C Data and modelling

The purpose of this appendix is to provide a description of the data and statistical analysis used in this study. A description of the data and their sources is given in section C.1. A description of the methods used to pool the various data sets and to check for the quality of the data is given in section C.2. The method for estimating the fiscal capacity (income) of each local government is given in section C.3. The approach used to estimate the factors that influence revenue raised by local governments and to determine the scope for local governments to raise additional revenue is given in section C.4. The results of the statistical analysis of factors affecting revenue raised by local governments is given in section C.5. The results of the statistical analysis of the relative potential (or scope) for local governments to raise additional revenue and the results of the analyses simulating the effects of increasing local government revenue are given in section C.6.

C.1 Data sources

The Commission has drawn on a variety of sources for the data used in this study. These are outlined below.

The Australian Capital Territory was not included in the analysis as the ACT Government undertakes all local government functions. It is not possible to separate the data for its local government from its Territory functions.

State grants commissions

In each State and the Northern Territory, local governments are required to keep records of their finances, the values and numbers of (rateable) properties in their incorporated area, the services they provide, and a variety of performance measures for annual reporting purposes and as part of their reporting obligations to their State grants commission (SGC). The Australian Bureau of Statistics (ABS) and the SGCs jointly develop the data collection forms to improve the national consistency of the data.

The SGCs made available to the Commission detailed data about revenue, expenditure, property values, some services provided by local governments (such as roads, water and sewerage) and various performance information on local governments in their jurisdiction. Some of the data, such as those for New South Wales were publicly available (DLG 2007b). Data were generally available from 1994-95, but structural breaks in the series (such as that arising from the introduction of accrual accounting) meant that the earliest useable data were from 2000-01.

Australian Bureau of Statistics

The ABS provided the Commission with a variety of published and unpublished data. These include the:

- Australian national accounts data (ABS Cat. 5206.0). The national accounts data includes estimates of gross operating surplus (for incorporated businesses), gross mixed income (for unincorporated businesses) by industry for each State for 2000-01 to 2004-05.
- Government Finance Statistics (GFS) data. The GFS data includes detailed revenue, expenditure and asset data at the local government level for 1999-2000 to 2005-06.
- Household Expenditure Survey (HES) (ABS Cat. no. 6503.0). The HES data are confidentialised unit record files that among other things provide data describing the payment by households of local government rates and charges. The data used by the Commission is for 2003-04.
- National Regional Profile (NRP) (ABS Cat. no. 1379.0.55.001). The NRP data are local government level data that include, among other things, demographic characteristics of each local government (such as the population by age group, number of persons born overseas, share of people of Indigenous background and the number of persons receiving income support). These data are available for the period 2000-01 to 2003-04.
- Working Population Profile of Censuses of Population and Housing of 2001 and 2006. Data from the Census used in this study includes detailed data that provide the number of persons according to their principal location of work.

Australian Taxation Office

The Commissioned sourced detailed data from the ATO's database on aggregate taxable income (ATI). ATI is an estimate from the personal income of individual taxpayers based on personal income tax returns. The series used in this study covers

the years 2000-01 to 2004-05.

The ATI is only available at the statistical local area and had to be concorded (aggregated) to the ABS's classification of local government areas.

Department of Infrastructure, Transport and Regional Development

The Australian Government's Department of Infrastructure, Transport and Regional Development (formerly DOTARS) regularly collects and publishes data regarding key descriptive statistics of local governments, such as the length of roads, resident population, geographic area, Commonwealth financial assistance and road grants paid to local governments. Key statistics are summarised in DOTARS (2007).

These data items were collected and used to verify the data obtained by the Commission from other sources.

C.2 Assembling the data set

Assembling the data set for the analysis required two distinct tasks:

- pooling together various data into a consistent panel of data
- checking the quality of the data.

Data pooling

The individual data sets collected by the Commission covered:

- local government revenue and expenditure
- local government property values and numbers of assessments (rateable properties)
- local government services (such as providing and maintaining kilometres of local roads)
- demographic characteristics (such as population and age profile)
- measures of personal and business income.

During the period for which data are available, there have been a number of mergers and boundary changes of local governments. To ensure that any analytical results reflect the underlying factors of local governments and not their changing boundaries, the Commission concorded the names and boundaries of local governments between 2000-01 and 2004-05 to those existing in 2005-06. That is,

the Commission established a process to ensure that the local government boundaries that existed in 2005-06 also 'hypothetically' existed in earlier years.

The various data sets are reported at various levels of aggregation. Personal income data from the ATO, for example, are available at the post code level, whereas the SGC data are available at the local government level. The Commission concorded all post code level data to coincide with the local government areas that existed in 2005-06.

Descriptive statistics for selected variables for the years between 2000-01 and 2005-06 are summarised in table C.1.

Quality control

There are differences between jurisdictions in the definitions of revenue, expenditure and number of assessments. These reflect differences in legislative frameworks that apply across jurisdictions, as well as the different functions undertaken by local governments. Several agencies have sought to ensure greater consistency in the data reported, as outlined below.

- The SGCs, as part of their annual data collection, seek to improve the consistency of the data within their States.
- The ABS seeks to address differences between jurisdictions that might arise from legislative differences, as well as minimising errors that arise through the process of filing data returns. The ABS also seeks to reconcile its local government statistics with the Australian and State government data of its Government Finance Statistics collection.

Nonetheless, there are numerous inconsistencies in the data, particularly for the smallest local governments. Some local government areas were listed as having no residential populations. The smallest population for one local government area, for example, was almost zero, after the concordance process. This led to a number of errors arising in the construction of per person estimates. The aggregate income for one rural council, for example, was reported to be over $9.7 million per person. On closer inspection, this estimate is an error arising from an underestimation of the local government area's population.

Table C.1 **Summary of selected statistics of initial pooled data**
2000-01 to 2005-06[a]

Variables	*No of observations*	*Units*	*Mean*	*Standard deviation*	*Minimum*	*Maximum*
Own-source revenue (broad)[b, c]	3 581	$ per person	1 532	2 049	3	32 229
Own-source revenue (narrow)[b, d]	3 581	$ per person	1 438	1 983	3	29 134
Aggregate income[b]	3138	$ per person	86 415	2 055 166	27	9 718 157
Business income[b]	3138	$ per person	35 129	614 701	15	5 884 108
Personal income[b]	3138	$ per person	51 286	1 568 116	6	3 834 048
Residential population	3 868	No. of people	30 446	59 091	0	992 176
Share of population						
Indigenous	625[e]	%	8.6	17.0	0	92.9
Born overseas	619[e]	%	13.0	9.7	0	52.0
Aged ≤ 4 years	3 206[f]	%	7.0	2.6	1.1	62.7
Aged 5–14 years	3 161[f]	%	14.4	3.0	0	46.6
Aged ≥ 65 years	3 205[f]	%	12.4	5.0	0	43.2
Unemployment rate	1 926[g]	%	6.0	3.8	0	34.5
Average population growth between 2001 and 2006	666[h]	%	0.63	2.07	–10.2	10.0
Road per person	3 799	Km per 1000 people	620	7 746	<1	340 096
Properties per person	3 601	Properties per person	0.57	0.62	0.005	17.8
Population density	3 810	People per km^2	359	901	<1	7 132
Area	3 972	1000s of km^2	8 225	24 494	0.36	378 533

[a] Not all variables were available for all years. For a definition of these variables, see tables C.6 and C.7. [b] The base year is 2005-06, adjusted using the ABS non-farm GDP deflator. [c] Defined as total revenue less grants. [d] Defined as total revenue less grants, interest, dividends and capital contributions. [e] The data for these variables were only available for 2001. These data were applied to each of the six years. [f] Data for these variables are only available for the period 2000-01 to 2004-05. [g] Data for this variable were only available for the period 2001-02 to 2003-04. [h] Data were only available for the average of the period. These data were applied to each of the six years.

Such types of errors were detected in estimates of populations, incomes, local government revenue and expenditure, road lengths and the numbers of rateable properties.

To address the problem that such variables might distort the analyses in the study, a number of variables were deleted from the dataset where the:

- total revenue variable was reported to be less than $1000 per year
- ratio of own-source revenue divided by fiscal capacity was greater than or equal to one, or less than 0.01[1]
- ratio of own-source revenue divided by total expenditure was greater than three
- per person financial assistance grants was less than or equal to $7
- residential population was less than or equal to 12 people
- per person own-source revenue was less than $7
- number of rateable properties per person was less than or equal to 0.006
- number of kilometres of roads per person was less than equal to 0.16.

In addition, not all variables were available for all councils in all years. Estimates of personal income (ATI data), for example, were not available for 2005-06. The removal of observations for 2005-06 and observations with unacceptable values reduced the size of the dataset from about 3900 to 2784 observations. The final dataset covers 602 local governments although not all local governments are represented in every year. On average, there are about 557 local governments every year (table C.2).

