Chapter 5

Measuring the extent of fiscal decentralisation: An application to the United States

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The goal of this chapter is to develop a taxonomy of decentralisation measures and how they are related to each other. In addition to introducing a common language for the different strands of literature, this taxonomy is instrumental for studying the outcomes of decentralisation. Using cross-state data from the United States, we show that aggregating distinct dimensions of fiscal decentralisation into a single indicator inevitably leads to a loss of information in the form of lower explanatory power. We conclude that the distinct aspects of decentralisation should enter regression analyses separately, in the most flexible functional form possible. In particular, we find that revenue autonomy is virtually orthogonal to the subnational share of revenues and expenditures, suggesting that it carries additional information. In this chapter we show also how the conventional measures of decentralisation can be modified to account for the differing dependence on external grants.

Introduction

For almost half a century, decentralisation of government has been approached from different angles by scholars in different fields of social sciences: public finance, public administration, and political science. This suggests that decentralisation, called rescaling in some fields, is a multifaceted process. In particular, at least three different dimensions jointly constitute this concept: the scope of authority, the degree of autonomy and the direction of accountability.

Despite the multiplicity of approaches, it appears that various definitions of decentralisation have as the common denominator the notion of transferring "power, resources, and authority" away from the central government (Schneider, 2003, p. 33). The literature however differs in the measurements of the kinds of power and resources transferred and the recipients of this power and resources. Essentially what is transferred can be classified into fiscal matters, such as the power to tax and spend, and non-fiscal matters, including autonomy and accountability. Concerning the recipients of the transferred powers and resources, the literature can be generally broken down into two categories: 1) traditional state/regional and local authorities, and 2) other cases, such as semi-autonomous government agencies, as in the case of New Public Management, or non-government entities, such as community schools, for-profit providers and so on.

The case of decentralisation to traditional local authorities has been discussed and measured in the literature along the three main dimensions: fiscal, political and administrative (*e.g.* Schneider, 2003). Going back to Philip (1954), the public finance literature commonly merges political and administrative aspects under one category labelled as the "regulation powers" while splitting the fiscal aspect into the powers of financing and delivery of public services.

Very recently, Blume and Voigt (2011) attempted to condense through factor analysis 25 commonly used indicators of decentralisation and federalism, including political, fiscal and administrative aspects (with the number of countries varying from 33 to 136 depending on the variable). When applying the Kaiser rule to drop all factors with eigenvalues under 1.0, their factor analysis suggests that the information captured by these indicators can be condensed to a dataset of seven dimensions, accounting for 70% of the variation in the original variables. Furthermore, the scree plot of the eigenvalues appears to level off after the fourth dimension, indicating that each additional dimension adds little marginal difference in the variance explained. These four leading dimensions, accounting for half of all variation in the dataset are: 1) election of local executives; 2) share of public resources raised/spent locally; 3) transfer dependence; 4) and election of local councils. The other three dimensions jointly explain an additional 20% of the variation in the original variables. These three other factors capture unconditional sharing of national tax revenue, veto power of the house of regional representatives and political fragmentation in the parliament.

One has to note that the reduction of dimensionality achieved through factor analysis does not imply that conceptually all aspects of decentralisation can be defined in terms of those seven principal components. Rather, the results mean that, in this cross-country sample, various manifestations of decentralisation would appear to be driven by these seven forces, which Blume and Voigt (2011) call "latent variables". However, this regularity might not hold in other contexts.

This taxonomy of decentralisation dimensions does more than just introduce a common language for the parallel discussions in different strands of literature. It is

believed to be instrumental for measuring and studying the outcomes of decentralisation. Thus almost a decade ago this was eloquently stated by Schneider (2003, p. 35):

> If there are multiple dimensions, then decentralisation along one dimension could be related to one set of causes and effects, and decentralisation along another dimension could relate to a different or opposite set of causes and effects. Alternatively, decentralisation along one dimension could interact or combine with decentralisation along another dimension (to produce outcomes). Researchers who do not explicitly look at each dimension or haphazardly aggregate dimensions will mismeasure the type and degree of decentralisation and draw incorrect inferences about the relationship between decentralisation and other phenomena.

Both theoretical and empirical studies have identified specific instances of lumping opposite sets of causes and effects under one decentralisation measure. Thus, the commonly used share of subnational expenditures lumps together in one explanatory variable two opposite effects: 1) that of tax competition resulting from revenue decentralisation and 2) that of over-fishing of the common revenue pool resulting from grant-financed expenditure decentralisation (Rodden, 2003). On the empirical side, Kyriacou and Roca-Sagalés (2011) find that fiscal decentralisation is positively correlated with governance quality, as measured by the World Bank's World Governance Indicators, while different measures of political decentralisation (such as regional elections or bicameralism) are negatively correlated with the governance quality.

