ABSTRACT

Title of Dissertation: WHAT TYPE OF FISCAL DECENTRALIZATION SYSTEM HAS BETTER PERFORMANCE?

Chih-hung Liu, Doctor of Philosophy, 2007

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Fiscal decentralization has been a pressing issue in the academic discipline of public finance as well as empirical economics for years. The conventional wisdom of fiscal decentralization advocates is that fiscal decentralization can facilitate the economic development of a country. In addition, the World Bank and IMF have identified over sixty countries where decentralization is an important element of development strategy. However, with the proliferating implementation of fiscal decentralization, the actual outcome has varied from country to country. Indeed, some countries did benefit from the introduction of fiscal decentralization policy. Meanwhile, quite a few other countries with a high degree of decentralization have suffered from economic crisis. In other words, the relationship between fiscal decentralization and economic performance is still inconclusive.

A major barrier to understanding is the lack of well-defined theoretical framework to empirically measure fiscal decentralization in a policy relevant way. The most widely used measurement is the ratio of sub-national government expenditure/revenue to total government expenditure/revenue. But this indicator is criticized too simple to capture

the dimensions of fiscal decentralization. Specifically, it ignores key qualitative dimensions, such as taxing power, borrowing power and the independence of local officials, which are also very important to implementing fiscal decentralization.

The primary contribution of this dissertation is a novel theoretical framework for empirical measurement of fiscal decentralization. The research question is: what types of fiscal decentralization system produce better economic performance? The innovative methodology, the application of cluster analysis, enables us to incorporate the quantitative measurement of fiscal decentralization as well as qualitative dimensions. We go beyond the traditional way of measuring a country's fiscal decentralization, treating it instead as a system with its own institutional design. Adopting this method requires us investigate the institutional arrangement for fiscal decentralization in a country. The institutional arrangement we review in detail includes: supra-national government, federal or unitary state, numbers of tiers of governments, taxing power, borrowing power, and independent local official. These components have also been recognized by many economists and policy analysts. What is original to this work is that, after identifying these institutional arrangements, we can group different countries with similar institutionally similar fiscal decentralization systems together in broad categories by using cluster analysis. We are then in a position to measure the successes of each cluster according to several indicators, such as: economic performance, fiscal performance, and governance performance. An inter- and intra-cluster comparison and one empirical model thus give a snapshot of the relationship between fiscal decentralization and economic performance. The ultimate goal, for policy analysis, is to be able to distinguish the desirable institutional arrangements of fiscal decentralization from the less desirable ones.

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Chapter I: Introduction

Fiscal decentralization, defined as the assignment of expenditure functions and revenue sources to sub-national levels of government, has become a clear trend in government reform in both developed countries as well as in transition economies. Traditional fiscal decentralization research focuses on the resulting economic benefits which accrue to its use. It has been argued, for example, that local governments are presumed to be more informed as to the demographics of their respective jurisdictions, and therefore will allocate public resources more efficiently and more effectively than the central government could. The World Bank has identified more than sixty countries where decentralization is an essential component of development strategy.

With the proliferation of fiscal decentralization practices around the globe, research studies have focused on the causes behind, and motivations for, a particular country's undertaking the reforms necessary to bring about fiscal decentralization. Some contend that, with the approach of globalization, governments no longer wield the financial power of a monopoly. In a global market, competition originates not only from neighboring countries but also from countries at such a distance they had not previously constituted a competitive threat. To compete in the global economy, industrial reorganization is insufficient. Governments must be able to restructure the ways in which they operate, and to respond to the rapid changes and unfamiliar challenges which globalization requires. Furthermore, with the increasing pressure in many countries for democratization, these governments can no longer afford to

ignore expressions of discontent and frustration demonstrated by their citizenry in the matter of providing necessary and adequate public services.

In order to successfully cope with the public's ever-increasing demands and to reduce the transaction costs inherent in providing timely public services in an evenly-distributed fashion, national governments must adapt to the varied and complex transformations occurring everywhere today. There are a number of ways which governments may undertake to achieve their goals. One way many experts believe offers great promise is through fiscal decentralization. It has been argued that the sub-national government is much more likely to know the local needs and is therefore more capable of delivering adequate levels of public services than national government are or could be, due primarily to the fact that most local governments are more closely scrutinized and have the local oversight of those living under its jurisdiction. This provides corresponding levels of accountability for local governments, which is higher and more certain than is possible with the central government. This has, in fact, led national governments in recent times to attempt to leverage this position by decentralizing many of the duties and responsibilities previously held by the national governmental entity to lower and more localized levels of governments.

