SCG) revenue and transfers.

Non-Tax share: Sub-central total: Total sub-central government (SCG) non-taxation revenue to total sub-central government (SCG) revenue and transfers.

Average share: Average of Expenditure share: Total and Revenue share: Total.

Vertical imbalance: Total sub-central governments' indebtedness to the central government to total sub-central government expenditure.

Transfer share: Total sub-central governments' share of transfers to in sub-central government total revenue and transfers.

Source: World Development Indicators, IMF Government Finance Statistics, author's calculations.

Corrected Measures:

Revenue decentralisation: Total sub-central governments (SCG) taxation revenue derived from sources where sub-central governments have at least minimum control according to OECD (2005) classification to total general government taxation revenue. Minimum control is defined as sources where (a) SCG sets tax rate and tax base; (b) SCG sets tax rate only (c) SCG sets tax base.

Tax autonomy: Central total: Total sub-central governments (SCG) taxation revenue derived from sources where sub-central governments have at least minimum control according to OECD (2005) classification to total general government taxation revenue. Minimum control is defined as sources where (a) SCG sets tax rate and tax base; (b) SCG sets tax rate only (c) SCG sets tax base.

Tax autonomy: Sub-central total: Total sub-central governments (SCG) taxation revenue derived from sources where sub-central governments have at least minimum control according to OECD (2005) classification to total sub-central governments taxation revenue. Minimum control is defined as sources where (a) SCG sets tax rate and tax base; (b) SCG sets tax rate only (c) SCG sets tax base.

Expenditure centralisation: Total central government consumption expenditure to total consolidated general government (GG) consumption expenditure.

Source: World Development Indicators, IMF Government Finance Statistics, author's calculations.

State Measures:

State expenditure share: Total: Total sub-central government (SCG) expenditure to total consolidated general government (GG) expenditure.

State expenditure share: State: Total state government expenditure to total consolidated general government (GG) expenditure.

State tax share: Local: Total local government taxation revenue to total general government tax revenue.

State tax share: State: Total state government taxation revenue to total general government tax revenue.

State tax share: Central total: Total sub-central government (SCG) taxation revenue to total general government tax revenue.

State tax share: Local sub-central total: Total local taxation revenue to total sub-central government (SCG) revenue.

State investment share: Total sub-central governments' investment to general government investment.

Source: ABS Australian National Accounts: State Accounts Cat 5220.0, author's calculations.

Table A1: Data definitions of variables

Variable	Definition
Aggregate Variables	
Growth	GDP per capita growth. *Source:* World Development Indicators *Units*: annual %
Inflation	Consumer Price Index. *Source:* World Development Indicators. *Units*: annual % change
Misery index	Misery Index = Unemployment + Inflation. *Source:* World Development Indicators and Australian Bureau of Statistics Labour Force, Australia Cat 6202.0. *Units*: percent points
Gov't expenditure	Government Expenditure. Source: World Development Indicators. Units: % GDP
Δ Fiscal balance: Central gov't	Annual change in central government fiscal balance. *Source:* IMF Government Finance Statistics. *Units*: % GDP
Investment	Gross fixed capital formation. The acquisition, less disposal, of fixed assets. *Source:* World Development Indicators. *Units*: % GDP
GDP per capita	Gross Domestic Product per capita. *Source:* World Development Indicators. *Units*: $
GDP	Gross Domestic Product. *Source:* ABS Key National Indicators Cat no. 1345.0. *Units:* $ millions
Disposable income	Disposable Income per capita. *Source:* ABS Household Income and Income, Statistics Distribution Cat 6523.0. *Units*: $
Money	Money and quasi money (M2). *Source:* World Development Indicators. *Units*: % GDP
Tax revenue (WDI)	Taxation Revenue. *Source:* World Development Indicators. *Units*: % GDP
Tax revenue (IMF)	Taxation Revenue. *Source:* IMF Government Finance Statistics. *Units*: % GDP
Trade	Average of exports and imports. *Source:* World Development Indicators. *Units*: % GDP
Fiscal balance	Fiscal balance. *Source:* ABS Yearbook Australia Cat 1301.0. *Units*: % GDP
Δ Fiscal Balance: sub-Central gov't	Annual Change in Subcentral Government Fiscal Balance. *Source:* IMF Government Finance Statistics. *Units*: % GDP
Gov't consumption	Government Consumption Expenditure. *Source:* World Development Indicators. *Units*: % GDP
Transfers	Transfers Share. *Source:* IMF Government Finance Statistics. *Units*: % Sub-central government total revenue and grants
Consumption	Final Consumption Expenditure. *Source:* World Development Indicators. *Units*: % GDP
Savings	Gross Domestic Savings. *Source:* World Development Indicators. *Units*: % GDP
Population	Population. *Source:* ABS Australian Economic Indicators Cat 1350. *Units*: in millions
Debt	Level of public debt. *Source:* ABS Australian Economic Indicators Cat 1350.0 *Units*: % GDP
GDP deflator	GDP Deflator. *Source:* World Development Indicators. *Units*: Annual %
Population growth	Population growth. *Source:* ABS Australian Economic Indicators Cat. no.1350.0. *Units*: annual %
Human capital	Secondary School Enrolment. *Source:* UNESCO Institute for Statistics. *Units*: % Gross
Unemployment	Unemployment. *Source:* ABS Labour Force, Australia Cat. no. 6202.0. *Units*: % Labour Force
Openness	Total exports. *Source:* World Development Indicators. *Units*: % GDP
State Variables	
Inequity	Defined in-text. *Source: ABS A*ustralian National Accounts: State Accounts Cat 5220.0.
State growth	GSP per capita growth. *Source: ABS* Australian National Accounts: State Accounts Cat 5220.0. *Units*: annual %
GSP per capita	Initial gross state product per capita. *Source: ABS* Australian National Accounts: State Accounts Cat 5220.0. *Units*: $
Inflation	Consumer Price Index. *Source: ABS* CPI, Australia Cat 6401.0. *Units*: Annual %
Aboriginal Population	Dummy variable that takes a value of 1 for f*or States that* have a relatively large Aboriginal population (Queensland, Western Australia and the Northern Territory), 0 otherwise.
Unemployment	Unemployment. *Source:* ABS Labour Force, Australia Cat. no.6202.0. *Units*: % Labour Force
Population	Population. *Source:* ABS Australian Demographic Statistics Cat no. 3101.0. *Units*: in