The common caveat in the empirical studies of decentralisation is that regulation, while being the most common form of government power, cannot be measured by any indicator constructed from fiscal data.[1] However, even setting aside the regulation aspect, using cross-country data from IMF's GFS, Martinez-Vazquez and Timofeev (2010) point out the importance of separately measuring different aspects of fiscal decentralisation. They show that aggregating distinct dimensions of fiscal decentralisation into a single indicator inevitably leads to a loss of information in the form of lower explanatory power. They conclude that in a multivariate framework the distinct aspects of decentralisation should enter regression analyses separately, in the most flexible functional form possible. In particular, they find that revenue autonomy is virtually orthogonal to the sub-national share of revenues and expenditure, suggesting that it carries information complementary to that contained in the decentralisation ratios. Similarly in their cross-country study, Blume and Voigt (2011) find that revenue autonomy is uncorrelated not only with the revenue and expenditure shares but also with political aspects, such as local elections. They come to a similar conclusion that "finer-grained indicators should aim at keeping conceptually separate the different dimensions of federalism."

This chapter aims to further corroborate these findings by showing the validity of these points in a completely different context: decentralisation within the US states. In addition, we suggest how the traditional measures of decentralisation can be modified to account for an additional aspect of decentralisation, namely the dependence on grants external to the state-local relations.

Dimensions of state-local decentralisation in the United States

Existing measures of fiscal decentralisation essentially boil down to a few core concepts: locally raised revenues, locally decided expenditure, locally spent intergovernmental grants, and the number and relative size of local government units. To visualise the essence of specific measures and the relationship among them, we use the tabular representation suggested by Martinez-Vazquez and Timofeev (2010). In Table 5.1 we apply this tabular visualisation to state-local finances in Georgia, USA. With this table, the structure of the total state-local finances in Georgia can be analysed, on the one hand, by the level of government generating public revenues (horizontal axis) and, on the other hand, by the level of government spending these resources (vertical axis).

The combination of three sources (federal, state and local) and two uses (state and local) breaks the total state-local finances into six parts or quadrants. For example, Table 5.1 shows that in the state of Georgia, 40% of total state-local expenditures fall into the most decentralised category of being both locally financed and locally administered (Quadrant VI). At the same time 39% of total state-local expenditure fall into the most centralised category of being both centrally financed and centrally administered (Quadrants I-II). An additional 21% represents an intermediate case of expenditure, which are locally administered but centrally financed (Quadrants IV-V).

Table 5.1. **Relative authority of different levels of government over total state-local finances in Georgia, USA, 2002**

		Revenue-raising authority		
		Federally financed **21%**	State financed **39%**	Locally financed **40%**
Expenditure responsibilities	State administered **39%**	(Quadrant I) **19%**	(Quadrant II) **20%**	(Quadrant III) **<0.2%**
	Locally administered **61%**	(Quadrant IV) **2%**	(Quadrant V) **19%**	(Quadrant VI) **40%**

Note: Over one fifth of local own revenue derives from piggybacking on state sales and excise taxes.

Source: Prepared by authors based on data from the Bureau of Census.

Because the shares of the six quadrants in the total add up to one, it suffices to know only five out of the six numbers to have a complete picture of the composition. Moreover, in states where state governments do not receive grants from local authorities, only four numbers are required to describe the vertical break-down of public finances (as Quadrant III is empty). Obviously, no single indicator among those used in the literature can relay all the information that requires four separate numbers to describe. Indeed, the expenditure ratio captures the combined share of grant-financed (Quadrants IV-V) and self-financed (Quadrant VI) expenditure by local governments but conveys no information on the size of these two parts relative to each other. This limitation is easily identifiable in each of the measures used in empirical decentralisation literature as summarised in Table 5.2.

Furthermore, given the insignificant share of federal transfers by-passing states and flowing directly to local authorities (on average 4% of state-local finances across all states), Quadrant IV could be also ignored, thus requiring only three numbers to describe state-local decentralisation. Indeed, as summarised in Table 5.2, any single indicator among those used in the literature, can be expressed as a rational function of the expenditure ratio (ER), revenue ratio (RR) and the share of federal grants in the state-local finances, DF=I +IV:

CR= (1-DF)*RR/ (1-ER),

RA= (1-DF)*RR/ER, and

VI=1-RA.

