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An Evaluation of the Financial Sustainability of Remote Australian Local Councils*

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Spatial remoteness in the sense of great distances between population centres and limited access to public services is an on-going problem in Australian local government, where there exist large, sparsely populated regions dominated by the 'tyranny of distance'. From a public policy perspective, it is important to understand the impact of remoteness on local authorities. Accordingly, in this paper, we estimate the relationship between remoteness and financial sustainability using a 2014–2018 sample of Australian local governments. In general, we find only limited empirical evidence for a relationship between geographical remoteness and financial sustainability as we have proxied it.

Keywords: structure and scope of government, publically provided goods, state and local government/intergovenmental relations, general regional economics, regional government analysis.

1. Introduction

While constituent councils in all local government systems have different characteristics and face different environmental challenges, in Australian local government, remoteness has a dramatic impact on councils (Dollery *et al.*, 2010; Sinnewe *et al.*, 2015). In essence, local authorities in remote areas face a different set of difficulties from their metropolitan and regional counterparts, derived in large part from the great distances between different parts of a local government area (LGA), between adjacent local government areas (LGAs) and between an LGA and its major service centres. These challenges lead remote councils to serve slightly different and often expanded roles, as well as facing higher costs. The net result is typically substantial differences in the performance of remote councils in Australian local government. Although municipal performance is multifaceted, in this paper we focus on financial sustainability. Local governments in remote areas are affected by 'slow' threats to long-term viability not present in most other regions that more directly impact financial sustainability rather than efficiency or effectiveness (Hastings *et al.*, 2016).

Existing Australian studies provide plausible grounds for presuming that remoteness may have an important impact on sustainability and, furthermore, that this may apply to certain aspects of

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sustainability more so than to other aspects. For example, Dollery *et al.* (2010) noted that, among a group of remote Queensland councils, financial condition measured in terms of debt was generally favourable, whereas 'unfunded depreciation' represented a long-term threat to sustainability. By contrast, Drew and Campbell (2016) examined the remote NSW LGA of Central Darling, concluding that consistently inadequate grant allocations from the NSW government had caused the council to experience a fiscal crisis in 2013. Remoteness was identified as a key contributing factor: its large area and its low population meant that it had an extensive network of roads and other infrastructure to maintain, but limited capacity to increase its revenue to meet this challenge. However, both of these studies examined relatively limited regional areas and relied on a close examination of their specific properties rather than using a comprehensive econometric framework. It is thus clear that a broader empirical study would provide a more thorough 'big-picture' perspective on the role of remoteness in local government.

While there have been previous studies of the impact of remoteness (see, for example, Larsen, 2002; Page & Midwinter, 1980; Sootla *et al.*, 2009), these studies have typically covered nations where local government remoteness is much less extreme than in Australia. In this paper, we seek to examine how geographical remoteness affects the financial sustainability of Australian local government. In essence, we test the hypothesis that there is no significant relationship between remoteness classification (as specified by the Australian Standard Geographical Classification) and two financial ratios (operating surplus ratio (OSR) and asset maintenance ratio (AMR)) measuring different aspects of financial sustainability. This approach sheds light on the differences in how local authorities in different parts of Australia behave and how these differences should be treated from a policy perspective. Furthermore, it examines how councils are influenced by their environment. Finally, our approach contrasts with earlier work on remote Australian local government that has been largely descriptive and/or qualitative (see, for example, Dollery *et al.*, 2010; Valle De Souza & Dollery, 2011; Dollery & Johnson, 2012; Blackwell *et al.*, 2015; Sinnewe *et al.*, 2015) by applying a comprehensive econometric framework to remoteness and performance. We apply a panel regression method to a 2014–2018 dataset encompassing all Australian municipalities to test this hypothesis. Sustainability is multi-dimensional and cannot be captured by a single variable. Accordingly, we use two different measures of sustainability: AMR and OSR (Dollery *et al.*, 2007).

The paper is divided into five main parts. Section 2 considers the nature of performance in local government, as well as the meaning and measurement of financial sustainability. Section 3 examines the role of local government in remote areas compared to Australian local government as a whole and describes key differences in the attributes of councils in remote areas compared to the national average. Section 4 focuses on the empirical strategy employed, whereas Section 5 presents the results obtained. The paper ends in Section 6 with some brief concluding comments.

2. Measurement of Financial Sustainability

Municipal performance has three main dimensions: sustainability, efficiency and effectiveness. In this paper, we focus on financial sustainability. Sustainability is usually defined as the ability for a council to continue its current activities regarding the provision of local public services into the future while maintaining its capital position over the long term (Galera *et al.*, 2016). However, there are several different definitions in use, with no 'standard' approach to sustainability measurement, as well as several interrelated elements that comprise sustainability (Caldas *et al.*, 2021).

Key performance indicators (KPIs) and financial ratios are often used as proxies of financial sustainability. KPIs can be any quantifiable measure of how an objective is being achieved, while financial ratios express relationships between accounting numbers in a size-independent manner, allowing for ready comparisons through time and/or between separate organisations. While these concepts overlap insofar as many financial ratios may be used as KPIs, they may neither overlap nor must KPIs assume a ratio form. This approach has often been favoured by Australian state governments. For example, in its financial assessment of NSW local government, the NSW Treasury Corporation (2013) used a list of ten financial ratios and provided benchmarks for each ratio, which were then combined into a 'financial sustainability rating'. However, the use of KPIs and financial ratios has also been widely criticised (Pilcher, 2005; Cruz & Marques, 2014). It has *inter alia* been argued that commonly used ratios neglect public expectations and cannot distinguish the results of council activities from non-discretionary environmental factors (Dollery *et al.*, 2007). Despite these shortcomings of KPIs in measuring sustainability, given their usefulness for empirical analysis, they are still frequently used. For example, Andrews (2013) employed this approach in his study of municipal financial sustainability in England and Wales.