	millions
Gov't consumption	Government Consumption Expenditure. *Source:* ABS Australian National Accounts: State Accounts, Cat. no. 5220.0. *Units*: % GSP
Consumption	Household Consumption Expenditure. *Source:* ABS Australian National Accounts: State Accounts, Cat. no. 5220.0. *Units*: % GSP
Investment	Gross Fixed Capital Formation. *Source:* ABS Australian National Accounts: State Accounts, Cat. no. 5220.0. *Units*: % GSP
Inflation: Capital cities	Consumer price index of capital cities (Index Numbers). *Source:* ABS Consumer Price Index, Australia Cat. no. 6401. *Units*: percent units
Trade	Trade. *Source:* ABS Australian National Accounts: State Accounts, Cat. no.5220.0. *Units*: % GSP
Human capital expenditure	Education Expenditure. *Source:* Commonwealth Grants Commission, Relative Fiscal Capacities of the States. *Units*: % GSP
Mining revenue	Mining Revenue. *Source:* Commonwealth Grants Commission, Relative Fiscal Capacities of the States. *Units*: % GSP

Notes: Δ denotes change. Variables expressed as a percentage of GDP or GSP were transformed into natural logarithms, as were those expressed in levels.

Table A2: Summary Statistics

Variable	Mean	Standard Deviation
Aggregate Variables		
Growth	1.803	1.769
Inflation	6.386	4.171
Misery index	13.314	3.662
Gov't expenditure	19.146	1.306
Δ Fiscal balance: Central gov't	-0.064	0.974
Investment	25.291	1.917
GDP per capita	21,692.97	12,692.45
GDP	21,692.97	12,692.45
Disposable income	20,929.67	12,107.86
Money	51.825	13.061
Tax revenue (WDI)	17.735	4.551
Tax revenue (IMF)	28.928	5.783
Trade	32.699	6.503
Fiscal balance	-0.699	1.588
Δ Fiscal Balance: sub-Central gov't	-0.068	0.524
Gov't consumption	18.096	1.052
Transfers	47.327	4.463
Consumption	18.096	1.052
Savings	25.925	4.867
Population	16,901,451	2,181,366
Debt	0.400	0.130
GDP deflator	6.271	4.440
Population growth	1.340	0.300
Human capital	107.624	33.377
Unemployment	6.928	2.105
Openness		

Appendix B

Bayesian Model Averaging in the Normal Linear Regression Model

The normal linear regression model is written as

$$\mathbf{y} = \alpha \iota_N + \mathbf{X}_r \boldsymbol{\beta}_r + \boldsymbol{\varepsilon} \tag{A.1}$$

where N is the number of time periods and K is the number of regressors: α is an intercept, ι_N is a $N \times 1$ vector of ones, $\mathbf{X}$ is a $N \times K$ matrix stacking all the potential explanatory variables, $\mathbf{X}_r$ is a $N \times k_r$ matrix containing some (or all) columns of $\mathbf{X}$ and the N-vector of errors $\boldsymbol{\varepsilon}$ is assumed to be $N(0_N, h^{-1} I_T)$. The data is for i = 1, ..., N individuals and the observations are stacked in an N-vector $\mathbf{y} = (y_1, ..., y_T)'$.