Table 5.2. **Informational limitations of different decentralisation measures used in the literature**

Measure	Graphical representation	Application
Expenditure ratio (ER)	IV+V+VI	Oates (1972), Woller and Phillips (1998), Zhang and Zou (1998), Davoodi and Zou (1998), Akai and Sakata (2002)
Revenue ratio (RR)	(III +VI)/(QIII+VI+ II +V)	Oates (1972), Akai and Sakata (2002)
Average ratio (AR)	(ER+RR)/2	Akai and Sakata (2002)
Revenue autonomy (RA)	(III+ VI)/ (IV+V+VI)	Akai and Sakata (2002),Habibi *et al.* (2003)
Vertical imbalance (VI)	(IV+V – III)/ (IV+V+VI)	DeMello (2000), Ebel and Yilmaz (2002)
Composite ratio (CR)	VI/(I + II)	Martinez-Vazquez and Timofeev (2010)

Note: Capital roman figures denote the share of each quadrant in the total state-local public finances.

Source: Authors' calculations.

It has to be acknowledged that the sufficiency of the three indicators stems from neglecting differences in local discretion when it comes to levying different local taxes and spending at the local level. In particular, Quadrant VI lumps together revenue from sources over which local governments have almost complete control, such as property taxes, with piggybacks on the state taxes, such a local option sales tax (LOST), often earmarked for specific local or area projects. In the state of Georgia, the LOST revenue accounts for 21% of local own-source revenue compared to one third accounted for by property taxes.

Besides the shares of different levels of government in total public revenues and expenditure, some empirical studies have also measured decentralisation by the number and average size of jurisdictions at each level.[2] Furthermore, when there are several tiers of local government, the territorial fragmentation of different tiers is weighted by their relative roles in the public finance (Breton and Scott, 1978).[3] To capture the fragmentation of different types of local authorities in the United States, we follow the approach of Martinez-Vazquez and Timofeev (2010), which is essentially Breton and Scott's indicator but without the normalisation by population or land area. The second modification of Breton and Scott's indicator is that different tiers of government are also weighted according to their role in generating public revenues (the R-Scale indicator) as an alternative to weighing according to their role in spending public resources (the E-Scale indicator). Below we illustrate the computation of the scale indicators using the example of the state of Georgia.

Formula: R-Scale = {[State government revenue] + [general purpose authorities' revenue]/# of general purpose authorities + [special purpose districts' revenue]/# of special purpose districts}/ State-local revenue.[4]

Example: R-Scale measure in the state of Georgia

1 jurisdiction at the state scale	State government revenue share = 42%
693 general purpose jurisdictions at the local tier	General purpose jurisdictions' revenue share = 24%
604 special purpose jurisdictions at the local tier	Special purpose jurisdictions' revenue share = 34%

R-scale = 0.42+ 0.24/693 + 0.34/604 =0.424.

Single indicator

As remarked above, a single decentralisation ratio is unlikely to capture the entirety of powers assigned to the sub-national level. This is because different aspects of government activities (regulation, financing, and delivery) cannot be captured with the same indicator. This has been previously pointed out in the literature, for example by Schneider (2003, p. 42): "No single indicator can capture the decentralisation concept fully, and no simple combination of indicators, such as an average or an index, can capture the multidimensionality of the concept."

However, sometimes a single indicator is needed that would at a glance show us a general trend in fiscal decentralisation, and also reveal relationships to other variables, in either a tabular or graphical form. While no single indicator can capture all aspects of decentralisation, some indicators might be more inclusive and informative than others. Thus, some indicators can be affected by and therefore carry information about other indicators but not the other way around. This can make some indicators more informative than others. For example, taxing authority usually requires political legitimacy for the local government in the form of being locally elected. Therefore, larger taxing powers can signal larger political autonomy. By contrast, having local elections does not necessarily require taxing powers as it is not unheard of that elected local councils being kept on a short leash by the national authorities by making them entirely dependent on the revenue transferred from the central government. Similarly, higher revenue-raising powers are usually necessitated by higher expenditure responsibilities and can therefore signal this feature. By contrast there are countries where local governments are responsible for major expenditure items, such as education and healthcare, without raising any significant amount of revenue locally.

While it would be impossible to capture a multi-dimensional process of decentralisation with a single indicator, we nevertheless can attempt to measure more than just one aspect, that is not only revenue or expenditure based. Thus, out of the various decentralisation measures summarised in Table 5.2, AR and CR can be expected to contain information on both revenues and expenditure, as both AR and CR are rational functions of the ER and RR indicators. However, collapsing the multi-dimensional fiscal space into a scalar indicator requires judgment (weighting) regarding the relative importance of different aspects of decentralisation. Furthermore, choosing specific – implicit or explicit weights – is not just about quantification. If there is a positive "progress" along all dimensions of decentralisation, we can confidently call it an increase in decentralisation and that would be reflected in higher values of the AR and CR indicators. But what if we have a significant increase in grant-financed local expenditure with a slight reduction of locally-generated revenues? Depending on how we weight these changes relative to each other, we might have an aggregate measure to show either an increase in the decentralisation or a decrease, that is qualitatively different assessments.