The International Federation of Accountants (IFAC, 2013) emphasised three 'dimensions' of assessing financial sustainability of public sector entities: (a) the 'service dimension' dealing with service quality and quantity; (b) the 'revenue dimension' dealing with funding and taxation; and (c) the 'debt dimension', which focuses on meeting financial obligations.

Each organisation has its own 'capacity' and 'vulnerability' in all three dimensions. For instance, it is unsustainable to provide inadequate services on a consistent basis. Capacity and vulnerability refer to how effectively a dimension can be controlled and the extent to which it is affected by exogenous factors.

While the IFAC (2013) approach is simply a framework for sustainability evaluation, it presents a key principle: there is no single variable which can adequately summarise all aspects of sustainability. This is consistent with Dollery *et al.* (2011) who argued that financial sustainability may be inextricably linked to 'community sustainability', which considers *inter alia* democratic representation and local social capital as worthy goals in their own right. This concept stems from the dual nature of local government as both a service provider and a democratic institution. Caldas *et al.* (2016) further contend that a 'holistic' view of sustainability is useful because short-term financial performance does not necessarily provide an accurate gauge of overall community welfare or council effectiveness.

The Canadian Institute of Chartered Accountants (CICA, 2009) provided guidelines on 'financial condition', which includes sustainability. Sustainability is defined as 'the ability of a government to maintain its existing programs and services [. . .] without increasing its debt or raising its taxes' (CICA, 2009, p. 111). Three sustainability metrics are proposed: annual surplus/deficit, 'financial assets-to-liabilities' (a measure of leverage) and 'net direct debt-to-provincial GDP' (describing the impact of a government's debt on the regional economy). The other two aspects are flexibility, or a government's ability to reduce its debts or increase its revenue if necessary, and vulnerability, which measures a government's dependence on external factors and exposure to risk. While these latter elements are comparable with the capacity and vulnerability of IFAC (2013), they are considered distinct from sustainability.

'Sustainability' thus encompasses competing goals whose relative importance is both subjective and dependent on the nature of the organisation. Financial sustainability is only one dimension of sustainability, and financial sustainability in itself covers several interconnected ideas. Thus, any attempt to summarise sustainability with a single index will invariably embody some implicit value judgement, rendering it arbitrary and applicable in well-defined instances. Cruz and Marques (2014, p.167) support this view, advocating a sustainability framework comprising 'social', 'environmental', 'economic' and 'governance' dimensions, cautioning that 'discretionary aggregation methods are theoretically incorrect and in general produce meaningless scores'.

3. Characteristics of Remote Councils

Australia is comparatively sparsely populated, with an average population density of 3.25 people per square kilometre in 2018, compared to a global average of 59.64 (World Bank, 2019). Furthermore, its population is concentrated in state capital cities (Australian Bureau of Statistics (ABS) 2018a). Given Australia's vast land area, there thus exist large regions of extremely low population density. Local authorities operating in these remote areas may experience additional difficulties and exhibit different characteristics. This complicates comparisons between remote councils, regional councils and urban councils.

The 'tyranny of distance' is a term often used to refer to the challenges imposed by vast spatial distances. In the present context, the 'tyranny of distance' will be applied in cases of either (a) large distances between an LGA and major Australian cities or (b) large distances between an LGA's seat and localities within the LGA. Blackwell (2012) describes the tyranny of distance as encompassing expensive and/or poor quality transportation and communication infrastructure and 'distant markets and decision-making' implying that services are provided by a distant authority with insufficient local representation. For example, the remote Queensland town of Longreach is approximately 990 km from state capital Brisbane and 200 km from the furthest edge of its own LGA (ABS, 2018b).

In Australia, local government represents the third tier of government. As at 2016, Australia had 537 local authorities with an average geographical area of 12,942 square kilometres and an average population of 44,257 (ABS, 2018a). Table 1 decomposes Australian local governments by state and territory. The differences broadly reflect existing differences in population density between states and territories, but are also reflective of the historical treatment of local government, especially the municipal mergers that have been implemented in recent decades across most states and territories, except for WA.

Local councils operate on the scale of individual cities and regions. They provide a variety of services that typically include local bridges and roads, public recreational facilities and waste collection. However, functional responsibilities can vary considerably. For instance, some councils are responsible for water supply and sewerage. Moreover, remote councils typically provide a broader range of services, and often offer additional functions usually associated with the private sector, such as banking and undertaker services, since these services cannot be viably provided by private firms (Dollery *et al*., 2010).

In Australia, property taxes (colloquially referred to as 'rates') represent the largest source of municipal funding. Fees and charges for specific services, developer charges on real estate development and intergovernmental grants also generate substantial income. In some instances, revenue derives from council-owned public enterprises, by leasing government assets or through returns on investments (ALGA n.d.). The composition of revenue for a specific council is affected by numerous factors, but broad patterns are evident for remote councils. For example, in 2016–2017, the urban NSW council of Inner West derived 48.4% of its revenue from 'rates and annual charges', 14.7% from 'user charges and fees' and 25.3% from 'grants and contributions'. By contrast, in 2016–2017, the remote NSW Cobar Council secured 15.9%, 34.2% and 47.8% of its revenue from the same sources. This example represents a typical illustration of the external grant dependency of more remote councils (Cobar Shire Council, 2017; Inner West Council, 2017).