About 71 of the 109 observations (or 65 per cent) removed from the dataset were local governments in Queensland and the Northern Territory. About 85 of the 109 observations (or 77 per cent) were urban fringe, urban regional and remote councils. For this reason, care must be taken when interpreting the analytical results, as the average results for these classes of councils might not always be representative of the sector as a whole.

Finally, all financial data were available in current (nominal) prices. Using the Australian non-farm GDP deflator, these were converted into real terms with 2005-06 as the base year.

[1] Own-source revenue is defined as total revenue less grants and subsidies.

Table C.2 **The observations and local governments in the final data set**
2000-01 to 2004-05, number

	Initial data set		*Final data set*		*Change in the average number of councils per year*
	Total number of observations[a]	*Average number of councils per year*	*Total number of observations*[b]	*Average number of councils per year*	
By State					
New South Wales	760	152	717	143	–9
Victoria	395	79	313	63	–16
Queensland	790	158	579	116	–42
South Australia	350	70	292	59	–11
Western Australia	710	142	701	140	–2
Tasmania	145	29	145	29	0
Northern Territory	180	36	37	7	–29
By class of local government					
Capital city	35	7	33	7	–
Urban developed	435	87	395	79	–8
Urban fringe	330	66	218	43	–23
Urban regional	635	127	506	101	–26
Rural	1 495	299	1 409	282	–17
Remote	400	80	223	45	–35
Total	**3 330**	**666**	**2 784**	**557**	**–109**

[a] Based on the number of observations of variables covered in table C.1. [b] For the period between 2000-01 and 2004-05.

Source: Productivity Commission estimates.

C.3 Estimating the income of local government areas

An important variable used in this study is the aggregate income of each local government's community. This variable is used in two distinct (but related) ways. First, it is used an indicator of the local government's *fiscal capacity* (chapter 4). It is also used in the statistical analyses of the relative potential of local governments to raise additional revenue.

Fiscal capacity

The preferred indicator of fiscal capacity is the aggregate disposable income of the local community (chapter 4). The indicator of a community's disposable income should be broadly defined. It is broader than normal definitions of personal income in that it ideally includes all income that is available to the community. It includes

personal income, corporate earnings, unrealised capital gains and imputed returns on assets (including home ownership).

In practice, however, it is difficult to derive such an indicator at the local government level. In the absence of readily available measures, other indicators are required. For the purpose of this study, an indicator of income is constructed using information about the aggregate taxable personal income of residents and the estimates of the gross operating surplus (GOS) (of incorporated businesses) in a local government area.

The indicator of fiscal capacity for each local government area is estimated to be equal to the disposable (that is, after income tax) personal income and the after-tax GOS of businesses in the area.

Personal income

Personal income is estimated using two components, discussed below. The first component of personal income is based on the ATI series published by the ATO. According to the BTRE (2005, p.2), real ATI:

> The reported individual taxable income is an undifferentiated aggregate of all the income accruing to taxpayers from any source. It therefore includes income derived from salary and wages, net [unincorporated] business income, distributions from partnerships or trusts, interest and dividends, eligible termination payments, some government pensions and allowances, superannuation payments and reportable fringe benefit amounts less any allowable deductions … [it] does not include the income of individuals who earned below the tax-free threshold, either positive or negative. Also, [undistributed] taxable income for companies, [and] funds … is *not* included.

An estimate of the post-tax ATI can be obtained from the BTRE (2005) which reports both taxable personal income and tax paid, though data can also be obtained from the ATO.

The second component of personal income is return from the ownership of dwellings as reported in the Australian national accounts. The ABS computes the return from the ownership of dwellings for both rental properties and owner-occupied housing. In the former case, it is equal to the gross rent paid on properties less operating expenses (defined to include local government rates, building insurance, repairs and maintenance, consumption of financial services and real estate agent commissions charged for the management of rental properties) (ABS Cat. no. 5216.0). No deduction is made for depreciation of fixed assets or cost of interest.

Data on returns from ownership of dwellings are available for each State. The total amount was allocated to each local government on the basis of its share of the State's total ATI. Actual and imputed amounts were deducted for the income tax paid on ownership of dwellings income in each local government area. The amount deducted was equal in proportion to the average income tax paid on ATI in each local government.

The use of ATI as an indicator of personal income has several limitations. First, it omits welfare payments, except for cases where such payments are potentially taxable and are reported to the Australian Taxation Office in personal tax returns. Second, it excludes the incomes of people earning below the tax-free threshold, who are not required to lodge tax returns. Third, it omits imputed income of households (such as imputed income of owner-occupied housing) and unrealised capital gains. A final limitation is that ATI is only a measure of taxable income of individuals. It does not include the undistributed incomes of incorporated businesses. ATI by itself, therefore, is likely to underestimate the aggregate income of a local government area. This might be substantial in low income communities, such as those with a high level of welfare dependence, and in communities with high levels of undistributed incomes.

The addition of the return from ownership of dwellings to ATI to estimate personal incomes has a limitation. Both measures include estimates of income derived from rental properties. From ABS Census data, it is estimated that numbers of rental properties account for about 25 per cent of the dwellings market. This, in effect, inflates personal income by about 4 per cent, on average.

Business income

Australian Taxation Office statistics on the taxation of businesses do not provide reliable estimates of the geographic distribution of the income of corporations that operate in more than one locality. This is because financial and taxation accounts are only reported for the legal entity as a whole according to the location of its head office and not for each site or location in which it operates.

Consequently, the Commission has sought to construct some other indicator of business income. Ideally, GOS would provide a useful measure, but ABS statistics only provide a measure that is equal to GOS plus gross mixed income (GMI), after deducting corporate income tax. The ABS national accounts data series provides estimates of GOS and GMI for each industry in each State (ABS 2007d). GOS is defined as income of incorporated businesses less expenses, but not depreciation and interest. GMI is analogously defined for unincorporated businesses (ABS 2000).

The second step was to deduct corporate income tax. The ABS estimates of GOS and GMI are gross income (before corporate income-tax) measures. The ATO provides data on the average corporate income tax paid for each industry. Imputed income tax was deducted from the ABS estimates of GOS and GMI.

The third step was to remove the estimate of GMI from the combined estimates of GOS and GMI. This is important as not doing so would lead to double-counting, as income from unincorporated businesses is included in ATI. Unfortunately, GOS and GMI estimates are not available separately for each industry in each State. However, separate GOS and GMI estimates are available for each State (ABS Cat. no. 5220.0). The share of GOS to GOS plus GMI was calculated for each State and applied to each State's industries. The limit of this approach is that it assumes that the share of GOS to GOS plus GMI is the same for all industries.

The fourth step was to allocate the state-wide industry estimates of GOS to each local government area. The ABS Census returns for 2001 and 2006 provide employment data on place of work, by industry, in each local government area. Using these data it is possible to allocate GOS for each industry to each local government areas according to the place of work of management and employees. The underlying assumption here is that GOS estimates the same across employees and local government areas.

Merits of this approach

The attraction of using GOS to estimate business income in each local government area is that it has the potential to be a relatively accurate measure of income. This is because fewer assumptions are required to convert the state-wide industry estimates into estimates for local governments. Principally, it assumes that differences in the business incomes of local government areas are fully explained by the composition of their business sector.

In contrast, estimating business income from the imputed return from property, an alternative approach considered by the Commission, requires more assumptions for business income estimates to be accurate. This method assumes that:

- the reported unimproved capital value of land reflects market estimates of the profitability of economic activity
- those values are reported accurately by State valuer generals and States grants commissions
- there is a stable relationship between unimproved capital values and capital improved values
- there is a constant rate of return to landholders from that property.

This is not to say that estimates of GOS do not have limitations, particularly when added to the above estimates of personal income. One is the double-counting of dividends included in both personal income and estimates of GOS — though dividends are estimated to be only about 3 per cent of personal income. ATI includes estimates of net income from unincorporated businesses (such as sole traders and partnerships).

Estimates of fiscal capacity

The distribution of communities' personal and business income per person by income, ranked by the total of each community, is shown in table C.3. The distribution of income by class of local government is shown in table C.4.

Table C.3 **Distribution of the fiscal capacity of local governments**[a, b]

2000-01 to 2004-05, dollars per person

Local government ranked in order of total income	*Personal income*	*Business income*	*Total income*[c]
Decile and mean			
Lowest	2 096	2 538	4 634
10 per cent	9 218	5 197	14 415
20 per cent	8 980	7 259	16 239
30 per cent	8 385	9 454	17 839
40 per cent	8 878	10 284	19 162
50 per cent (median)	16 058	4 723	20 781
60 per cent	13 298	9 227	22 524
70 per cent	14 463	10 567	25 030
80 per cent	10 184	19 298	29 483
90 per cent	7 094	31 988	39 083
Highest[d]	22 001	438 162	460 163
Mean[e]	12 837	15 213	28 050

[a] Based on a sample of 2784 observations, representing 602 councils over five years. Data were not available for all councils for all years. [b] The base year is 2005-06, adjusted using the ABS non-farm GDP deflator. [c] Totals might not add due to rounding. [d] The maximum per person business income is in Perth, reflecting both large business income and relatively small residential population. [e] The average is calculated across councils and does not reflect the average across the Australian population.