Notwithstanding this shortcoming, the aggregate indicators (AR and CR) are still more informative than either ER or RR alone. Indeed, devolving responsibility for only the administration of some services but not for their financing will raise CR by decreasing its denominator.[5] However, devolving the responsibility for both administration and financing of this service will both decrease the denominator and increase the numerator of CR thus resulting in a larger increase in the ratio than in the first case. Thus, the CR indicator weights more heavily comprehensive decentralisation than just the decentralisation of administration. The same holds for the AR indicator.

Empirical evidence on the relative performance of the decentralisation measures for the state-local finances in the United States

In the previous discussion, we have pointed out conceptual differences among various decentralisation indicators in terms of the scope of various dimensions of decentralisation that they capture. However, in practice, the importance of these conceptual differences will depend on the extent of divergence in the progress along various dimensions of decentralisation. Thus, when we have uniform progress along all dimensions of decentralisation, then expenditure decentralisation will be the same as revenue decentralisation and both decentralisation ratios will be telling us the same information while the revenue autonomy indicator would not give any information because it would be always equal to one minus the share of federal grants in the state-local finances (1-DF).

Further to the point, Martinez-Vazquez and Timofeev (2010) report that, using the scale indicators (R-scale and E-scale) on the IMF's GFS data adds little additional information on top of that relayed by the decentralisation ratios as the two scale indicators are almost perfectly inversely correlated with the corresponding decentralisation ratios used in their construction. This suggests that the territorial fragmentation does not develop independently from the fiscal ratios, at least in the countries included in the GFS dataset.[6]

Therefore, we examine next in this chapter differences in the actual behaviour of the seven decentralisation indicators in relationship to each other and in statistical association with some variables of interest:

1. Expenditure ratio (ER)

2. Revenue ratio (RR)

3. Average ratio (AR)

4. Composite ratio (CR)

5. Revenue autonomy (RA)

6. E-scale

7. R-scale

We start by summarising the relationships among these indicators in a visual form by means of a biplot. The biplot display is a commonly used multivariate method for graphing row and column elements (in this case, states and their decentralisation indicators correspondingly) using a single display (Gabriel, 1971). The rays originating from the centre of the graph are linear projections of the seven indicators onto the

two-dimensional subspace where most variability occurs in the original multidimensional dataset, capturing almost 95% of total variation in our case.[7]

The principal component biplot is a powerful tool that allows us to capture the relationship between the different indicators. Variable rays representing uncorrelated indicators are orthogonal. The smaller the inner angle between rays, the higher is the positive correlation between the values of the corresponding indicators. For negatively correlated variables, the inner angle is greater than 90°. Because biplot is a two-dimensional projection of a multi-dimensional space, it deforms the relative configurations among objects depending on the angle of projection. We use the projection aspect that preserves angles among indicators but not necessarily distances among states.

Similar to the cross-country findings by Martinez-Vazquez and Timofeev (2010), we also observe that the R-scale indicator is almost perfectly inversely correlated with the corresponding ratio (RR) used in its construction to weigh the government tiers. This suggests that the territorial aspect of decentralisation (territorial fragmentation) does not develop independently from the revenue decentralisation within the US states. However, the negative correlation between the E-scale and ER is strictly less than unity thus suggesting that, unlike revenue raising powers, the assignment of expenditure responsibilities to local authorities might be unrelated to the extent of their fragmentation.

We also find that the two aggregate measures (AR and CR) are almost perfectly and positively correlated, which is not surprising given that they are constructed from the same ingredients (ER and RR) but using different functional forms.