Remote councils are unsurprisingly typically small in terms of absolute population, the quantum of service outputs and numbers of households and businesses, but frequently cover a large spatial area. In our data set, 'remote' and/or 'very remote' area councils have an average population of 3394. This derives from the 'tyranny of distance' that limits municipal size: it is difficult to administer and offer

Table 1. *Local government areas (LGAs) by state or territory*

State/Territory	Number of LGAs	Average population	Average area (km^2)
New South Wales (NSW)	128	60,404	5,528
Victoria (VIC)	79	78,130	2,876
Queensland (QLD)	77	61,080	22,413
South Australia (SA)	70	24,417	5,168
Western Australia (WA)	137	18,657	18,443
Tasmania (TAS)	29	17,845	2,345
Northern Territory (NT)	17	14,011	78,136
Other	2	1,225	75
Total Australia	537	44,257	12,942

Source: ABS (2016, 2018a).

services to a large area with a low population density. Thus, enlarging an LGA in the sense of population or number of households by expanding its boundaries simultaneously increases its spatial size. Typically, when the effects of municipal scale are investigated, scale is treated in terms of service outputs or proxies like population size, which is accurate when one is interested in the structure of scale economies only (Coelli *et al*., 2005; Drew & Dollery, 2014). However, establishing the optimal scale of a remote council is more difficult because of the deleterious effects of large physical distances between different parts of an LGA on both performance and local democratic representation. These costs may be relatively insignificant for urban or even regional councils, thus casting further doubt on the idea that 'bigger is better' in Australian local government. Sanders (2012, p. 487) supports this perspective, describing the NT council of Central Desert as 'so large and geographically dispersed that it spends much of its time and energy trying to keep in touch with its many far-flung parts.'

In general, in remote areas there is a greater cost per capita of providing given municipal services. Large spatial distances from major population centres and large distances between regions within an LGA imply greater transportation costs (Blackwell, 2012). Services with a 'network' aspect, such as road maintenance and sewerage systems, experience economies of density – with a decrease in the cost per unit as the number of users per unit of area increases – because the quantum of new infrastructure needed to connect one additional user depends on proximity to the existing network (Bel, 2012). Empirical evidence of density economies has been found for solid waste collection (Carvalho *et al*., 2015). Since all residents use these services, a low population density means that remote councils cannot take advantage of economies of density (Dollery & Fleming, 2006). Furthermore, because the size in terms of service output is limited by the challenges associated with having a large area, remote councils will also be unable to benefit from economies of scale, where the cost per unit of output falls as the quantity of output increases, holding the ratios between inputs constant. Thus, it is almost invariably more costly to provide given municipal services in remote areas than in regional or urban areas.

It has been argued that in general remote areas have suffered from chronic decline due to various long-term challenges, termed 'slow burns' by Pendall *et al*. (2010). Two such threats are (a) depopulation and (b) a lower standard of living compared to the rest of Australia. These factors are related in that spatial disparities in the level of wellbeing encourage residents to move elsewhere. Of LGAs in 'remote' or 'very remote' areas, 70% experienced a decrease in population from 2014 to 2018, compared to 38% of all LGAs. A lower population typically implies fewer ratepayers and, thus, a decrease in an important source of council revenue, which may damage sustainability. These trends do not apply uniformly across all regional areas: some remote areas are supported by relevant local industries – most importantly, mining – rendering them resistant to 'slow burns', but perhaps vulnerable to factors affecting that industry.

A further threat to the ongoing sustainability of remote local government may result from the nature of Australian fiscal federalism. In essence, local authorities may lack the flexibility to raise additional revenue or reduce expenditure. Following the IFAC (2013) framework, their 'capacities' may be poor (Kim, 2017). Under Australian state and territory constitutions, their constituent local authorities are subject to state laws and are thus 'creatures of statute' (Dollery *et al*., 2006). In practice, this often manifests itself in constraints on municipal revenue raising, including property tax limitations, cost shifting by federal and state governments and periodic forced amalgamation programs (Dollery *et al*., 2006). Furthermore, due to the high degree of vertical fiscal imbalance in the Australian federation, local government systems are often reliant on intergovernmental grants that are frequently inadequate (Warren, 2013).

An unusual feature of Australian local government is the phenomenon of unincorporated areas. These comprise regions with no local authorities and instead where state or territory government agencies are responsible for the functions normally associated with councils. Unincorporated areas are present in all states, except Queensland and Tasmania. Most unincorporated areas are small, but in NSW and especially SA, a significant proportion of the state is unincorporated. There is also the special case of the Australian Capital Territory (ACT), where there are no local governments and thus the entirety of the territory is technically unincorporated. The ACT territory government instead performs the functions of local government. Outside the ACT, unincorporated areas occur largely in remote areas because of their small dispersed populations, the absence of community of interest and the lack of any kind of regional centres to serve as bases of operations (Blackwell, 2012). The key disadvantage of unincorporated areas as opposed to LGAs is the absence of local democratic representation. Despite the existence of certain limited forms of representation, such as the NSW Western Lands Commission, the Lord Howe Island Board and the SA Outback Communities Authority, these do not adequately replace local governments in their role as local democratic institutions (Blackwell, 2012).

4. Empirical Methodology

4.1. Sample

We use a short-and-wide panel data set comprising all Australian local governments from 2014 to 2018. The total sample size is 2695. Of these, 2530 observations (93.9% of the total) are complete. While all explanatory variables were available for every observation, one or both dependent variables were unavailable for the remaining 165 observations. 148 of these were entirely the result of missing data and were included in the analysis, while the last 17, which needed to be dropped entirely, occur where the values were known but are (a) invalid due to an accounting number being of an unexpected sign, (b) undefined, generally caused by divide-by-zero errors or (c) identified as outliers.

We use two different dependent variables and fifteen explanatory variables. Separate models are estimated for each dependent variable, each discussed further below. The dependent variables AMR and OSR represent different aspects of sustainability. The main explanatory variables of interest are the median remoteness category and the difference between the highest and lowest remoteness categories present. The remaining explanatory variables are environmental variables, used to mitigate the effects of endogeneity caused by missing variables.

Missing data were handled by multiple stochastic imputation. In this method, observations with missing data are still included, in contrast to some other methods, such as listwise deletion, where observations with missing data are simply removed. These methods can avoid inconsistency in regressions, which occurs when listwise deletion is used when the presence or absence of data is correlated with the other variables in the sample or with the true value of the variable (Tsikriktsis, 2005). Multiple stochastic imputation is an extension of regression imputation, in which a preliminary regression using the data that is not missing is employed to generate estimates for the missing values. Although an improvement over listwise deletion, basic regression imputation can exaggerate regression results, producing models that appear to be a better fit than they really are. Multiple stochastic imputation solves that problem by firstly adding random noise to the estimated replacement values according to the standard error of the preliminary regression. To eliminate the sampling variation introduced by the addition of this noise, the regression is then done multiple times with re-randomised replacement values, and the regression results are combined to produce the final estimates.