Source: Productivity Commission estimates.

Table C.4 **Distribution of the fiscal capacity, by class of local government**
2000-01 to 2004-05, dollars per person[a, b, c]

	Personal income	*Business income*	*Total income*
Capital city	18 488	98 307	116 795
Urban developed	17 715	7 069	24 783
Urban fringe	13 013	5 072	18 085
Urban regional	12 359	10 163	22 522
Rural	11 774	12 730	24 504
Remote	11 009	54 411	65 420
All councils	12 837	15 213	28 050

a The estimates of total, personal and business income are an average for that class. They are calculated across councils and do not reflect the average across the Australian population. **b** Based on a sample of 2784 observations representing 602 councils over five years. Data were not available for all councils for all years. **c** The base year is 2005-06, adjusted using the ABS non-farm GDP deflator.

Source: Productivity Commission estimates.

C.4 Approach to estimating the factors affecting revenue and the relative potential to increase revenue

The terms of reference ask the Commission to examine the factors that might influence revenue raised by local governments and revenue-raising capacity. Estimating the revenue-raising capacity of local governments raises a number of economic (theoretical) issues as well as some statistical issues.

Overall approach

As noted, an indicator of the ability of local governments to raise revenue is their fiscal capacity. However on average, the ratio of revenue raised to assessed fiscal capacity for local governments in Australia is low — the weighted mean is less than 5 per cent (chapter 5). There are, though, substantial variations in the ratio across governments with similar fiscal capacities. This indicates that a range of factors, in addition to fiscal capacity, are influencing the willingness of communities to pay for local government services, and hence the capacity of their local governments to raise revenue.

One way to identify which factors determine the revenue raised by local governments is to estimate the demands (reflecting preferences, among other things) of each local community for local government services. Two examples include Bergstrom and Goodman (1973) and Borcherding and Deacon (1972). Since the demand is analogous to expenditure, estimating the demand for local government

services would assist in identifying the factors that influence the ability of local governments to raise revenue from their communities.

As noted in chapter 4, it is difficult to estimate the demands for local public goods because many local governments provide a range of services, the prices of which are not observable. It is not sufficient to simply use the council tax rate as a determining factor, since council taxes comprise less than one-half of local government own-source revenue.

The Commission's approach assumes that the revenue of a local government is reflected by a number of attributes of its community and services. These might include the community's income and population, as well as the length of roads and numbers of properties served by the local government. In addition, sociodemographic factors might assist in identifying the preferences of the community, and thereby, better describing the local government's revenue-raising behaviour. A number of participants to this study observed that persons aged 65 and over were more sensitive to increases in rates, and this had an influence on how much revenue a local government was able to raise from its community, for example.

Statistical issues

The terms of reference ask the Commission to determine the revenue-raising capacity of local governments. The approach undertaken here is to identify the scope for local governments to raise additional revenue. However, estimating the scope of local governments to raise additional revenue raises a number of practical challenges. As noted in chapters 2 and 3, there is considerable variation between local governments. Few local governments share attributes or qualities that are similar, and many councils are markedly different. In other words, there is considerable *heterogeneity* among local governments and this is reflected in the data.

Data are available at the council level for key variables — such as the level of own-source revenue, the income of the community, the length of roads, the number of rateable properties, size of the incorporated area and so on. The ABS also collects various data describing the sociodemographic characteristics of communities.

But these data items are not extensive. Other data items are collected, but these are not generally comparable across jurisdictions. Each of the State grants commissions have different data requirements of local governments. Data items that are reported for some jurisdictions are not collected in others. The NSW Local Government

Grants Commission, for example, collects data on the number of library circulations, an item that is not routinely publicly reported in other jurisdictions. The ABS Census provides some data at the local government level, but this is only available for every Census period. Other ABS collections are usually based on surveys and are not available at the local government level.

Quite apart from the heterogeneity of local governments, another challenge associated with the data is its quality. As noted earlier, there are noticeable measurement errors in the data. It is widely acknowledged that the quality of data from local government sources is, on the whole, not very reliable. Though some measurement errors are due to smaller councils not having sufficient resources to commit to maintaining administrative data collections, others are due to the inadequate collection and validation of data by the grants commissions in some of the States.

There is anecdotal evidence that some governments have scope to raise *additional* revenue. This has been identified in a number of studies (for example, PwC 2006; Access Economics 2005, 2006a, 2006b and 2007). They have identified that some local governments can raise more revenue (as well as reduce costs) by, among other things, improving their communication strategies with their communities and adopting better rating strategies (chapter 8).

The Commission examined the suitability of a number of techniques (models) that might provide an assessment of the scope of local governments to raise additional revenue, while addressing the challenges of heterogeneity among councils and paucity of data, as well as problems associated with the quality of data.

There are a number of techniques that have been used to benchmark the performance of businesses and even local governments. Two techniques include data envelopment analysis (DEA) and corrected ordinary least squares (Coelli, Battese and Rao 1998; Kumbhakar and Lovell 2000).

Data envelopment analysis

DEA is the more widely used technique. In this technique, the revenue raised by decision-making units (in this case, local governments) is compared to a group of 'peer' local governments. 'Best-practice' local governments are given a rank of 1.00 (or 100) and the ranks of all other local governments are assessed in terms of how much revenue they can generate for a given set of inputs — relative to how much the best-practice local governments can raise for the same inputs.

A limitation with DEA, however, is there are no means by which measurement error can be accounted for. It is quite possible that the observed best-practice local governments are those that exhibit the most measurement error rather than some underlying best practice. In other words, DEA is sensitive to 'outliers'.

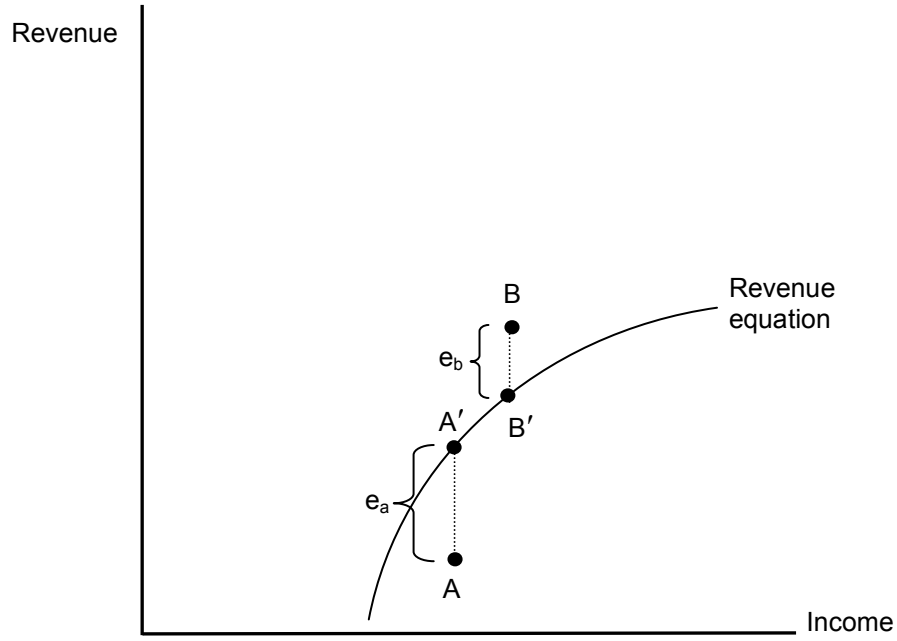
Ordinary least squares

There is a stream of literature that asks a similar question to that being asked in this study. The international comparative taxation literature is concerned with identifying the factors that determine national government revenue (tax) raising, and measuring the scope for national governments to raise additional revenue (see Bird, Martinez-Vazquez and Torgler 2004; Davoodi and Grigorian 2007; Leuthold 1991; Piancastelli 2001; and Teera and Hudson 2004).

This stream of literature uses a number of statistical methods, although ordinary least squares is most commonly used, to identify both the factors determining revenue raised by local governments and the scope to raise more revenue. The general approach used in this literature when applied to local governments is illustrated in figure C.1. Consider two councils A and B. Assume that it is possible through multivariate regression analysis to establish a relationship between the revenue of a local government and its fiscal capacity (income). This is represented with the revenue equation which is estimated for councils A and B (figure C.1).

Once a revenue equation is estimated it then becomes possible to measure the potential for each government to increase its revenue by reference to the estimated function. Local government A raises less revenue than local government B even though their communities have similar incomes. The difference between how much local government A raises relative to the predicted level (A') represents how much less than the 'average' it is raising given its fiscal capacity. Similarly the difference between how much revenue local government B raises relative to the predicted level (B') represents how much more than the 'average' it is raising given its fiscal capacity.