Tanzi (2002) has argued that the trend toward decentralization has its origins in several different loci. First, deepening democratization has given citizens greater rights and freedoms to express their preferences for a more optimal provision of public goods and services. Second, globalization is creating market areas that are no

longer identical to, or aligned with, strictly national boundaries. That is, competition is no longer confined within a nation's boundaries. National governments must compete with neighboring countries, while local governments must compete with other jurisdictional governments. Third, decentralization is similar to the economic term, "superior good," which becomes more desirable when incomes increase (Bahl & Linn 1992; Martinez-Vazquez & McNab 2003). Fourth, marked differences in income distribution also play an important role in facilitating the trend toward fiscal decentralization because those who enjoy higher levels of disposable income are seen as naturally having different desires and priorities for the provision of public goods and services than do those who have less income.

Other issues loom large in the field of economics, as well as in public policy, in the current and ongoing debate over issues of fiscal decentralization. One of the more pressing questions concerns the consequences of implementing fiscal decentralization: why have some states been able to succeed in this regard while others have failed? This question is yet to be answered satisfactorily. A brief comparison of two countries' attempts in this area provides a cogent example of the dilemma. Since the 1990s, China has embarked upon a series of reforms based on principles of fiscal decentralization, the implementation of which has been accompanied by double-digit economic growth rates. Argentina is also highly decentralized in terms of sub-national governments having expenditures and revenues as an acceptable percentage of the total government's expenditures and revenues. Argentina, unlike China, experienced two major financial crises, in 1993 and 2001,

associated with undisciplined fiscal behavior by sub-national governments, for which the central government ultimately had to take responsibility (Mussa, 2002).

It is a point of contention that an effective course of action would include different considerations; i.e., rather than only re-assigning public resources to lower levels of government, grant discretionary powers, such as taxing, and borrowing, as well as the power to independently appoint personnel at the sub-government level as well.

These issues have served to highlight the importance of effective institutional arrangements to insure the ultimate success of fiscal decentralization policies. This dissertation takes the view that success requires rethinking the ways in which this process is undertaken, and asserts that it is the institutional design of a fiscal system rather than simply the reallocation of public resources to appropriate levels of government which will ultimately determine success or failure. Just as fiscal decentralization can be variously defined, so, too, are there various approaches to implementing policies based on principles of fiscal decentralization. Some of the implementations may require only the reassignment of public resources, while others may go further and emphasize the concomitant need for structural reform, including the granting of greater autonomy and responsibility to lower level governmental entities.

The significance of successful outcomes regarding fiscal decentralization has given rise to a number of public finance experts who have attempted to formulate normative studies and well-functioning institutional arrangements in this regard,

rather than focusing solely on the reallocation of public resources. Bahl (1999b) expresses the view that fiscal decentralization should be regarded as a system with different components. Each component can be a method to implement fiscal decentralization. Bahl & Martinez-Vazquez (2005) further illustrate this concept with a normative approach to sequencing fiscal decentralization.

The dissertation accepts the view that fiscal decentralization should be regarded as a fiscal system. However, our emphasis focuses on an individual country's unique mix of institutional arrangements to implement fiscal decentralization, leading them to develop different components of the system they identify toward that end. The focal point of this research is to identify the different types of fiscal decentralization systems that are currently implemented. Each type of fiscal decentralization system may, and likely will, demonstrate much diversified performance strength and weaknesses. Two research questions are presented and studied in this dissertation:

1. What types of fiscal decentralization plans have been or are currently being implemented?
2. What are the performance strengths and weaknesses of various types of fiscally decentralized systems?

The first question will be addressed using cluster analysis, while the second question will be examined through an investigation of the inter- and intra-cluster performance comparison, and one empirical model.