4.2. Dependent Variables

We use two separate dependent variables as sustainability proxies to capture multiple aspects of financial sustainability. As we noted earlier, computing sustainability by means of a single variable is arbitrary and unlikely to adequately describe financial sustainability. Based on the IFAC (2013) framework and using the performance indicator approach, we make use of the following measures of sustainability:

- AMR (denoted y_1), defined as the ratio of capital expenditure to the necessary capital expenditure needed to maintain the current capital stock (Wingecarribee Shire Council, 2016)
- OSR (denoted y_2), defined as the ratio of operating surplus to operating revenue, as suggested by Galera *et al.* (2016). However, for the purposes of this paper, we use a transformed version of this variable: we instead divide operating revenue by operating expenditure. This variable contains the same information but has a minimum of 0 and a ’neutral’ value of 1 like the AMR, making comparisons between models using each of the two variables easy

The AMR variable has the disadvantage that 'necessary capital expenditure' is not standardised: in many cases it was based on depreciation and the ratio is sometimes defined as capital expenditure divided by depreciation. The terms 'asset sustainability ratio' and 'asset renewal funding ratio' are often used interchangeably but sometimes they are defined differently. In other instances, the necessary capital expenditure was an *a priori* estimate or a 'planned' amount of expenditure. For example, in South Australia, the denominator used in the calculation is 'asset renewal and replacement expenditure identified as warranted in a Council's infrastructure and asset management plan' (South Australian Local Government Grants Commission, 2021, p. 24). This approach has the advantage that it can account for the effects of disposals and the condition of assets, but it is dependent to a degree on the priorities of the council in question and the methodology underlying the calculation of this value is not entirely transparent. While all the variations of AMR measure the same concept, there will certainly be systematic differences in their values, leading to a data quality problem. To account for differences in standards between states, state dummy variables are included in the model.

The transformed version of OSR (y_2) can be shown to equal the reciprocal of one minus the standard version of the variable (denoted y_{2s} for the purposes of the following calculation). Operating revenue and expenditure are labelled R and E, respectively, so operating surplus equals R – E.

$$y_2 = \frac{R}{E}$$

$$y_2 = \frac{1}{\frac{E}{R}}$$

$$y_2 = \frac{1}{1 - \left(1 - \frac{E}{R}\right)}$$

$$y_2 = \frac{1}{1 - \left(\frac{R-E}{R}\right)}$$

$$y_2 = \frac{1}{1 - y_{2s}}$$

When operating surplus is zero, implying that operating revenues and expenditures are equal, then the transformed OSR gives the value 1. If revenue is zero, then the transformed OSR reaches the minimum possible value of 0. If expenses are zero, then it becomes undefined, expanding to arbitrarily large as expenses shrink.

These two variables each serve a clear purpose. The OSR deals with operating expenditure while the AMR deals with capital expenditure. Our choice of dependent variables is inspired by the IFAC (2013) framework. OSR surplus measures the revenue dimension of sustainability (and to a lesser extent is associated with the debt dimension as well), whereas the AMR could be considered a measure of the service dimension insofar as numerous council services involve maintaining various forms of infrastructure. Sufficient capital expenditure can be seen as essential for a given council to meet its service responsibilities. An AMR <1 or an operating deficit for a single year does not necessarily indicate a problem, but if this is a consistent state of affairs, it indicates either a continuously deteriorating capital stock or that the council's day-to-day operations are consistently producing losses. Both of these scenarios clearly denote unsustainability. It should be noted that Australian local governments use accrual accounting.

4.3. Explanatory Variables

Remoteness is measured according to the ABS' Australian Standard Geographical Classification remoteness structure system. This is a set of boundaries devised using the Accessibility/Remoteness Index of Australia (ARIA), compiled by the Hugo Centre for Migration and Population Research at the University of Adelaide, which uses a methodology based on relative access to services calculated using distances by road to 'service centres' of varying sizes. It is an ordinal scale embracing five categories (ABS, 2016):

1 Major cities of Australia
2 Inner regional Australia
3 Outer regional Australia
4 Remote Australia
5 Very remote Australia

Two complexities arise from measuring remoteness in this way because it is an ordinal categorical variable based on a set of geographic boundaries. Firstly, with ordinal categorical explanatory variables there is no guarantee that the separation between categories is the same: there is no reason why the difference in remoteness between 'inner regional' and 'outer regional' needs to be the same as the difference between 'outer regional' and 'remote' (Agresti, 2010). Three common approaches are to ignore the problem and treat it as any other variable, to include several powers of it to capture some of the non-linearity and to apply dummy coding (McCullagh, 1980). Stevens (1946) suggests that, while it is only proper to speak of medians and percentiles of such variables and the means and standard deviations of such variables are not meaningful, treating these variables as continuous as in either of the first two approaches can be justifiable if it simplifies models enough to be pragmatic. However, our sample size is sufficient for a large number of explanatory variables and we thus choose this third option. We apply simple effect contrast coding using four dummy variables. For remoteness categories 2–5, one dummy variable takes the value 1 and the rest 0. These are labelled x_2 through x_5 for the sake of clarity. Remoteness category 1 is used as the reference category, for which all four dummy variables take the value −1 (University of California n.d.). This has the effect of comparing categories against the mean of the entire sample.

The second problem we face is that the boundaries that determine remoteness areas often pass through LGAs, resulting in LGAs spread across more than one remoteness classification, with a few extreme cases containing parts in three or four different classifications (ABS, 2016). Furthermore, there is a possibility that there may be differences between councils that fall under a single remoteness classification and councils that are spread across many classifications, because being spread across several remoteness classifications may imply heterogeneity or reflect historical factors regarding how they were formed. Our solution is to take the highest remoteness category among all of those present in a LGA because this was found to result in a slightly better fit than simple alternatives. We also introduce a 'difference' variable, denoted d, equal to the number of categories of separation between the highest and lowest remoteness classifications present.