Figure C.1 **Scope for raising additional revenue**



Teera and Hudson (2004) provide an example of this approach. Their statistical technique is based on a fixed effects model, though they also use the similar random effects model. Applying their technique to our example of local government, figure C.1 can be represented mathematically as:

$$R_{ij} = f\left(Y_{ij}\right) + e_{ij} \tag{1}$$

The dependent variable R_{ij} is the own-source revenue of local government i in year j and Y_{ij} is the fiscal capacity of local government i in year j. The term e_{ij} represents a variety of unknown influences that affect R_{ij}. They would include unobservable local government-specific factors such as the expenditure requirements, the preferences of the local community and the scope for efficiency improvements in each council. It also includes a random term that accounts for random events (such as measurement error and seasonal effects like drought).

The coefficients of the variables in the revenue equation provide the basis for analysing the factors that influence the revenue raised by local governments. The relative revenue-raising potential is found by calculating a revenue-raising index:

$$\text{Index} = \frac{R}{\hat{R}} \tag{2}$$

where the numerator is the actual own-source revenue of local government (A or B in figure C.1) and the denominator is the predicted own-source revenue (the A′ and

B′ in figure C.1). If the ratio is less than 1, the revenue-raising effort is below the average (as in the case of local government A). If it is greater than 1, the revenue-raising effort is greater than the average (as in the case of local government B).

A limit to this approach is that no account is taken to separate the unobservable idiosyncratic factors from the true random errors. As a result, the deviations from the regression equation include the effect of random errors contained within the e_{ij} term.

$$\text{Index} = \frac{f(Y) + e_{ij}}{f(Y)} \tag{3}$$

As a result, the index tends to provide an exaggerated estimate (positively or negatively) of each local government's revenue-raising effort. In the context of this study, it would imply that some local governments have relatively more or less scope to raise revenue than they might do in practice.

While this approach to measuring relative revenue raising offers some attractive features, an approach that separates the effects of the unobservable factors and the random errors is more desirable.

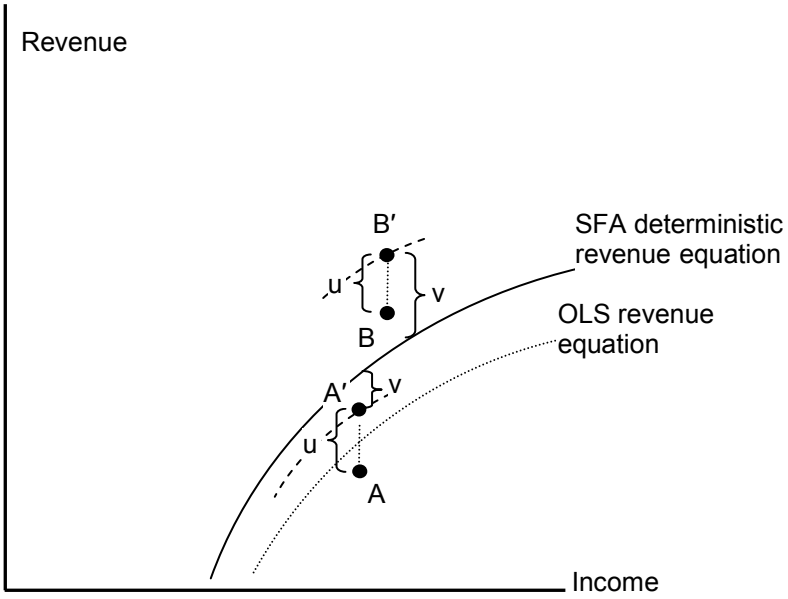
Stochastic frontier analysis

SFA is a statistical technique similar in nature to the fixed and random effects model described above. It was originally developed to study efficiency and productivity (Coelli, Rao and Battese 1998; Greene 1997; Kumbhakar and Lovell 2000). SFA also can be applied to study capacity utilisation which has a strong parallel to this study (UNFAO 2003).

The difference between the ordinary least squares approach (a variant of this approach is used by Teera and Hudson [2004]) and SFA is illustrated in figure C.2. As with ordinary least squares (OLS), SFA establishes a relationship between the various explanatory factors. In figure C.2, this is given by the SFA deterministic revenue equation.

One difference between SFA and OLS is the estimation of the 'deterministic' equation. The SFA revenue equation tends to have a different intercept than the OLS equation. The slope of the coefficients tend to be slightly different. This reflects the practice of pushing the revenue equation upwards towards a frontier.

Figure C.2 **Scope for increased revenue raising**



Source: Adapted from Coelli, Rao and Battese (1998).

Another difference is that SFA then stochastically repositions the revenue equation *for each observation* by an amount equal to the random error term *v*. Each uniquely shifted revenue equation becomes the frontier of that observation. In the example in figure C.2, the frontier is shifted downwards for local government A (by the amount *v* which is negative) and shifted upwards for local government B (by the amount *v*, which is positive). The remaining distance between the observed value of each local government (*A* and *B*) and the revised (stochastic) frontier (*A′* and *B′*) is the relative revenue-raising potential. For both local governments A and B this is equal to the amount *u*. The revenue-raising index is constrained to be between 0 and 1 in value.

In practical terms, it is very unlikely that any local government is ranked as having a revenue-raising index equal to 1. This is because the frontier is determined from all the observations in the data set, not just a group of neighbouring peers. In other words, even the better performing local governments have scope to raise additional revenue because even they can learn from other councils in the sample.

Mathematically, a stochastic frontier regression takes the general form:

$$R_{ij} = f\left(Y_{ij}\right) - u_{ij} + v_{ij} \qquad (4)$$

where R_{ij} and Y_{ij} are own-source revenue and fiscal capacity respectively, u_{ij} is a

one-sided distribution of the scope to raise additional revenue and v_{ij} is the random error term. The v_{ij} term captures random variations across councils reflecting the effect of random events, that might include:

- measurement error in the variables
- other random factors that affect revenue raised per person across councils (for example, droughts)
- the combined effects of other omitted factors, many of which are not amenable to quantification. These might include local preferences and attitudes towards local governments (Coelli, Rao and Battese 1998).

Both u_{ij} and v_{ij} are assumed to be independently and identically distributed, while u_{ij} can adopt a half-normal, truncated half-normal or exponential distribution (depending upon the specification) and has a positive mean. It is assumed that v_{ij} adopts a normal distribution with a zero mean and has a constant variance.

When the estimated function is in logarithmic form, a local government's revenue-raising index can be derived through:

$$\text{Index}_{\text{j}} = exp\left(-\text{u}_{\text{ij}}\right) \tag{5}$$

If u_{ij} equals zero (that is, there is no scope to raise additional revenue) then the index equals one. On the other hand, if after allowing for the known factors a council raises less revenue than its hypothetical benchmark, u_{ij} will be positive and the index will be less than one. This can be taken to be an indication that it has the potential to increase its revenue.

The indices resulting from the application of SFA are more realistic to those derived from random or fixed effects models. SFA leads to a more conservative assessment of the potential for local governments to increase their revenue since it makes allowances for measurement error, random shocks and omitted variables.

Extensions to the basic stochastic frontier analysis

SFA has an additional advantage over the other techniques listed above. It is able to account for the heterogeneity among councils in a way that makes economical use of variables.

As noted earlier, SFA partitions the error structure into a one-sided non-normal distribution of the u_{ij} and a two-sided normal distribution of the v_{ij}. In the presence of significant heterogeneity in the data, as experienced in this study, it is not always guaranteed that SFA will be able to identify the u_{ij} error structure even where there

is good reason to believe that such a structure exists. In such a case, the entire error will be consigned to v_{ij}.

Ordinarily, this is a sign that there are omitted variables. In ordinary least squares, this problem is addressed by adding variables into the equation with the expectation that they would account for the heterogeneity. This too, can be done in SFA. However, as noted, there are often too few variables available with which to fully account for the heterogeneity among councils.

An alternative approach is to estimate two additional equations simultaneously with the primary model explaining the variances of the u_{ij} and v_{ij} terms. The stochastic frontier regression equation takes the form:

$$\begin{aligned} R_{ij} &= f\left(Y_{ij}\right) - u_{ij} + v_{ij} \\ \mu_{ij}^{u} &= H_{ij}\delta + \xi_{ij} \\ \mu_{ij}^{v} &= H_{ij}\theta + \zeta_{ij} \end{aligned} \tag{6}$$

where H represents the range of factors that are thought to be correlated with the heterogeneity in the model, δ and θ the estimated parameters, and ξ_{ij} and ζ_{ij} represent the independent and identically distributed error terms. H is regressed against the means of the residuals (μ_{ij}) of both *u* and *v*. In the case of μ_{ij}^{v}, the H variables reduce the heterogeneity in the v_{ij} error structure, thereby permitting more variation to enter into the u_{ij} error structure. It is possible that some of the variation passed to the u_{ij} error structures will reflect heterogeneity rather than just the scope to raise additional revenue. In this case, H is also regressed against μ_{ij}^{u} so that none of the variation remaining in the u_{ij} is associated with heterogeneity.