There are r = 1, ..., R models, denoted by $\mathbf{M}_r$ and since there are 2^K possible subsets of $\mathbf{X}$, $R = 2^K$. Each model depends on a vector of parameters $\boldsymbol{\theta}_r$ and is represented by a prior $p(\boldsymbol{\theta}_r \mid \mathbf{M}_r)$, likelihood $p(\mathbf{y} \mid \boldsymbol{\theta}_r, \mathbf{M}_r)$ and posterior $p(\boldsymbol{\theta}_r \mid \mathbf{y}, \mathbf{M}_r)$. From here the posterior model probabilities $p(\mathbf{M}_r \mid \mathbf{y})$ can be obtained.

The Normal Linear Regression likelihood function for each model can be written in terms of Ordinary Least Squares (OLS) quantities as

$$p(\mathbf{y} \mid \boldsymbol{\beta}, h) = \frac{1}{(2\pi)^{\frac{N}{2}}} \left\{ h^{\frac{1}{2}} \exp\left[-\frac{h}{2} (\boldsymbol{\beta} - \hat{\boldsymbol{\beta}})' \mathbf{X}' \mathbf{X} (\boldsymbol{\beta} - \hat{\boldsymbol{\beta}}) \right] \right\} \left\{ h^{\frac{v}{2}} \exp\left[-\frac{hv}{2s^{-2}} \right] \right\} \tag{A.2}$$

where

$$v = N - k \tag{A.3}$$

$$\hat{\boldsymbol{\beta}} = (\mathbf{X}'\mathbf{X})^{-1} \mathbf{X}' \mathbf{y} \tag{A.4}$$

$$s^2 = \frac{(\mathbf{y} - \mathbf{X}\hat{\boldsymbol{\beta}})'(\mathbf{y} - \mathbf{X}\hat{\boldsymbol{\beta}})}{v} \tag{A.5}$$

The choice of prior under model uncertainty can have a significant influence on posterior model probabilities.[26] To control this problem, Fernandez *et al*. (2001a) propose a benchmark prior distribution that they show to have very little impact on posterior results. This involves

[26] See George (1999) and Kass and Raftery (1995) for more detail.

using a Normal-Gamma natural conjugate prior with the following hyperparameters: an improper non-informative prior for parameters common to all models, specifically and *h*, and a g-prior structure for r. The standard non-informative priors for *h* and are as follows:

$$p(h) \propto \frac{1}{h} \tag{A.6}$$

$$p(\alpha) \propto 1 \tag{A.7}$$

Assuming a common prior for *h* is customary in the Bayesian literature since *h* keeps a constant meaning (residual standard deviation of $\mathbf{y}$ given Z) across models when conditioning across the full set of regressors.[27] Also, to ensure the non-informative prior for the intercept has the same interpretation for each model, namely the mean of $\mathbf{y}$, Fernandez *et al*. (2001b) suggest subtracting the means off all explanatory variables.

The Normal-Gamma natural conjugate prior was used as analytical results exist for posterior moments and posterior model probabilities. This implies that the prior for r can be written as

$$\boldsymbol{\beta}_r \mid h \sim N(\underline{\boldsymbol{\beta}}_r, h^{-1}\underline{\mathbf{V}}_r) \tag{A.8}$$

where the priors of explanatory variables are hypothesised to have no effect on the dependent variable. Finally, a g-prior is used as the benchmark prior for $\underline{\mathbf{V}}_r$ as it only necessitates finding the scalar hyperparameter g_r.[28] Thus, the conditional probability of the explanatory variables is presented as:

$$\boldsymbol{\beta}_r \mid h \sim N\left(\mathbf{0}_{k_r}, h^{-1}\left[g_r \mathbf{X}_r' \mathbf{X}_r\right]^{-1}\right) \tag{A.9}$$

The posterior, derived by multiplying the prior by the likelihood function, follows a multivariate t distribution with mean and covariance matrix:

$$E(\boldsymbol{\beta}_r \mid \mathbf{y}, \mathbf{M}_r) \equiv \bar{\boldsymbol{\beta}}_r = \overline{\mathbf{V}}_r \mathbf{X}_r' \mathbf{y} \tag{A.10}$$

$$\text{var}(\boldsymbol{\beta}_r \mid \mathbf{y}, \mathbf{M}_r) = \frac{\overline{s}_r^2}{v-2} \overline{\mathbf{V}}_r \tag{A.11}$$

[27] See for example Raftery *et al.* (1997)).
[28] For a more detailed explanation of the g-prior and its properties see Zellner (1986).