In addition to the variables concerning remoteness, our data s*et al*so contains a number of environmental variables to account for the impact of external factors and thus mitigate the effects of endogeneity. These include the log of population z_7, as a measure of scale. In the sense of quantity of services provided, scale has long been studied as a key factor affecting local government performance. Research has most commonly examined the effects of scale on performance in terms of (a) expenditure per capita or (b) technical efficiency (see, for example, Fahey *et al*. (2016)). While neither of these exactly reflect the concepts of sustainability discussed earlier, they are clearly related. No consensus has formed on the nature of size effects in local government, but there are strong reasons to believe that they may be present (Bel, 2012). Economies and diseconomies of scale in local government can occur for many of the same reasons they occur in firms. These reasons include fixed costs, specialisation, division of labour and increasing complexity of the management structure with size. Furthermore, scale is correlated with remoteness, because the populations of LGAs in remote areas are limited by their physical expanses, so excluding a measure of scale from the model will likely cause endogeneity (Hill *et al*., 2011). The model also contains three demographic variables: percentage of Aboriginal and Torres Strait islander (ATSI) population z_8, percentage of population with a non-English speaking background z_9 and percentage of population of working age z_{10}. These have been frequently applied and found to be significant in past studies on Australian local government.

For example, Tran *et al.* (2018) found that size, the proportion of ATSI residents and the number of retirees were all important determinants of total council expenditure in South Australian local government. In studies of local government performance, a common environmental variable is population density. However, we have omitted it in this case to avoid severe multicollinearity with remoteness.

Finally, we have a set of six dummy variables to indicate which state or territory each observation is in, labelled z_1 through z_6. This is especially important because reporting requirements differ between states and we needed to adapt our data collection methods based on what sources were available. Thus, by including state dummy variables, we attempt to account for any state-contingent changes in data quality. In common with remoteness, simple effect contrast coding is applied, using WA as the reference category. Table 2 displays some summary statistics of the data set and Table 3 provides a correlation table of the non-categorical variables.

4.4. Statistical Instrument

While we have a panel data set, we find that it is unsuitable for common panel methods, such as the fixed effects and random effects models, because several of our explanatory variables are time-invariant or nearly so, including remoteness. Fixed effects and random effects models include individual-specific effects that replace the usual intercept term and are constant over time. Random and fixed effects differ from each other in the assumptions made about these individual effects terms. Random effects require the additional assumption that the individual-specific effects are uncorrelated with the explanatory variables, but it has greater statistical power as a result. Fixed effects are not suitable in the current context; time-invariant variables, such as remoteness, cannot be included because they are perfectly collinear with the individual-specific effects. Because the focus is on remoteness, a different model is required. Random effects does not have this limitation, but the assumption regarding the individual effects appears unlikely to be met and thus the estimates of such a procedure would probably be biased (Allison, 2009). We instead use an independently pooled model, which combines data from all years without considering the time dimension and generally performs better when the time dimension is short, but has the disadvantage that the environmental variables are still required (Hill *et al.*, 2011).

Another possible alternative is to use a dynamic panel model, which is characterised by the inclusion of autoregressive terms, meaning that time-lagged versions of the dependent variable are

Table 2. *Descriptive statistics of data set*

Variable	Mean	St. Dev	Minimum	Median	Maximum	Skewness	Kurtosis
AMR (y_1)	1.04	0.67	−0.08	0.95	7.65	3.22	22.27
OSR (y_2)	1.04	0.32	0.06	1.03	6.82	5.68	78.18
Remoteness difference (d)	0.46	0.58	0.00	0.00	3.00	0.96	3.54
ln(Population) (z_7)	9.37	1.83	4.11	9.48	14.02	−0.18	2.31
ATSI% (z_8)	10.13	20.41	0.00	3.24	98.40	3.21	12.41
Non-English% (z_9)	12.06	17.15	0.00	4.55	89.29	2.40	8.66
Working Age% (z_{10})	63.79	5.41	47.00	63.17	100.00	1.20	6.53
Category							**Frequency**
Remoteness 1							84
Remoteness 2							96
Remoteness 3							176
Remoteness 4							91
Remoteness 5							92

Table 3. *Correlation table for data set*

	y_1	y_2	d	z_7	z_8	z_9
y_2	0.141					
d	−0.026	0.093				
z_7	−0.106	0.216	0.257			
z_8	0.005	−0.112	−0.143	−0.369		
z_9	−0.076	0.019	−0.224	0.221	0.459	
z_{10}	0.003	0.028	−0.188	0.093	0.198	0.456

included as explanatory variables. Dynamic panels have the key advantage that they can account for serial correlation when the data set has few time periods, whereas most approaches to handling serial correlation perform poorly under this condition (Zeileis *et al*., 2020). Including autoregressive terms in a fixed effects or random effects framework leads to a further problem called Nickell bias, in which the first lagged dependent variable necessarily suffers from endogeneity and estimates are biased by an amount depending on the number of time periods. With five time periods, such as in our data set, this bias will be extreme. This problem can be corrected using the difference GMM and system GMM approaches, which both include additional autoregressive terms in an instrumental variables framework. These are used with fixed effects models, however, so they are inapplicable in our case (Roodman, 2009).

For each of our two dependent variables, there will be a 'baseline' regression, containing only the environmental variables, while omitting the remoteness dummy variables and the remoteness difference. This, by itself, gives no information about remoteness, but we use the results of this regression to calculate certain statistics. There is then a final version of each regression, which uses all variables. These specifications are compared with each other to test for the significance of remoteness. For the sake of interest, a specification including only remoteness and no control variables is also estimated.