Figure 5.1. **Principal component biplot for decentralisation indicators in the United States in 1992**
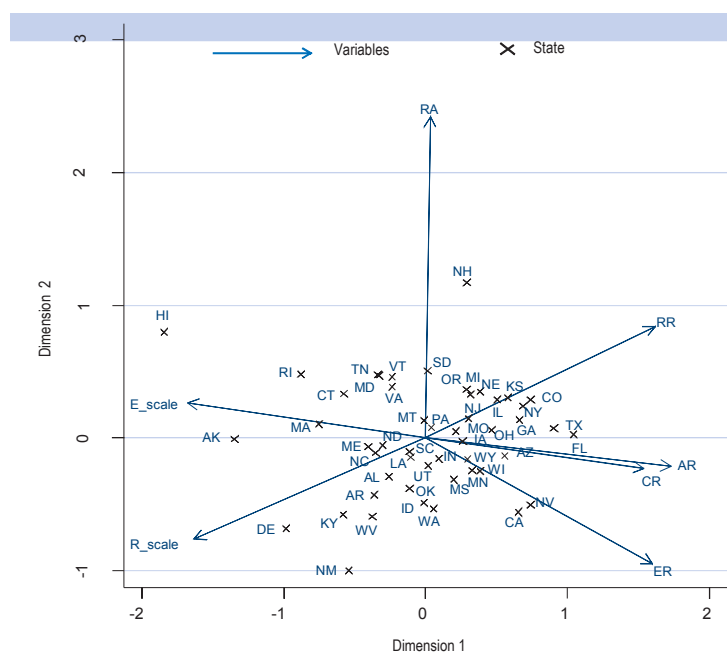
Source: Prepared by the authors based on data from the Census of Government.

The Revenue autonomy indicator has clear relationships with the Revenue ratio (positive) and the Expenditure ratio (negative). This latter negative association conforms to the prediction by Martinez-Vazquez and Timofeev (2010), which was derived under

the assumption that the elasticity of the revenue ratio measure with respect to the expenditure ratio measure is less than one.[8] This possibility that two dimensions of the same decentralisation process can move in opposite directions might partially explain the inconsistencies in the findings of existing studies of decentralisation outcomes. It also poses challenges for meta-analyses of those studies, such as the recent one by Feld *et al.* (2010), comparing estimates of the impact on growth obtained in studies using inconsistent measures of decentralisation, including the expenditure ratio and revenue autonomy indicator.

As a robustness check, in Table 5.3 below we report coefficients of pair-wise correlations between our seven indicators. The relationships uncovered by examining the projections of those variables on the two-dimensional biplot space for the most part accord with the values of correlation coefficients. The slight differences are due to the biplot approximation as the rank of our dataset is more than two.

The individual points on the biplot chart are linear projections of our observations labelled with corresponding state codes. Because the variables are normalised by subtracting the mean and dividing by the standard deviation, data points located in the centre of the graph represent US states with average values of the decentralisation indicators. Data points located away from the centre in the direction of some variable ray represent states with values of that variable that are distinct from the average.

Table 5.3. **Coefficients of pair-wise correlation**

	ER	RR	AR	CR	RA	E-scale	R-scale
ER	1.00	0.72	0.95	0.84	-0.36	-0.91	-0.73
RR	0.72	1.00	0.90	0.74	0.34	-0.85	-1.00
AR	0.95	0.90	1.00	0.86	-0.07	-0.95	-0.91
CR	0.84	0.74	0.86	1.00	-0.03	-0.80	-0.73
RA	-0.36	0.34	-0.07	-0.03	1.00	0.09	-0.30
E-scale	-0.91	-0.85	-0.95	-0.80	0.09	1.00	0.87
R-scale	-0.73	-1.00	-0.91	-0.73	-0.30	0.87	1.00

Source: Authors' calculations.

As one can see from the biplot graph, New Hampshire is the outmost outlier in the positive direction along the revenue autonomy ray, while Washington state is the outmost outlier in the negative direction. A few states stand out in the direction of the fiscal ratios: Florida having the largest share of sub-national revenues and expenditure while Hawaii having the smallest sub-national shares but at the same time among the highest values of the revenue autonomy indicator.

Next we examine how much information is lost in practice by *i)* using a single indicator rather than several, or *ii)* one single indicator rather than another single indicator.

This empirical exercise aims to compare the explanatory power of alternative decentralisation indicators in terms of the share of variation in the outcome variable explained by the given indicator(s), known as the R-squared. In computing the R-squared, we do not include any additional regressors, *i.e.* we are running a univariate regression.

Although additional regressors could explain more variation in the outcome variable, this additional explanatory power would be due to the regressors other than the decentralisation measures we are trying to compare. Being just a squared coefficient of correlation, the R-squared captures the strength of statistical association between decentralisation and the variable of interest but it does not imply causality; in fact, the coefficient of correlation might represent the effect of that socio-economic variable on decentralisation. This suits our purpose because we are interested in evaluating the ability of alternative indicators to capture information about decentralisation regardless of whether it is used on the left-hand side or the right-hand side of a regression equation.