Using two secondary models is a more economical method than using the primary model alone to explain the variance of the overall model, as fewer variables appear to be needed.

The model used in this study

It is apparent that the local government's population is a major contributing factor in its ability to raise revenue. An objective of the analysis was to separately identify the effects of population size from other variables (such as the level of local public goods) that might also be influenced by population size.

Assume a local government's revenue (R_{ij}) is a function of its fiscal capacity (Y_{ij}), the key services supplied by local governments (Z_{ij}), and the control variables used to account for the heterogeneity between local governments using secondary models

(denoted using the term $\left|H_{ij}\right.$):

$$R_{ij} = f\left(Y_{ij}, Z_{ij} \left| H_{ij} \right.\right) \tag{7}$$

Assume for the moment that the primary equation takes a Cobb-Douglas functional form:

$$R_{ij} = AY_{ij}^{b_1} Z_{ij}^{b_2} \tag{8}$$

where *A* is a scale parameter and the *b*'s are elasticity parameters. Assume also that both the local government's fiscal capacity and its grants can be expressed as:

$$r_{ij}P_{ij} = A\left(y_{ij}P_{ij}\right)^{b_1}\left(z_{ij}P_{ij}\right)^{b_2} \tag{9}$$

where r_{ij}, y_{ij} and z_{ij} represent per person revenue, per person fiscal capacity and local government services per person respectively and P_{ij} represents the size of the local government's population. Dividing through by P_{ij} and rearranging the terms gives:

$$r_{ij} = Ay_{ij}^{b_1} z_{ij}^{b_2} P_{ij}^{(b_1+b_2-1)} \tag{10}$$

This functional form facilitates the decomposition of the income effects into a per person effect for income and services, and a scale effect (for the size of the population). The marginal effect of population on own-source revenue is equal to (b_1+b_2-1).

The general functional form used in this study is:

$$r_{ij} = f\left(y_{ij}, z_{ij}, P_{ij} \left| h_{ij} \right.\right) \tag{11}$$

where r_{ij}, y_{ij}, z_{ij} and h_{ij} are the per person equivalents of R_{ij}, Y_{ij}, Z_{ij} and H_{ij}, and P_{ij} is the population of the community.

Several functional forms were considered by the Commission for the primary equation: the transcendental logarithmic (translog) function, extended logarithmic quadratic function and a simpler logarithmic quadratic function. The choice of functional form was determined based on the overall descriptive power of the model, parsimony of variables and the ease of interpretation of the results.

The translog function took the form:

$$\ln r_{jit} = a + \sum_i b_i \ln x_{jit} + \frac{1}{2}\sum_i \sum_k c_{ik} (\ln x_{jit} \ln x_{jkt}) - u_{jt} + v_{jt} \quad (12)$$

where t is the time period, j is the local government, and x_{jit} and x_{jkt} are the factors (i,k) contributing to per person own-source revenue r_{jit}. The form is the most flexible but also the most costly in terms of the number of variables.

The extended logarithmic quadratic took the form:

$$\ln r_{jit} = a + \sum_i b_i \ln x_{jit} + \frac{1}{2}\sum_i c_i (\ln x_{jit})^2 + \sum_n d_n D_{nj} + \sum_i \sum_n e_n (D_{nj} \ln x_{jit}) + \frac{1}{2}\sum_i \sum_n f_{in} (D_{nj} \ln x_{jit})^2 - u_{jt} + v_{jt} \quad (13)$$

where D_{nj} is the vector of dummy variables for each of the ACLG classes of local governments. This functional form is also relatively flexible and allows a test of whether there are significant differences between ACLG classes.

The simpler logarithmic quadratic took the form:

$$\ln r_{jit} = a + \sum_i b_i \ln x_{jit} + \frac{1}{2}\sum_i c_i (\ln x_{jit})^2 + \sum_m d_m S_{mj} + \sum_n e_n D_{nj} - u_{jt} + v_{jt} \quad (14)$$

where S_{mj} is the vector of dummy variables for each State. This functional form offers the least flexibility of the forms discussed, but is more flexible than a linear (Cobb-Douglas) model.

Variables used in the analysis

A review of the literature (such as Shadbegian 1999 and Mullins 2004) and submissions to this study suggest that some of the factors that would be included in the regression analysis include:

- the income of the local community, including both personal and business income
- the local public services provided by the local government (such as the length of roads provided and whether the council supplies water and sewerage services)
- the classification of local government
- the State of the local government (as a proxy for the regulatory and economic environment in which they operate)
- the population characteristics of the community, such as its residential population, population density and population growth.

Sociodemographic characteristics (such as the age distribution, unemployment

levels and Indigenous composition of the population) are often suggested as contributing to the service needs of the community. The ALGA (2004), for example, noted that ageing communities placed demands on local government services (such as social and activity support services, meals programs, in-home support, respite and allied health services), leading to higher levels of expenditure and revenue. The South Australian Centre for Economic Studies (SACES 2002, p. 20) said:

> In inner metropolitan areas, which are experiencing urban regeneration and an influx of younger higher income households, there is probably a greater willingness to pay for enhanced public services.

Sociodemographic variables can be used as factors that might explain the determinants of own-source revenue raised by councils, or as factors that might explain the heterogeneity of local governments in the secondary models. A full description of the variables, their definitions and sources, is given in table C.5. Unless otherwise specified, financial and population variables are specified in natural logarithms.

Table C.5 **Summary of variables**

Variable	*Definition*	*Data sources*
Dependent variables in the first (primary) model		
Own-source revenue (broad)	Own-source revenue broadly defined. Equal to total revenue of local government less current and capital grants, per person.	ABS government finance statistics data (unpublished).
Own-source revenue (narrow)	Own-source revenue narrowly defined. Equal to total revenue of local government less interest, dividends, grants and capital contributions.	ABS government finance statistics data (unpublished).
Independent variables in the first (primary) model		
Per person personal income	Equal to personal post-tax income plus income from the ownership of dwellings, per person.	Income data obtained from the BTRE, and ownership of dwelling data from the ABS.
Per person business income	Equal to gross operating surplus of the local government area, excluding income from unincorporated businesses, per person.	Gross operating surplus data obtained from the ABS, and apportioned to local governments on the basis of employment by local government area. Place of work data obtained from ABS Census data.
Water	A dummy for whether water and sewerage services were provided by each local government.	

Table C.5 **(continued)**

Variable	*Definition*	*Data sources*
Population	Residential population of local government.	ABS (3218.0).
Roads per person	Kilometres of sealed and unsealed roads (undifferentiated) as a proxy for the level of road services.	From Australian Department of Infrastructure, Transport and Regional Development (DITRD).
Properties per person	Number of assessable or rateable properties in the local government area as a proxy for the level of property-based services provided by each local government.	State grants commissions.
NSW	A value of '1' if the council is in New South Wales, '0' for others.	
Qld	A value of '1' if the council is in Queensland, '0' for others.	
WA	A value of '1' if the council is in Western Australia, '0' for others.	
SA	A value of '1' if the council is in South Australia, '0' for others.	
Tas	A value of '1' if the council is in Tasmania, '0' for others.	
NT	A value of '1' if the council is in the Northern Territory, '0' for others.	
Capital city	Dummy for UCC local governments.	Based on DITRD Australian Local Government Classification.
Urban fringe	Dummy for UFV to UFS local governments.	Based on DITRD Australian Local Government Classification.
Urban regional	Dummy for URV to URS local governments.	Based on DITRD Australian Local Government Classification.
Rural	Dummy for RAV to RAS and RSG local governments.	Based on DITRD Australian Local Government Classification.
Remote	Dummy for RTL to RTX local governments.	Based on DITRD Australian Local Government Classification.
Independent variables in the μ_{ij}^{u} and μ_{ij}^{v} models		
Per person grants	Commonwealth current grants to local governments. A proxy for Commonwealth financial assistance grants.	ABS government finance statistics data (unpublished).
Young	Share of population aged 4 and under.	ABS National Regional Profile data.
Student	Share of population aged between 5 and 14.	ABS National Regional Profile data.
Old	Share of population aged 65 and over.	ABS National Regional Profile data.
Overseas born	Share of population born overseas.	ABS 2001 Census and National Regional Profile data.
Unemployment rate	Unemployment rate.	ABS National Regional Profile data.
Indigenous	The share of persons identified as Indigenous, as at 2001 Census.	ABS 2001 Census and National Regional profile data.
Population growth rate	Average rate of population growth between 2000-01 and 2005-06 squared.	ABS resident population data.
Area	The local government's incorporated area in terms of thousands of square kilometres.	State grants commissions and the Australian Department of Transport and Regional Services.
Population density	The number of residents per square kilometre of local government area.	Derived from data provided by the ABS and the Australian Department of Transport and Regional Services.