In a preliminary test, we carried out a Breusch-Pagan test to check for the presence of heteroscedasticity. This is done by taking the squared residuals of a regression and using those as the dependent variable for an auxiliary regression using the same explanatory variables. The LM-statistic is equal to the product of the sample size and the R-squared of this auxiliary regression, and it follows a chi-square distribution with degrees of freedom equal to the number of explanatory variables (Hill *et al*., 2011). We found an LM-statistic of 61.30 for the OSR model and 76.21 for the AMR model. In both cases, we conclude at the 5% significance level that heteroscedasticity is present. Furthermore, in both cases, the source of the heteroscedasticity appears to be the state dummy variables; that is, the size of an observation's residual appears to depend on which state the observations are drawn from. The presence of heteroscedasticity induces bias in an unknown direction in OLS parameter standard error estimates. Thus, to mitigate heteroscedasticity, our regressions use Huber-White standard errors which agree with OLS errors under homoscedasticity, but remain robust when this assumption does not hold.

We test two hypotheses:

- Hypothesis 1: There is no relationship between remoteness classification and AMR
- Hypothesis 2: There is no relationship between remoteness classification and OSR.

To test our hypotheses, we need to test for the significance of all remoteness terms together – remoteness classification, its powers and remoteness difference. Due to the extremely high correlation between remoteness and its powers, looking at the significance of each one individually would likely be misleading. An F-test would usually be used for this purpose, but the standard method of calculating the F-statistic does not work when robust standard errors are used (Zaiontz, 2015). We thus tested our hypotheses using a likelihood ratio test, which may be superior anyway (Hill *et al.*, 2011).

5. Discussion of Results

Tables 4–9 contain the regression results for each regression: both 'baseline' and complete models for both dependent variables. We also include a third specification that includes only the remoteness variables, excluding the controls.

In the AMR model, as shown by Tables 4–6, remoteness is significant at the 5% significance level in the complete model, suggesting a non-linear relationship between remoteness and AMR. Examining the coefficients on the remoteness dummy variables shows that AMR is highest in the lowest remoteness category – category 1 (major cities of Australia) – then drops abruptly thereafter, but remains relatively similar among the remaining categories. Category 1 is associated with an AMR of 0.13 above average and is the only remoteness category to achieve statistical significance, whereas the other categories are associated with AMR of between 0.02 and 0.05 below average. The results show a clear contrast between urban councils and all other councils: the difference between remoteness categories 1 and 2 is far greater than the difference between categories 2 and 5, implying that despite the significance of remoteness overall, the conditions in Australia's highly remote areas discussed in Section 2 might not be important to AMR.

Also significant for the AMR model at the 5% significance level are scale in terms of population, ATSI population and several of the state dummy variables. Despite the strong negative correlation between remoteness and scale, the effects of both appear to have the same sign, with both being associated with a decrease in sustainability. This is consistent with economies of density being important to Australian local government performance, but contrasts with earlier work that found evidence of scale economies. Finally, the results for the state dummy variables indicate higher than average sustainability in Queensland (z_3) and Tasmania (z_5) and lower than average sustainability in SA (z_4), Victoria (z_6) and WA (the reference category). These differences between states probably reflect

Table 4. *Regression results for baseline model with asset maintenance ratio as dependent variable*

Variable	Coefficient	Standard error	t^*	p
Intercept	1.3121	0.2560	5.1255	0.0000
ln(Population) (z_7)	−0.0443***	0.0100	−4.4239	0.0000
ATSI% (z_8)	−0.0034**	0.0013	−2.7038	0.0075
Non-English% (z_9)	−0.0002	0.0012	−0.1689	0.8098
Working Age% (z_{10})	0.0034	0.0043	0.8046	0.4250
NSW Dummy (z_1)	−0.0093	0.0277	−0.3360	0.7286
NT Dummy (z_2)	0.0303	0.1145	0.2650	0.7907
QLD Dummy (z_3)	0.1312**	0.0452	2.9043	0.0039
SA Dummy (z_4)	−0.2105***	0.0416	−5.0634	0.0000
TAS Dummy (z_5)	0.3997***	0.0541	7.3893	0.0000
VIC Dummy (z_6)	−0.2506***	0.0316	−7.9330	0.0000
WA Dummy†	−0.0911**	0.0347	−2.6239	0.0092
Statistic				**Value**
R^2				0.0704
R^2_{adj}				0.0669
$\hat{\sigma}$				0.6325

*$p < 0.05$; **$p < 0.01$; ***$p < 0.001$; †For reference categories, values were calculated from separate simulations that had different dummy coding but were otherwise identical.

Table 5. *Regression results for complete model with asset maintenance ratio as dependent variable*

Variable	Coefficient	Standard error	t^*	p
Intercept	1.5511***	0.2788	5.5631	0.0000
Remoteness 1[†]	0.1322**	0.0417	3.1705	0.0019
Remoteness 2 (x_2)	−0.0348	0.0300	−1.1626	0.2600
Remoteness 3 (x_3)	−0.0228	0.0250	−0.9094	0.3736
Remoteness 4 (x_4)	−0.0492	0.0361	−1.3591	0.1795
Remoteness 5 (x_5)	−0.0254	0.0449	−0.5654	0.5746
Remoteness difference (d)	−0.0314	0.0293	−1.0747	0.2962
ln(Population) (z_7)	−0.0473**	0.0145	−3.2713	0.0013
ATSI% (z_8)	−0.0026	0.0014	−1.8665	0.0641
Non-English% (z_9)	−0.0022	0.0013	−1.6497	0.1091
Working Age% (z_{10})	0.0830	0.4756	0.1748	0.8540
NSW Dummy (z_1)	−0.0182	0.0283	−0.6435	0.5307
NT Dummy (z_2)	0.0836	0.1155	0.7237	0.4739
QLD Dummy (z_3)	0.1414**	0.0440	3.2110	0.0014
SA Dummy (z_4)	−0.2341***	0.0434	−5.5510	0.0000
TAS Dummy (z_5)	0.4041***	0.0540	7.4712	0.0000
VIC Dummy (z_6)	−0.2606***	0.0317	−8.2193	0.0000
WA Dummy[†]	−0.1091**	0.0358	−3.0496	0.0025
Statistic				Value
R^2				0.0772
R^2_{adj}				0.0720
$\hat{\sigma}$				0.6307

*$p < 0.05$; **$p < 0.01$; ***$p < 0.001$; †For reference categories, values were calculated from separate simulations that had different dummy coding but were otherwise identical.