Table 5.4 provides some evidence on the explanatory power of different indicators of fiscal decentralisation for five socio-economic outcomes in the US states:[9]

- real per capita income growth

- real per capita GDP growth

- employment growth

- population growth

- government size

For each of the outcome variables, we report the share of total variation explained by the pair of indicators corresponding to the respective column and row, while adjusting for the number of explanatory variables employed (adjusted R-squared). In the diagonal cells, where the row and the column represent the same indicator, we report the share of total variation explained by that single indicator (the squared coefficient of its correlation to the outcome variable). The decentralisation indicators are for 1992 while the values for the outcome variables are averaged over 1992-96, following Akai and Sakata (2002). While lagging the fiscal indicators can help capture causality, we do not claim any causal link but rather discuss the strength of a statistical association. This is because our discussion of measuring decentralisation equally applies whether decentralisation is measured as a dependent or independent variable.

The explanatory power of each pair of decentralisation indicators varies among the outcome variables and overall is higher for personal income growth and lower for employment growth. While for any pair of decentralisation indicators the explained share of variation in the outcome variables is smaller than the joint explanatory power of all seven indicators, according to an adjusted R-squared, the loss of explanatory power is considerable only for the government size regression.

Even after adjusting for the number of regressors, there is a substantial difference in explanatory power between the best performing pair of indicators and either of the two individual single indicators, or the best performing single indicator for that matter. It also comes as little surprise that no single indicator performs well for all outcome variables. The expenditure ratio performs best for employment growth. The revenue ratio performs best in the government size regression. The average ratio is the best performer for GDP growth and personal income growth. The composite ratio is the best performer for population growth. As a standalone indicator, revenue autonomy has almost no explanatory power.

Table 5.4. **Explanatory power of a pair of decentralisation indicators (adjusted R-Squared)**

	ER	RR	AR	CR	RA	E-Scale	R-scale
	Real per capita income growth						
	ER	RR	AR	CR	RA	E-Scale	R-scale
ER	0.236						
RR	0.28	0.272					
AR	0.28	0.28	0.286				
CR	0.239	0.273	0.411	0.14			
RA	0.243	0.31	0.271	0.122	-0.0194		
E-Scale	0.231	0.271	0.376	0.127	0.127	0.143	
R-scale	0.24	0.347	0.273	0.17	0.225	0.17	0.187

Variation explained by all seven indicators: 0.380

	Real per capita GDP growth						
	ER	RR	AR	CR	RA	E-Scale	R-scale
ER	0.251						
RR	0.241	0.175					
AR	0.243	0.246	0.255				
CR	0.29	0.157	0.38	0.119			
RA	0.235	0.275	0.257	0.129	0.0105		
E-Scale	0.263	0.157	0.324	0.113	0.146	0.131	
R-scale	0.236	0.191	0.257	0.117	0.239	0.123	0.128

Variation explained by all seven indicators: 0.341

	Employment growth						
	ER	RR	AR	CR	RA	E-Scale	R-scale
ER	0.23						
RR	0.222	0.0792					
AR	0.22	0.226	0.189				
CR	0.213	0.177	0.173	0.178			
RA	0.223	0.219	0.225	0.228	0.0517		
E-Scale	0.247	0.0924	0.206	0.21	0.168	0.111	
R-scale	0.221	0.0661	0.216	0.192	0.218	0.0943	0.0624

Variation explained by all seven indicators: 0.216

	Population growth						
	ER	RR	AR	CR	RA	E-Scale	R-scale
ER	0.0835						
RR	0.0987	-0.00586					
AR	0.0936	0.105	0.0485				
CR	0.107	0.264	0.188	0.123			
RA	0.0766	0.0483	0.0669	0.148	0.0262		
E-Scale	0.0642	0.114	0.0472	0.163	0.0949	0.0659	
R-scale	0.0774	-0.0142	0.0547	0.224	0.0692	0.0893	0.000367

Variation explained by all seven indicators: 0.242

	Government size						
	ER	RR	AR	CR	RA	E-Scale	R-scale
ER	0.0688						
RR	0.122	0.14					
AR	0.13	0.122	0.113				
CR	0.0512	0.155	0.177	0.0423			
RA	0.0785	0.128	0.102	0.0257	-0.0179		
E-Scale	0.0779	0.216	0.282	0.0532	-0.0026	0.0155	
R-scale	0.0715	0.221	0.0939	0.0606	0.065	0.0837	0.079

Variation explained by all seven indicators: 0.334

Note: Dependent variables are in levels, 1992-1996 average; independent variables are in logs, 1992.

Source: Authors' calculations.

We also attempted to take into consideration the fact that, unlike in the cross-country setup of Martinez-Vazquez and Timofeev (2010), for state-local finances a pair of indicators might not perform that well because federal grants introduce an additional, third dimension. To address this, we repeated this empirical exercise as a second step of a partitioned regression on three decentralisation indicators. More specifically, in the first

step we regressed all variables on the share of federal grants in state-local finances. Then in the second step, we replicated regressions reported in Table 5.4 but this time replacing each variable with the residuals from regressing that variable on the federal dependence in the first-step regression. This produced results that are qualitatively very similar to those reported in Table 5.4.