Estimation approach

The approach to estimating the final stochastic frontier model was to initially estimate the model using ordinary least squares (OLS). Three possible model specifications were tested — translog, extended and simple log quadratic models. Statistical and economic criteria were used to choose the final functional form and preferred set of variables. The final OLS model was then used to inform the starting point for estimating the stochastic frontier model.

The initial regressions of the translog model yielded 369 variables for estimation, the extended log quadratic yielded 219 variables, and the simple log quadratic yielded 43 variables. After removing insignificant variables, the modelling results show that:

- translog function had an adjusted R-squared of 0.87 with 167 variables
- extended log quadratic model had an adjusted R-squared of 0.82 with 73 variables
- simple log quadratic model had an adjusted R-squared of 0.78 with 30 variables.

The last of the three OLS models served as a starting point for stochastic frontier regressions. The first two models were eliminated because of the lack of parsimony in variables. The final version of the log quadratic model had about 18 to 20 independent variables.

Four versions of the stochastic frontier model were estimated. These reflect differing assumptions about the appropriate dependent variable and the variables in the secondary models. The dependent variables include:

- Own-source revenue broadly defined total revenue less grants and subsidies.
- Own-source revenue narrowly defined to include rates, fees and charges, payments in lieu of rates and fines. This definition excludes interest, dividends and capital contributions as these were not thought to contribute to ordinary income of local governments (LGASA, sub. DR86).

Several different combinations of independent variables were used in the secondary models to explain the heterogeneity across councils:

- per person financial assistance grants from the Commonwealth
- a number of demographic variables (such as the share of persons aged 65 and over).

C.5 Factors affecting revenue raised

The results of the stochastic frontier regressions for all Australian local governments are presented in table C.6. With a few exceptions, only the statistically significant variables are presented. The coefficients on the variables are broadly consistent across the various specifications of the models.

Own-source revenue per person increases with both personal income per person and business income per person. An interpretation of this result is that as each after-tax source of income increases, the community prefers to spend proportionally less of it on local government services (chapter 4). The coefficient on business income is smaller than that of personal income, suggesting that a local government's revenue stream is more inelastic (that is, less sensitive) to changes in business income than to changes in personal income.

In terms of local government services, own-source revenue per person also increases with the length of roads per person. This suggests that as the length of roads (in per person terms) increases, so do the per person costs of maintaining them. Similarly, own-source revenue per person increases with the number of rateable properties per person, reflecting increased levels of services and expenditure needs. Some councils are required to supply water and sewerage services. As expected, the revenue raised by councils supplying water and sewerage services is higher.

In terms of other factors that might influence the costs of local government services, own-source revenue per person decreases with the size of the population, which suggests economies of scale. Population density, however, was not found to be statistically significant. Population density was not strongly correlated with own-source revenue, but was correlated with population level. This suggests that communities that benefit from economies of scale also benefit from economies of density. Population growth was found to be positively correlated with own-source revenue, confirming the view that communities experiencing population growth are also those likely to be raising more own-source revenue per person.

There are also differences in the level of revenue raised by councils between States. The reference State for comparisons is Victoria. Councils in New South Wales and Queensland on average tend to raise more revenue than councils in Victoria, whereas councils in South Australia, Western Australia and the Northern Territory raise less than Victoria.

Table C.6 **Results of the stochastic frontier regression analysis**

Dependent and independent variables	*Model 1 Log of own-source revenue per person (broad)*	*Model 2 Log of own-source revenue per person (narrow)*	*Model 3 Log of own-source revenue per person (broad)*	*Model 4 Log of own-source revenue per person (narrow)*
Primary model				
Characteristics				
Log of personal income per person	0.309[a]	0.275[a]	0.314[a]	0.280[a]
Log of business income per person	0.089[a]	0.108[a]	0.063[a]	0.075[a]
Log of roads per person	0.079[a]	0.078[c]	0.093[a]	0.097[a]
Log of properties per person	0.084[a]	0.072[a]	0.060[a]	0.052[a]
Water (categorical variable)	0.237[a]	0.219[a]	0.253[a]	0.224[a]
Log of residential population	–0.125[a]	–0.145[a]	–0.099[a]	–0.118[a]
Population growth rate	0.009[a]	0.004[a]	0.011[a]	0.005[a]
State[e]				
New South Wales	0.168[a]	0.169[a]	0.205[a]	0.185[a]
Queensland	0.110[a]	0.154[a]	0.140[a]	0.169[a]
South Australia	–0.147[a]	–0.094[a]	–0.116[a]	–0.090[a]
Western Australia	–0.096[a]	–0.078[a]	..	..
Tasmania	–0.075[c]	..	–0.077[a]	..
Northern Territory	–0.711[a]	–0.714[a]	–0.447[c]	–0.511[a]
ACLG class[f]				
Capital city	0.845[a]	0.964[a]	0.729[a]	0.788[a]
Urban fringe	..	–0.103[a]	0.079[b]	
Urban regional	0.074[d]	..	0.156[a]	0.103[a]
Rural agricultural	–0.221[a]	–0.290[a]	–0.086[c]	–0.136[a]
Remote	..	–0.069[d]	0.157[b]	0.132[a]
Constant	4.225[a]	4.527[a]	3.954[a]	4.311[a]
Secondary model				
Log σ_v^2				
Log of grants per person	0.534[a]	0.551[a]	0.553[a]	0.564[a]
Share of persons aged <5 years			–10.544[a]	–12.503[a]
Share of persons aged 5–14 yrs			–3.453[b]	–5.146[a]
Share of persons aged >64 years			–7.204[a]	–8.8134[a]
Constant	–5.656[a]	–5.836[a]	–3.771[a]	–3.425[a]
Log σ_u^2				
Log of grants per person	–0.521[a]	–0.604[a]	–0.610[a]	–0.552[a]
Share of persons aged <5 years			–17.399[c]	–20.590[b]
Share of persons aged 5–14 yrs			54.915[a]	57.710[a]
Constant	..	..	–6.955[a]	–7.522[a]
Mean of u	0.889	0.894	0.876	0.877
Number of observations	2854	2854	2254	2254
Number of councils[g]	604	604	601	601
Log likelihood	–758.133	–646.463	–516.387	–437.158

[a] Significant at less than the 0.1 per cent level. [b] Significant at 1 percent level. [c] Significant at the 5 per cent level. [d] Significant at the 10 per cent level. [e] The reference State captured in the constant term is Victoria. [f] The reference ACLG region captured in the constant term is urban developed. [g] Not all councils are represented in all years. **..** Not significant at 10 per cent level or below.

Source: ABS unpublished; ATO unpublished; State grants commissions unpublished; Productivity Commission estimates.

There are also differences in the level of revenue raised by councils between different ACLG classes The reference ACLG class for comparison is urban developed. Capital city, and to some extent urban regional councils, tend to raise more own-source revenue per person than urban developed councils. This most likely reflects the higher per person (resident) costs of servicing those areas. Rural councils raise less than urban developed (after taking account of other factors such as roads, population and income). This suggests that rural communities, on average, make fewer demands on their councils than do urban developed councils.

Accounting for heterogeneity

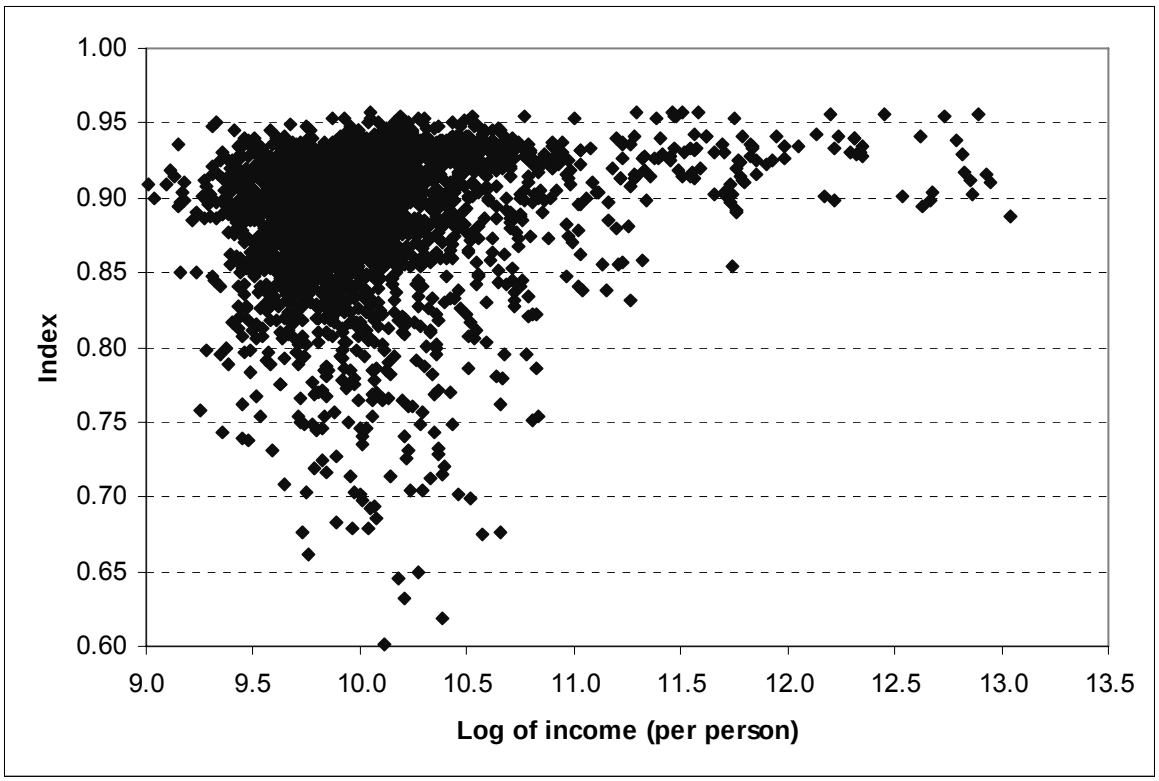
Table C.6 also includes the results for the regressions of the secondary models to account for the heterogeneity of the sample. The measure of per person financial assistance grants and the proportion of persons aged four or less were statistically significant. Other demographic variables, such as the proportion of the population that was Indigenous, was not significant. The strong correlation of grants in each of the four models reaffirms that this variable reflects the distribution of financial assistance grants by the State grants commissions. The Commissions distribute more grants to councils with higher needs. These councils are usually those already making relatively high per person revenue-raising effort.