where $\bar{v} = N$ degrees of freedom and

$$\overline{\mathbf{V}}_r = \left[(1 + g_r) \mathbf{X}_r' \mathbf{X}_r \right]^{-1} \tag{A.12}$$

$$\bar{s}_r^{-2} = \frac{\frac{1}{g_r + 1} \mathbf{y}' \mathbf{P}_{\mathbf{X}_r} \mathbf{y} + \frac{g_r}{g_r + 1} (\mathbf{y} - \bar{\mathbf{y}}\iota_N)'(\mathbf{y} - \bar{\mathbf{y}}\iota_N)}{\bar{v}} \tag{A.13}$$

with

$$\mathbf{P}_{\mathbf{X}_r} = \mathbf{I}_N - \mathbf{X}_r (\mathbf{X}_r' \mathbf{X}_r)^{-1} \mathbf{X}_r' \tag{A.14}$$

The marginal likelihood for model *r*, using the g-prior, is:

$$p(\mathbf{y} \mid \mathbf{M}_r) \propto \left(\frac{g_r}{g_r + 1} \right)^{\frac{k_r}{2}} \left[\frac{1}{g_r + 1} \mathbf{y}' \mathbf{P}_{\mathbf{X}_r} \mathbf{y} + \frac{g_r}{g_r + 1} (\mathbf{y} - \bar{\mathbf{y}}\iota_T)'(\mathbf{y} - \bar{\mathbf{y}}\iota_T) \right]^{-\frac{N-1}{2}} \tag{A.15}$$

To calculate the posterior model probabilities the following formula is used:

$$p(\mathbf{M}_r \mid \mathbf{y}) = cp(\mathbf{y} \mid \mathbf{M}_r) p(\mathbf{M}_r) \tag{A.16}$$

where *c* is a constant. Prior model probabilities are assumed to be equal. This allows for $p(\mathbf{M}_r)$ to be dropped and only the marginal likelihood function to be used in Bayesian computation. Thus:

$$p(\mathbf{M}_r \mid \mathbf{y}) = \frac{p(\mathbf{y} \mid \mathbf{M}_r)}{\sum_{j=1}^{R} p(\mathbf{y} \mid \mathbf{M}_j)} \tag{A.17}$$

Finally, Fernandez *et al*. (2001b) suggest that the optimal values for the g-prior should be chosen according to the following:

$$\begin{aligned} g_r &= \frac{1}{K^2} \quad \text{if} \quad N \leq K^2 \quad \text{or} \\ g_r &= \frac{1}{N} \quad \text{if} \quad N > K^2 \end{aligned} \tag{A.18}$$

In our context, we employ a BMA with a uniform prior on model probabilities: $p(M_r) = p_r = 2^{-k}$. Furthermore, since $N < K^2$, equation the g-prior is specified as $g_r = 1/K^2$.

Analytical computations of the equations presented above are possible. However, due to

the large number of potential regressors involved this is not feasible as there are a very large number of terms involved in the sums. Thus, the Markov Chain Monte Carlo Model Composition (MC^3) methodology of Madigan and York (1995) is used. This algorithm takes draws from the parameter space in such a way that it replicates draws from the posterior by taking most draws from parameter spaces where posterior probability is high.

The MC^3 algorithm adopted is based on the Metropolis-Hastings algorithm where candidate models are drawn from a particular distribution over the model space and then accepted with a specified probability. If the candidate model fails to be accepted, the chain of models remains at the current model ($\mathbf{M}^{(S)} = \mathbf{M}^{(S-1)}$, where $\mathbf{M}^{(S)}$ is the model drawn at replication *S*). Then the next candidate model is drawn from the set of models including the current model, all models which delete one explanatory variable from the current model and all models which add one explanatory variable to the current model. The probability of acceptance is calculated as:

$$\alpha(\mathbf{M}^{(s-1)}, \mathbf{M}^{*}) = \min\left[\frac{p(\mathbf{y}\,|\,\mathbf{M}^{*})\,p(\mathbf{M}^{*})}{p(\mathbf{y}\,|\,\mathbf{M}^{(s-1)})\,p(\mathbf{M}^{(s-1)})}, 1\right] \tag{A.19}$$

The models generated by the MC^3 algorithm are then averaged over the number of draws to calculate the posterior results. To analyse the data, the Bayesian framework above is employed with a Uniform prior on model probabilities: $p(\mathbf{M}_r) = p_r = 2^{-k}$. Furthermore, since $N < K^2$, equation (A.18) specifies the g-prior as $g_r = 1/K^2$. The results reported are from 1 million recorded draws after 500 000 burn-in replications to account for the starting value of the chain. Results for 500 000 replications with 100 000 burn-in draws produced similar conclusions. This indicates that increasing the draws from 1 million will not significantly alter the results. Thus, 1 million draws is sufficient for this analysis.