Conclusions

This chapter corroborates previous findings from cross-country studies, showing that aggregating distinct dimensions of decentralisation into a single indicator inevitably leads to a loss of information in the form of lower explanatory power. Because the validity of this point has been shown in a completely different context from that of the previous studies, it should leave no doubt that the distinctions among the dimensions of decentralisation are not just theoretical hair-splitting but have real implications for applied studies.

Previous studies did not take into account how grants to the central budget from foreign and sub-national entities might affect the decentralisation indicators constructed from cross-country data. This could lead to incomparable measures of decentralisation in poor developing countries, where a significant share of international assistance can be in the form of central government budget support grants. In this chapter, we show how the traditional measures of decentralisation can be modified to account for the dependence on grants external to the state-local relations in the United States. This approach can be also applied to the case of foreign grants in a cross-country context.

The main message of this chapter is that there is no single best measure of fiscal decentralisation. This reinforces earlier calls for distinct aspects of decentralisation to enter regression analyses separately, in the most flexible functional form possible.[10] Even when we include measures of various decentralisation aspects as separate regressors, we effectively assign relative weights (given by the regression coefficients). However, in this case the weights are less arbitrary than in a composite measure, as they are determined by the relative impacts of the decentralisation aspects on the specific dependent variable.

One problem with regression-derived weights is that, if different aspects of decentralisation have a common driver (*e.g.*, more fragmented local governments might have less taxing powers), then the regression might fail to clearly attribute the impact to separate decentralisation indicators, thus resulting in statistically insignificant weights (estimated coefficients). A composite indicator would not have such a problem as it assigns predetermined (arbitrary) weights as a result of the chosen functional form for the formula used to compute the decentralisation measure. However, these arbitrary weights do not reflect the relevance of different aspects of decentralisation for the outcome that is being studied. Therefore, a composite variable might perform well for one outcome but not so well for some other outcome variable. By contrast, including disaggregated indicators in the regression would assign weights specific to that particular causal relationship.

To avoid the problem of multi-collinearity without resorting to arbitrary weights, one can reduce the dimensionality of a set of decentralisation measures by way of factor analysis, as in Blume and Voigt (2011), and then use the resulting principal components as explanatory variables in the regression analysis. However, the interpretation of the principal components may not always be transparent or even intuitive.

Finally, explanatory variables should include both fiscal and non-fiscal variables. Thus, in addition to measuring both fiscal importance and fiscal autonomy of sub-national governments, any study of economic outcomes should also control for other institutional arrangements such as: territorial structure of sub-national jurisdictions, political arrangements including legal status of local authorities, clarity in the delineation of powers among levels of government, or sub-national borrowing powers and financial infrastructure. Voigt and Blume (2010) find that fiscal performance and government efficiency outcomes are strongly affected by a number of non-fiscal dimensions of decentralisation: electing municipal governments locally, empowering states to veto at least some federal-level legislation and the political fragmentation of parliament in terms of the heterogeneity of interests.

Notes

1. Indirectly, however, fiscal data can capture the relative roles of different tiers of government in regulation. To the extent that regulation requires manpower to prescribe and enforce regulatory norms, the relative share of local governments in total public administration expenditure or in the total civil service of a country should reflect the role of local government in regulation. Concerning the regulation of local government services, the extent of funding mandated by the national government can be measured by the share of conditional grants in local government revenue (Levin, 1991).

2. See, for example, Oates (1985), Nelson (1986) and Eberts and Gronberg (1990).

3. Breton and Scott's indicator is computed as the average size (population-wise or land-wise) of the different tiers of government weighted according to the shares of those tiers in total public expenditure. However, Martinez-Vazquez and Timofeev (2010) argue that population and land area should play a more flexible role and enter them as separate explanatory variables and instead use the inverse of the number of jurisdictions.

4. General purpose authorities include county, municipal and township governments, while special purpose districts include independent school districts and special districts.

5. In states where all local government expenditure are financed by the state government, the CR indicator of decentralisation would be insensitive to changes in the amount of these centrally financed expenditures. This might be a good quality of a decentralisation indicator, as a lack of any source of marginal revenue for local governments makes reaping the benefits of decentralisation less feasible.

6. It can be shown that, when territorial fragmentation and decentralisation ratios are independent from each other, the negative correlation between a scale indicator and the corresponding decentralisation ratio is strictly less than unity. Moreover, the higher is the variation in territorial fragmentation relative to the variation in the decentralisation ratio, the weaker is this negative correlation between the scale indicator and the corresponding decentralisation ratio. For proof see Annex 5.A1.