The choice of variables to control heterogeneity across the four models had a role in determining the average revenue-raising score across councils. This score (the 'mean of u') varies between 0 and 1, and indicates how much revenue a local government currently raises relative to its potential. Across the four classes, the mean of scores varies between 0.876 and 0.894, suggesting an average potential to increase revenue of between 10 and 13 per cent.

C.6 Relative potential to increase revenue

Drawing on the results from model 1, the indices of current own-source revenue raised relative to the amount of own-source revenue that could potentially be raised, are plotted versus aggregate income in figure C.3.

Figure C.3 **Estimates of the relative potential to increase own-source revenue, by aggregate income**
2000-01 to 2004-05



Source: ABS unpublished; ATO unpublished; State grants commissions unpublished; Productivity Commission estimates.

The distribution of the indices of the potential to increase revenue is presented in table C.7. The unweighted and weighted averages of the index of revenue-raising potential are 0.88 and 0.86 respectively, which suggests that own-source revenue might be able to be increased by about 12 per cent and 14 per cent respectively, on average.

Table C.7 **Distribution of the estimated indices of each local government's own-source revenue relative to its potential own-source revenue, by class of local government**

2000-01 to 2004-05, per cent[a]

Decile and mean	*All councils*	*Capital city*	*Urban developed*	*Urban fringe*	*Urban regional*	*Rural*	*Remote*
Lowest	0.56	0.75	0.56	0.67	0.60	0.67	0.84
10 per cent	0.83	0.77	0.75	0.78	0.83	0.87	0.90
20 per cent	0.86	0.78	0.80	0.82	0.85	0.88	0.91
30 per cent	0.87	0.80	0.83	0.83	0.86	0.89	0.91
40 per cent	0.89	0.82	0.85	0.85	0.87	0.90	0.92
50 per cent (median)	0.89	0.85	0.86	0.85	0.88	0.91	0.93
60 per cent	0.90	0.87	0.87	0.86	0.89	0.91	0.93
70 per cent	0.91	0.89	0.88	0.88	0.89	0.92	0.94
80 per cent	0.92	0.91	0.89	0.89	0.90	0.92	0.94
90 per cent	0.93	0.93	0.91	0.91	0.91	0.93	0.95
Highest	0.95	0.94	0.93	0.94	0.94	0.94	0.95
Mean (unweighted)[b]	0.88	0.85	0.84	0.85	0.87	0.90	0.92
Mean (weighted)[c]	0.86	0.81	0.85	0.86	0.88	0.89	0.91

[a] Based on a sample of 2784 observations, representing 602 councils over five years. Data were not available for all councils for all years. [b] Average not weighted by relative population share. [c] Average weighted by relative population share.

Source: ABS unpublished; ATO unpublished; State grants commissions unpublished; Productivity Commission estimates.

Cost recovery from own-source revenue

Cost recovery from own-source revenue is defined to be equal to own-source revenue (broadly defined) divided by total expenditure, using ABS data. It is a measure of the extent to which a local government is recouping its expenditure from own sources of revenue. This indicator is not a measure of the real cost recovery or financial viability of local governments because it does not include any:

- costs from outstanding infrastructure renewals and maintenance
- grants that would contribute to the actual cost recovery of local governments.

The current ratios of cost recovery from own-source revenue are illustrated in table C.8. Between 2000-01 and 2004-05 own-source revenue recovered 0.76 (76 per cent) of local government total expenditure, across Australia on average. On average, rural and remote council's cost recovery were substantially lower than the national average.

Table C.8 **Distribution of the ratio of cost recovery from own-source revenue**

2000-01 to 2004-05, ratio[a, b]

Decile and mean	*All councils*	*Capital city*	*Urban developed*	*Urban fringe*	*Urban regional*	*Rural*	*Remote*
Lowest	0.07	0.76	0.61	0.50	0.47	0.15	0.07
10 per cent	0.46	0.82	0.78	0.73	0.61	0.43	0.24
20 per cent	0.55	0.88	0.83	0.82	0.70	0.50	0.35
25 per cent	0.58	0.91	0.85	0.83	0.74	0.52	0.38
30 per cent	0.62	0.95	0.86	0.86	0.78	0.56	0.41
40 per cent	0.70	1.02	0.89	0.89	0.83	0.60	0.48
50 per cent (median)	0.77	1.05	0.93	0.94	0.86	0.65	0.51
60 per cent	0.83	1.13	0.96	0.98	0.91	0.71	0.55
70 per cent	0.89	1.18	0.99	1.02	0.97	0.77	0.59
75 per cent	0.92	1.19	1.01	1.05	0.99	0.80	0.63
80 per cent	0.96	1.22	1.03	1.07	1.03	0.83	0.68
90 per cent	1.06	1.29	1.09	1.18	1.11	0.93	0.80
Highest	1.80	1.35	1.67	1.80	1.55	1.69	1.26
Mean[c]	0.76	1.06	0.94	0.96	0.87	0.68	0.52

[a] The own-source revenue cost recovery ratio is defined as total revenue less current and capital grants, divided by total expenditure. [b] Based on a sample of 2784 observations, representing 602 councils over five years. Data were not available for all councils for all years. [c] Average weighted by relative population share.

Source: ABS unpublished; ATO unpublished; State grants commissions unpublished; Productivity Commission estimates.

Simulating the effects of increases in own-source revenue

The final modelling exercise is a simulation of the effect of increasing own-source revenue (assuming the results from model (1)) on each local government's:

- total revenue per person
- revenue-raising effort (defined as own-source revenue divided by fiscal capacity)
- cost recovery from own-source revenue.

The purpose of the simulation exercise is to provide some insights into how material the scope for local governments to raise additional revenue is on local government finances. It is not intended to demonstrate that local governments should seek to recover all their costs from own-source revenue.

It must be noted that these simulations are partial in nature. They do not consider the effects of demand for services that might arise from increases in revenue raised (since increasing fees and charges, for example, might induce a reduction in the demand for some services), and any commensurate change in expenditure.

The estimated index of the potential to increase own-source revenue is used to calculate the increase in each local government's hypothetical total revenue per person (table C.9). Across all local governments, total revenue is projected to increase by about $140 per person.

Table C.9 **Effect of a hypothetical increase in own-source revenue on total revenue per person, by class of council**

2000-01 to 2004-05, per person[a]

Local governments by ACLG class	*No. of observations*	*No. of councils*	*Actual total revenue*	*Potential total revenue*	*Average increase in total revenue*
			$	$	$
Capital city	33	7	4 251	4 751	500
Urban developed	394	87	829	955	126
Urban fringe	219	48	905	1 029	123
Urban regional	506	111	1 317	1 453	135
Rural	1 409	298	2 367	2 502	135
Remote[b]	223	51	6 642	6 837	194
All councils	2 784	602	2 208	2 350	142

[a] Average not weighted by population share. [b] Care must be exercised due to concerns about the quality of data from remote local governments.

Source: ABS unpublished; ATO unpublished; State grants commissions unpublished; Productivity Commission estimates.

The effect of a hypothetical increase in own-source revenue on revenue-raising effort is illustrated in table C.10. Across all councils, the revenue-raising effort is projected to increase from 5.8 to 6.4 per cent. Since local governments vary in size (there are a relatively large number of small local governments), the revenue-raising effort adjusted for population size is also presented in table C.10. The average revenue-raising effort across the Australian population is projected to increase from 4.5 to 5.1 per cent.