Table 6. *Regression results for model with only remoteness, using asset maintenance ratio as dependent variable*

Variable	Coefficient	Standard error	t^*	p
Intercept	1.0441***	0.0182	57.4578	0.0000
Remoteness 1[†]	−0.0443	0.0263	−1.6833	0.1070
Remoteness 2 (x_2)	−0.1244***	0.0220	−5.6476	0.0000
Remoteness 3 (x_3)	0.0370	0.0211	1.7572	0.0874
Remoteness 4 (x_4)	0.0643*	0.0306	2.0997	0.0382
Remoteness 5 (x_5)	0.0673	0.0345	1.9549	0.0527
Remoteness difference (d)	−0.0400	0.0239	−1.6732	0.1012
Statistic				Value
R^2				0.0121
R^2_{adj}				0.0102
$\hat{\sigma}$				0.6514

*$p < 0.05$; **$p < 0.01$; ***$p < 0.001$; †For reference categories, values were calculated from separate simulations that had different dummy coding but were otherwise identical.

Table 7. *Regression results for baseline model with operating surplus ratio as dependent variable*

Variable	Coefficient	Standard error	t*	p
Intercept	0.5987***	0.1048	5.7147	0.0000
ln(Population) (z_7)	0.0156*	0.0061	2.5475	0.0114
ATSI% (z_8)	−0.0013**	0.0005	−2.7763	0.0063
Non-English% (z_9)	0.0004	0.0005	0.7803	0.4554
Working Age% (z_{10})	0.0053**	0.0018	2.9767	0.0032
NSW Dummy (z_1)	0.0780***	0.0122	6.3829	0.0000
NT Dummy (z_2)	−0.0280	0.0284	−0.9877	0.3372
QLD Dummy (z_3)	−0.0723***	0.0116	−6.2387	0.0000
SA Dummy (z_4)	−0.0423***	0.0110	−3.8513	0.0002
TAS Dummy (z_5)	0.2589***	0.0460	5.6341	0.0000
VIC Dummy (z_6)	−0.0515***	0.0126	−4.0833	0.0002
WA Dummy†	−0.1427***	0.0152	−9.3858	0.0000
Statistic				Value
R^2				0.1423
R^2_{adj}				0.1391
$\hat{\sigma}$				0.2967

*$p < 0.05$; **$p < 0.01$; ***$p < 0.001$; †For reference categories, values were calculated from separate simulations that had different dummy coding but were otherwise identical.

changes in reporting requirements and data quality between states, but there may also be systematic differences due to institutional environment and various other environmental factors.

It can be observed from Tables 7–9 that, in contrast to the AMR model, the result regarding remoteness in the OSR model is less conclusive. Remoteness category 3 is statistically significant, associated with an OSR of 0.03 below average. The other remoteness categories are not significant, but appear to demonstrate a non-linear relationship where OSR is high at both the highest and lowest remoteness levels. Scale is no longer significant, whereas proportion of working age population is now significant instead, although its effect does not appear particularly important in practical terms. The remoteness difference variable is not significant in either model, meaning that there is no evidence of any difference in the sustainability of councils of uniform remoteness and councils with parts in multiple remoteness categories.

The LR-statistic is equal to $2(LLF_1 - LLF_0)$, where LLF_0 and LLF_1 are the log-likelihood functions under the null and alternate hypotheses. Table 10 summarises the LR-statistics for AMR and OSR models. The LR-statistic for the complete AMR model over the baseline is 19.74 while for the OSR model it is 10.61. According to Wilks' theorem, if the null hypothesis is true, these statistics approach a chi-square distribution with degrees of freedom equal to the difference in the number of parameters between the models – in our case 4 – as the sample size goes to infinity. Because we have a large sample size, this test is appropriate. The corresponding critical value of the chi-squared distribution for a 5% significance level is 9.49. (Wilks, 1938).

We thus reject hypothesis 1 that there is no relationship between remoteness and AMR as well as hypothesis 2 that there is no relationship between remoteness and OSR. The models suggest that the effects of remoteness in the case of OSR are non-linear with a U-shaped relationship, but the evidence is not especially compelling. There is, however, clear evidence for a non-linear relationship between remoteness and AMR, where there is a major difference in AMR between councils in major cities and all other councils, but the differences between the remaining categories are not substantial. We could thus interpret this as evidence of a relationship between remoteness and both the service and revenue aspects of sustainability.

Table 8. *Regression results for complete model with operating surplus ratio as dependent variable*

Variable	Coefficient	Standard error	t*	p
Intercept	0.7229***	0.1203	6.0069	0.0000
Remoteness 1†	0.0203	0.0210	0.9702	0.3404
Remoteness 2 (x_2)	0.0096	0.0174	0.5523	0.5875
Remoteness 3 (x_3)	−0.0330***	0.0097	−3.3978	0.0010
Remoteness 4 (x_4)	−0.0188	0.0147	−1.2757	0.2085
Remoteness 5 (x_5)	0.0218	0.0234	0.9347	0.3520
Remoteness difference (d)	0.0141	0.0119	1.1834	0.2480
ln(Population) (z_7)	0.0120	0.0085	1.4234	0.1581
ATSI% (z_8)	−0.0014**	0.0005	−2.8887	0.0043
Non-English% (z_9)	0.0001	0.0005	0.2619	0.7545
Working Age% (z_{10})	0.3935*	0.1721	2.2867	0.0238
NSW Dummy (z_1)	0.0793***	0.0119	6.6480	0.0000
NT Dummy (z_2)	−0.0136	0.0300	−0.4553	0.6537
QLD Dummy (z_3)	−0.0835***	0.0140	−5.9835	0.0000
SA Dummy (z_4)	−0.0455***	0.0124	−3.6711	0.0004
TAS Dummy (z_5)	0.2643***	0.0469	5.6329	0.0000
VIC Dummy (z_6)	−0.0536***	0.0137	−3.9228	0.0003
WA Dummy†	−0.1473***	0.0176	−8.3506	0.0000
Statistic				**Value**
R^2				0.1457
R^2_{adj}				0.1409
$\widehat{\sigma}$				0.2964

*$p < 0.05$; **$p < 0.01$; ***$p < 0.001$; †For reference categories, values were calculated from separate simulations that had different dummy coding but were otherwise identical.