Currently, there is a large and wide-ranging literature focusing on the issues

that are relevant to the question of whether fiscal decentralization will deliver the economic benefits that its advocates claim. The literature, therefore, primarily discusses and analyzes relationships between fiscal decentralization and economic performance. Results of the examinations of the theoretical underpinnings of fiscal decentralization remain inconclusive, while empirical studies of fiscal decentralization are considered controversial and problematic. Two main problems remain unresolved in the empirical analysis literature. They are: (1) the absence of qualitative indicators for measuring fiscal decentralization; and (2) the endogenous problem inherent in the empirical models.

The first problem is of particular importance in this literature. The current and most widely used fiscal decentralization indicator, sub-national government revenue and expenditure as a percentage of total government revenue and expenditure, has been criticized as a too-simplistic a measure to accurately gauge the degree of fiscal decentralization among the nations embarking on this course of action. The qualitative dimensions of fiscal decentralization, such as the power of sub-national governments to decide issues such as the appropriate tax base, tax rate, and borrowing power etc., must be considered. Lack of consideration for the qualitative indicator, in our viewpoint, would lead to biased and specious empirical estimations of fiscal decentralization on economic development. The second problem, while not as significant as a public policy issue, nevertheless poses a threat to these empirical analyses as more and more studies begin to question whether fiscal decentralization is simply one endogenous variable to economic growth.

In accordance with the aforementioned statements and arguments, innovation for this fiscal decentralization topic would require going beyond the simple formulation of a comprehensive indicator, and to base our analysis on the more fruitful typological approach to measure the diverse nature of fiscal decentralization in countries while also incorporating institutional factors into the model to investigate the relationship between the types of fiscal decentralization systems and economic performance.

With these imperatives foremost, we endeavor in the present study to establish a model that can properly exhibit the multi-faceted dimensions of fiscal decentralization and then use it to classify the various countries' fiscal decentralization systems based on their customized institutional arrangements. In this dissertation, we do not attempt to deal with any issues surrounding the question of whether there is a statistical association between fiscal decentralization and economic performance; rather, we delve into other issues that heretofore have not received the attention they deserve. First, we employ cluster analysis to determine what types of fiscal decentralization system are currently implemented; then, we investigate the differences in economic performance by conducting inter-cluster comparisons on several major indicators. Undertaking this study, however, also requires accurate measurements of fiscal decentralization. The currently used quantitative indicators are not appropriate to serve that function in this dissertation. We suggest that the qualitative dimensions of fiscal decentralization should also be considered.

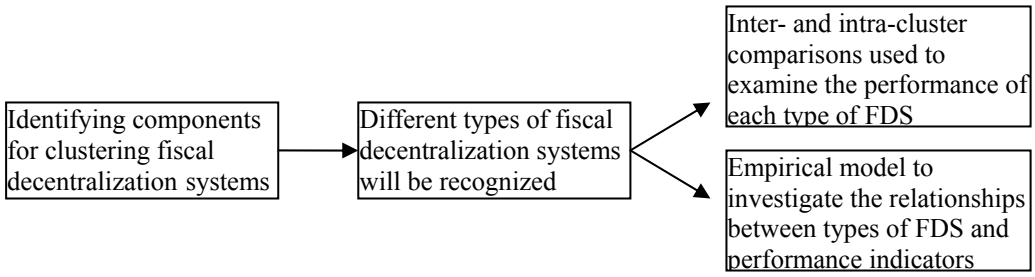
In this chapter, we outline the goals and the methodological plan for this

dissertation, as well as the motivation underlying this selected topic. Cluster analysis refers to a wide variety of techniques used to group entities into homogeneous sub-groups on the basis of their similarities. The technique helps to reduce the complexity of a dataset and thereby enhance our ability to accurately predict an attribute of observations. Considering the multiple-dimensions of fiscal decentralization, we regard cluster analysis as particularly parsimonious and efficient and is therefore an ideal method for conducting our research on this topic.

After the initial classification of fiscal decentralization systems using cluster analysis, we will also examine each cluster to further identify inter-cluster performance differences, e.g., structural similarities characterizing the cluster; structure differences across clusters. Utilizing this technique allows us to examine whether there is substantiating evidence regarding the link between fiscal decentralization and economic performance. Currently, we are attempting to examine the indicators of economic performance, fiscal performance, and governance performance. We then explore the relationship between different types of fiscal decentralization systems and performance indicators with two empirical models.