The effect of a hypothetical increase in own-source revenue on the cost recovery from own-source revenue is illustrated in table C.11. The own-source revenue cost recovery could potentially increase from 0.76 to 0.87. When the different populations across local governments are taken into account, the own-source revenue cost recovery across the Australian population could feasibly increase from 0.94 to 1.09 — reflecting the influence of the larger local governments.

Table C.10 **Effect of a hypothetical increase in own-source revenue on revenue-raising effort, by class of local government**

2000-01 to 2004-05, per cent[a]

Local governments by ACLG class	*Revenue-raising effort not adjusted for population*			*Revenue-raising effort adjusted for population*	
	Actual mean	*Hypothetical mean*	*Hypothetical distribution*[b]	*Actual mean*	*Hypothetical mean*
Capital city	4.2	4.9	2.8–6.8	5.2	6.4
Urban developed	3.1	3.6	3.0–4.0	3.1	3.6
Urban fringe	4.4	5.1	3.6–6.2	4.1	4.7
Urban regional	5.4	6.2	4.3–7.7	5.8	6.5
Rural	6.4	7.0	4.6–8.5	6.0	6.6
Remote	8.7	9.3	2.2–13.0	6.4	6.9
All councils	5.8	6.4	3.8–7.8	4.5	5.1

[a] Based on a sample of 2784 observations representing 602 councils. Not all councils are represented in all years. [b] This is the distribution of the middle 50 per cent (inter-quartile range) of observations around the median hypothetical revenue-raising effort.

Source: ABS unpublished; ATO unpublished; State grants commissions unpublished; Productivity Commission estimates.

Table C.11 **Effect of a hypothetical increase in own-source revenue on cost recovery from own-source revenue, by class of local government**

2000-01 to 2004-05[a, b]

Local governments by ACLG class	*Cost recovery not weighted by population share*			*Cost recovery weighted by population share*	
	Actual	*Potential*	*Hypothetical distribution*[c]	*Actual*	*Potential*
	Ratio	Ratio	Ratio	Ratio	Ratio
Capital city	1.06	1.25	1.13–1.34	1.01	1.23
Urban developed	0.94	1.11	0.99–1.20	0.94	1.10
Urban fringe	0.96	1.12	0.99–1.21	1.00	1.16
Urban regional	0.87	0.99	0.84–1.13	0.95	1.08
Rural	0.68	0.75	0.58–0.89	0.74	0.83
Remote	0.52	0.56	0.41–0.68	0.56	0.61
All councils	0.76	0.87	0.64–1.06	0.94	1.09

[a] The own-source revenue cost recovery ratio is defined as total revenue less current and capital grants, divided by total expenditure. [b] Based on a sample of 2784 observations representing 602 councils over five years. Not all councils are represented in all years. [c] This is the range of the middle 50 per cent (inter-quartile range) of observations around the median hypothetical cost-recovery ratio.

Source: ABS unpublished; ATO unpublished; State grants commissions unpublished; Productivity Commission estimates.

Care must be exercised when interpreting the results of table C.11. Even if a council is reported to be recovering less than its expenditure from own-source revenue, this

does not imply that it is currently operating a deficit — other sources of income (namely Commonwealth and State government grants) might be augmenting its revenue.

Finally, the proportion of councils that are not recovering their costs, before and after a hypothetical increase in revenue, are reported in table C.12. It is apparent that despite an improvement in revenue-raising effort, many councils, including the majority of rural and remote councils, will not be recovering their costs without financial assistance from other governments.

Table C.12 **Estimates of the proportion of local governments that are grant dependent, by class of local government**

2000-01 to 2004-05, per cent[a]

Local governments by ACLG class	*No. of councils*	*Councils that are grant dependent*		*Councils that are grant dependent after raising additional revenue*	
		No. of councils	*Share of councils*	*No. of councils*	*Share of councils*
Capital city	7	2	36	–	–
Urban developed	87	63	72	27	27
Urban fringe	48	31	64	16	36
Urban regional	111	84	76	51	50
Rural	298	277	93	245	87
Remote[b]	51	49	96	42	95
All councils	602	506	84	371	67

[a] Based on a sample of 2784 observations, representing 602 councils over five years. Data were not available for all councils for all years. [b] Care must be exercised due to the quality of data from remote local governments.

Source: ABS unpublished; ATO unpublished; State grants commissions unpublished; Productivity Commission estimates.

Sensitivity of predictions

Sensitivity tests were undertaken of the predictions implied by the stochastic frontier equations reported in table C.6. Selected results from tables C.7, C.11 and C.12 were reproduced for the period 2000-01 to 2003-04. The results of models (1) and (3) were different to those for models (2) and (4) — the latter two excluded observations for 2004-05 because demographic data were not available for that year. Thus, to ensure comparability between the estimates from each of the models, the simulation results were reproduced for 2000-01 to 2003-04.

The results of the sensitivity tests for the ratio of each local government's revenue-raising potential are summarised in table C.13. For capital city and urban

developed councils, the estimates of model (1) are at the bottom end of the range of estimated ratios. Most of these differences appear to be explained by the choice of the dependent variable. When capital contributions, interest and dividend income are included in the definition of own-source revenue, capital city and urban developed councils have *more* scope to raise additional own-source revenue than do other councils.

Table C.13 **Sensitivity tests: local government's own-source revenue relative to its potential own-source revenue**
2000-01 to 2003-04, per cent[a, b]

Local governments by ACLG class	*Model (1)*[c]	*Range of estimated indices*[d]
Capital city	85.6	83.8–95.1
Urban developed	85.2	85.0–91.6
Urban fringe	85.6	81.0–86.6
Urban regional	87.8	85.9–88.3
Rural	90.4	87.5–91.2
Remote	93.0	90.7–93.9
All councils	89.0	87.6–89.6

[a] The own-source revenue cost recovery ratio is defined as total revenue less current and capital grants, divided by total expenditure. [b] Based on a sample of 2225 observations representing 601 councils over four years. Not all councils are represented in all years. [c] Average weighted by relative population share. This estimate is based on the results of model (1) (table C.6). It differs from the finding in table C.7 because of differences in sample sizes. [d] This range is of the means of the four models presented in table C.6.

Source: ABS unpublished; ATO unpublished; State grants commissions unpublished; Productivity Commission estimates.

The results of the sensitivity tests for the cost recovery ratio of each local government are summarised in table C.14. Capital city and urban developed councils could be at the higher end of estimates of own-source revenue cost recovery, when capital contributions, interest and dividend income are included in the definition of own-source revenue.

Finally, the results of the sensitivity tests for the proportion of councils unable to recover their costs are summarised in table C.15. When capital contributions, interest and dividends are included in the definition of own-source revenue, relatively fewer capital city council and urban developed councils are likely to be under-recovering their costs.

Table C.14 Sensitivity tests of the effect of a hypothetical increase in own-source revenue on cost recovery from own-source revenue, by class of local government

2000-01 to 2003-04, ratio[a, b]

Local governments by ACLG class	*Actual*[c]	*Model (1)*[c]	*Range of average potential cost recovery ratios*[d]
Capital city	1.07	1.24	1.05–1.24
Urban developed	0.93	1.10	0.95–1.10
Urban fringe	0.95	1.11	0.94–1.18
Urban regional	0.87	0.99	0.91–1.02
Rural	0.67	0.74	0.69–0.77
Remote	0.57	0.61	0.59–0.62
All councils	0.76	0.86	0.79–0.88

a The own-source revenue cost recovery ratio is defined as total revenue less current and capital grants, divided by total expenditure. **b** Based on a sample of 2225 observations representing 601 councils over four years. Not all councils are represented in all years. **c** Average weighted by relative population share. This estimate is based on the results of model (1) (table C.6). it differs from the finding in table C.8 because of differences in sample sizes. **d** This range is of the means of the four models presented in table C.6.

Source: ABS unpublished; ATO unpublished; State grants commissions unpublished; Productivity Commission estimates.

Table C.15 Sensitivity tests of the effect of a hypothetical increase in own-source revenue on the proportion of councils not recovering their costs, by class of local government

2000-01 to 2003-04, per cent[a, b]

Local governments by ACLG class	*Actual*[c]	*Model (1)*[c]	*Range of proportion of councils not recovering costs*[d]
Capital city	32	0	0–32
Urban developed	72	29	29–64
Urban fringe	66	29	18–66
Urban regional	77	52	48–72
Rural	93	88	84–93
Remote	93	91	91–92
All councils	85	68	67–80

a The own-source revenue cost recovery ratio is defined as total revenue less current and capital grants, divided by total expenditure. **b** Based on a sample of 2225 observations representing 601 councils over four years. Not all councils are represented in all years. **c** Average weighted by relative population share. This estimate is based on the results of model (1) (table C.6). It differs from the finding in table C.12 because of differences in sample sizes. **d** This range is of the means of the four models presented in table C.6.