Table 9. *Regression results for model with only remoteness, using operating surplus ratio as dependent variable*

Variable	Coefficient	Standard error	t*	p
Intercept	1.0113***	0.0089	113.7128	0.0000
Remoteness 1†	0.0983***	0.0121	8.1179	0.0000
Remoteness 2 (x_2)	0.0302*	0.0140	2.1553	0.0355
Remoteness 3 (x_3)	−0.0094	0.0094	−1.0023	0.3299
Remoteness 4 (x_4)	−0.0643***	0.0129	−4.9738	0.0000
Remoteness 5 (x_5)	−0.0548**	0.0176	−3.1143	0.0020
Remoteness difference (d)	0.0765***	0.0109	7.0386	0.0000
Statistic				**Value**
R^2				0.0343
R^2_{adj}				0.0325
$\widehat{\sigma}$				0.3146

*$p < 0.05$; **$p < 0.01$; ***$p < 0.001$; †For reference categories, values were calculated from separate simulations that had different dummy coding but were otherwise identical.

Table 10. *Results of likelihood ratio tests*

Dependent variable	LR*	*p*-value
Asset maintenance ratio (y_1)	19.74***	0.0006
Operating surplus ratio (y_2)	10.61*	0.0313

p-values are approximate.

6. Conclusion

We have found that remoteness may have a non-linear relationship with the AMR, together with inconclusive evidence for a weaker relationship with the OSR. All other variables held constant, a greater degree of remoteness is associated with less financial sustainability. However, while remoteness was significant, we found that while councils in the lowest remoteness category were more sustainable, the difference between the remaining four categories was minimal. This suggests that, notwithstanding the unique challenges faced by remote Australian local governments due to (a) large distances between councils, (b) large distances to population centres, (c) small rate bases and (d) extensive spatial areas, there may be little difference in sustainability between remote areas and regional areas of intermediate remoteness. One explanation is that both economies of density and the challenges facing remote councils primarily affect efficiency and technology rather than sustainability. These dimensions are inter-related since if the quantity of inputs required to produce a given output changes, then *ceteris paribus* cost will also change, thus causing financial sustainability to either worsen or improve. This implies limited correlation and that efficiency and sustainability are likely to move together in the short run. It does not entirely preclude the possibility of high efficiency but poor sustainability or *vice versa*, given that there exist other, less tangible factors unrelated to efficiency that can also affect sustainability.

It is notable that the coefficient for scale was negative and significant in the AMR models and positive albeit not significant in the OSR models, thereby not dispelling confusion regarding the role of scale in municipal performance. Drew and Dollery (2016a) found that scale was one of several factors that improved various aspects of sustainability. However, while scale was measured identically – by log of population – more financial ratios were considered together. The non-linear relationship found seems to contradict PriceWaterhouseCoopers (PWC) (2006), which found that remote councils suffered from severe sustainability problems. PWC (2006) also employed KPIs, but used a much smaller 2004/05 sample of 100 councils.

We employed multiple regression models to estimate the relationship between remoteness and financial sustainability of local governments. A negative relationship between remoteness and sustainability in the sense of AMR combined with the less pronounced results for OSR underlined the importance of density economies. Network-type services affected by economies of density often rely on physical capital stock that requires maintenance, thus linking them to the AMR. This explains why councils with limited density may struggle to adequately maintain their assets. We also found that remoteness difference was not significant in either model. This indicated that council areas heterogeneous with regard to remoteness, like 'regional councils', are neither significantly more nor less sustainable. The non-linear nature of the estimated relationship between remoteness and sustainability implies that remote councils are not substantively less viable than other councils in other areas. Given the broader role of these councils, it is advantageous for their communities that they continue as fully-formed local governments.

The fact that we found the AMR to have the strongest relationship with remoteness confirms that a major threat to municipal sustainability in remote areas is an inability to maintain key assets to an adequate standard over the long term, a proposition raised by both Drew and Campbell (2016) and Dollery *et al*. (2010). This has several important policy implications. Firstly, it means that councils in remote areas are likely to remain dependent on state government grants going into the future if communities in these areas are to remain viable; these councils are likely to have little resilience if cost-shifting occurs, for example. Secondly, this dependence could be mitigated somewhat if these remote councils had the flexibility and control over their finances to better meet their expanded roles. However, given that there only a significant difference in the sustainability of the lowest remoteness category compared to the others, but not among any of the other categories, it is probably not necessary to implement specific rules applying only to remote councils. Finally, it highlights the importance of having long-term plans for asset management. Ambitious infrastructure projects are certainly designed to have benefits accruing over a long time horizon, but they also are likely to require maintenance for many decades at great expense. For instance, roads represent the greatest single cost category for Australian local government. Accordingly, if local councils are going to be responsible for these infrastructure projects, then local authorities should be evaluated in advance if there is a significant probability that municipal finances will eventually become insufficient to cover these costs.

A key limitation of our results concerns the scope of our research. We examined only two variables to proxy financial sustainability and we considered financial sustainability and not the broader community sustainability. Moreover, while we examined two dimensions of financial sustainability – AMR and OSR – this left other aspects of financial sustainability uncovered. For example, reliance on external funding was not considered (Dollery *et al.*, 2010). Future work could examine the impact of these other attributes of financial sustainability.

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Conflict of Interest Statement

The authors declare that they have no conflicts of interest to disclose.

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