7. Somewhat similar to the R-squared in the case of a regression, the goodness of fit of a biplot is defined as the fraction of the sum of squares of singular values accounted for by the two largest singular values of the dataset.

8. In our dataset the elasticity of the revenue ratio measure with respect to the expenditure ratio measure is 0.72.

9. We chose this set of outcome variables because they were used previously in studies of state-local decentralisation in the United States (see, for example, Xie *et al.*, 1999; Akai and Sakata, 2002; Stansel, 2005; Akai *et al.*, 2009; and Hammond and Tosun, 2011). The list of variables and data sources and descriptive statistics are presented in Annex 5.A1, Tables 5.A1 and 5.A2, respectively.

10. For example, Feltenstein and Iwata (2005) use a vector autoregressive (VAR) model to simultaneously determine relative weights of different decentralisation aspects in a composite measure for China and to estimate the impact of this synthesised decentralisation measure on the country's economic growth and inflation.

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Annex 5.A1

Lemma: If territorial fragmentation and decentralisation ratios are independent from each other, the negative correlation between a scale indicator and the corresponding decentralisation ratio is strictly less than unity.

Proof:

Let us consider a simplified case of a two-tier government: central and local.

Let R stand for a decentralisation ratio (revenue or expenditure). Then a related scale measure can be expressed as following:

$S= (1-R) +R/\#,$

where # is the number of local government units

Let's denote $(1/\#-1)$ as G, then

$S=1+R*G$

Recalling that VAR $[X] =E[X^2]-E^2[X]$ and COV$[X, Y] =E[X*Y]-E[X] *E[Y]$, we express the correlation between R and S as

$$\frac{\text{cov}[R,S]}{\sqrt{VAR[R]*VAR[S]}} = \frac{E[R*S]-E[R]*E[S]}{\sqrt{E[R^2]-E^2[R]}*\sqrt{E[S^2]-E^2[S]}}.$$

If R and G are independent, then

$E[R*S] = E[R] +E[R^2] * E[G]$, and

$E[S] = 1+E[R]* E[G]$,

$E[S^2]-E^2[S] =E[R^2] * E[G^2]-E^2[R]*E^2[G]$,

Substituting these into the correlation formula yields

$$\frac{E[R]+ E[R^2]*E[G]-E[R]-E^2[R]*E[G]}{\sqrt{E[R^2]-E^2[R]}*\sqrt{E[R^2]*E[G^2]-E^2[R]*E^2[G]}} = E[G]*\sqrt{\frac{VAR[R]}{VAR[R*G]}}.$$

Now recall the law of total variance:

$VAR[X] =E[VAR[X|Y]] +VAR[E[X|Y]]$.

If R and G are independent, then VAR [G |R] =VAR [G] and E [G |R] =E [G], which yields

VAR[R*G] =E [VAR[R*G |R]] +VAR [E[R*G |R]] =E [R^2]*VAR [G] +VAR[R]*E^2 [G].

Substituting this into the correlation formula yields

$$E[G]*\sqrt{\frac{VAR[R]}{VAR[R*G]}} = -\sqrt{\frac{E^2[G]*VAR[R]}{E[R^2]*VAR[G]+VAR[R]*E^2[G]}} = \frac{-1}{\sqrt{\frac{E[R^2]*VAR[G]}{E^2[G]*VAR[R]}}+1}$$

This is because E [G] <0.

It is clear that the latter expression is negative and less than unity in absolute value unless VAR [G] =0.

Moreover, the higher is the variation in territorial fragmentation relative to the variation in decentralisation ratios, the weaker is this negative correlation between the scale indicators and corresponding decentralisation ratios.

Table 5.A1. **Variables description and sources**

Variable	Description	Source
incpc_gr	Real per capita income growth rate	U.S.Census
gdppc_gr	Real per capita GDP growth rate (chained 2005 dollars)	U.S.Census
emp_gr	Employment growth rate	U.S.Census
pop_gr	Population growth rate	U.S.Census
gov_siz	Government size, defined as the share of total state and local tax revenues in personal income	U.S.Census

Source: Authors' calculations.

Table 5.A2. **Variables descriptive statistics**

Variable	Obs	Mean	Std. Dev.	Min	Max
incpc_gr	50	0.016	0.007	-0.007	0.028
gdppc_gr	50	0.025	0.012	-0.014	0.051
emp_gr	50	0.022	0.012	-0.003	0.059
pop_gr	50	0.014	0.010	0.002	0.052
gov_siz	50	0.116	0.014	0.095	0.181

Source: Authors' calculations.