Using these innovative methods and this statistical analysis, we can investigate the current policy issue of fiscal decentralization; furthermore, the creation here of comprehensive measurements of fiscal decentralization would make original contributions to this field of study. In brief, the structure of research can be depicted as follows:

Figure 1.1: Structure of dissertation



Chapter II: Literature review and arrangement

Several parts of the fiscal decentralization literature are reviewed in this chapter. Presented first are several theoretical arguments regarding fiscal decentralization have been proposed since the pioneering work of Oates (1972). As mentioned previously, most theoretical arguments on fiscal decentralization focus on the economic benefit that may ensue. Thus, early in the literature review, those studies concerned with the relationship between fiscal decentralization and economic performance are examined. Next the focus is on the previous literature that attempts to create comprehensive measurements and typologies of fiscal decentralization. Finally, we examine the prior use of the major tools of this dissertation in literature for social science studies, viz., cluster analysis and empirical analysis.

I. Literature Review

1. Theoretical arguments

Theoretical arguments surrounding fiscal decentralization have been the subject of investigation by economists as well as by policy analysts. This theoretical examination was first undertaken by the pioneering works of Tiebout (1956), Musgrave (1959), and Oates (1972). Fiscal decentralization is widely advocated on the premise that it improves economic performance by increasing economic efficiency in the provision of public sector services. Some, however, argue that fiscal decentralization can impact economic performance when sub-national governments

have uncontrolled expenditures, which adversely affects national fiscal policy. Macroeconomic stability may be hampered by the sub-national government's spending. Consequently, in the following paragraphs we canvass the arguments regarding both the positive and the negative effects of fiscal decentralization policy.

Several arguments are put forth to support the view that fiscal decentralization can engender economic growth. The first and most widely accepted argument is that fiscal decentralization enhances economic efficiency (Oates, 1972). This argument relies heavily on the premise that the sub-national government is more in tune with local needs and is thus much more capable than the national government in delivering necessary services and collecting taxes.

After this theoretical examination, a number of empirical studies investigate the relationship between fiscal decentralization and economic growth since the 1990s, including Kim (1995), Davoodi, Xie & Zou (1995), Davoodi & Zou (1998), Martinez-Vazquez & McNab (1998, 2001a, 2003), Zhang & Zou (1997, 1998), Lin & Liu (2000), McNab (2001), DeSai (2003) and Lee (2003). Some of the empirical studies are conducted with cross-country datasets while other experiments focus on case studies within a single country but use datasets comprising various national regions. We find that both cross-country experiments and case studies yield inconsistent conclusions on the issue of whether fiscal decentralization promotes economic growth.

The next argument postulates that fiscal decentralization can improve economic performance through strengthening a country's governance. A growing

body of literature has emerged in recent years that recognize a positive association between decentralization and governance. Inman & Rubinfeld (1997) assert that fiscal decentralization has been shown to strengthen social capital and encourage political participation that usually leads to a higher level of accountability for government behavior. By fostering the emergence and strengthening of democratic institutions, fiscal decentralization reduces opportunities for malfeasance and the misallocation of public resources. Resources that would otherwise be diverted are then available for investment and for the provision of public goods, thereby enhancing long-term economic growth (McNab, 2001). Fiscal decentralization has been further credited with fostering central bank independence (CBI) and thereby ensuring transparency in government as well as in the banking sector (Huther & Shah, 1998).

With respect to the argument of democratic governance, many empirical studies have also been undertaken to test this argument. Some scholars focus on the relationship between fiscal decentralization and corruption (Fishman & Gatti 2000; Gurgur & Shah 2002), while others associate fiscal decentralization with some type of general governance indicator, ranging from citizen participation, transparency in government, the rule of law, among others (Huther & Shah 1998; DeMello & Barenstein 2001). Despite the diversity of conclusions with regard to the issue of fiscal decentralization versus economic growth, there appears to be greater consensus among the empirical conclusions on the issue of whether fiscal decentralization promotes improved governance.

Third, fiscal decentralization is said to promote economic performance by

enhancing macroeconomic stability. Fukasaku & DeMello (1998) contend that fiscal decentralization is expected to promote sound macroeconomic management through efforts that streamline public sector activities, reduce operational and informational costs of service delivery, which thus stimulate private sector development. However, Ter-Minassian (1997a) asserts there are significant costs associated with insuring macroeconomic stability through fiscal decentralization. Achieving this goal requires thoroughly disciplined sub-national borrowing. As to the empirical studies, in relation to this argument, there is less focus in the literature regarding the relationship between fiscal decentralization and macroeconomic stability. The primary explanation stems from the fact that macroeconomic stability has a high level of relevancy to economic growth. As a result, some take the view that macroeconomic stability is the indirect effect of fiscal decentralization on economic growth (Lee, 2003).

Fukasaku & DeMello (1998) have conducted the first empirical study using cross-country datasets searching for the association between fiscal decentralization and macroeconomic stability. Fukasaku & DeMello use the central government's fiscal balance, inflation, and M2 growth as the indicator for macroeconomic stability. Their findings suggest that fiscal decentralization is likely to generate fiscal and monetary imbalances that impair the performance of economic growth in developing countries. OECD countries are, nevertheless, better equipped to reap the benefits of fiscal decentralization while maintaining the fiscal discipline that appears to lead to increased economic growth.

These findings are consistent with the argument that fiscal decentralization is a superior good, proposed by Bahl & Linn (1992) and Tanzi (2002), who posit that it is only at relatively high levels of per capita income that decentralization becomes sufficiently attractive to taxpayers that its benefits can be fully exploited, unburdened by the experiences of countries with a lower level of per capita income.

Fourth, those who contend that fiscal decentralization bears an inverse relationship to the size of the public sector are considered. Brennan & Buchanan (1980) contend that fiscal decentralization is itself a powerful constraint on Leviathan: competition among governments in the context of the "inter-jurisdictional mobility of persons in pursuit of fiscal gains can offer partial or possibly complete substitutes for explicit fiscal constraints on the taxing power" (Brennan & Buchanan 1980, pp. 184). Accordingly, the Leviathan model implies that, with all other things being equal, the size of the public sector bears an inverse relationship to the extent of fiscal decentralization (Oates 1985, pp. 748).

Oates (1985) also played a pioneering role in empirical studies exploring the relationship between fiscal decentralization and public sector size, but reached a different conclusion than Brennan and Buchanan. Using a cross-sectional sample of 57 countries, Oates' findings suggest that a strong, systematic relationship does not exist between the size of government and the degree of centralization of the public sector. Following Oates' path-breaking study, Marlow (1988), Grossman (1989a, 1989b), and Joulfaian & Marlow (1990) endeavored to test the Leviathan hypothesis. Their conclusions varied.

Just as there are many arguments supporting the view that fiscal decentralization has a positive effect on economic performance, so there are numerous contentions in support of the opposing view: that fiscal decentralization may hamper economic performance. First, contrary to the arguments proposed by Oates (1972), Prud'homme (1995) in fact suggests that fiscal decentralization can actually undermine economic efficiency. Prud'homme believes the arguments presented by Oates are rooted in fragile ground. He argues that not only do locally elected officials not always satisfy the preferences of local needs, but, that,even if the locally elected officials seek to satisfy the preferences of local needs, the local bureaucracy does not always go along with the expectations of elected officials. Consequently, Prud'homme regards as problematic the assumption that fiscal decentralization necessarily promotes economic efficiency. Prud'homme further suggests that providing a given local public service entails economies of scale. The welfare losses attributable to economies of scale that would result from decentralization always remain a distinct possibility. So the oft-cited argument for economic efficiency is in fact undermined by fiscal decentralization.

The argument that fiscal decentralization promotes economic performance by increasing political participation and improving governance has encountered criticism. Conyers (1990) holds a different view and contends that decentralization may increase the participation of people at the local level, but sometimes it is only a small privileged elite group who actually get to participate. And, such elites may often pursue their own narrowly focused self-interests, which may be divergent from those

of the rest of the local populace. Viewed in this light, fiscal decentralization may indeed promote participation in the democratic process, but it would not necessarily improve economic performance. Tanzi (2002) recognizes the existence of a relationship between decentralization and corruption because sub-national institutions are usually less developed than those of the central government due to the fact that local governments provides lower salaries, fewer prospects for advancement, and a weaker mechanism for surveillance and therefore for accountability. Under these circumstances, the problem of corruption may be more severe and widespread in local governments than in central ones.

Third, there appears to be a potential conflict between fiscal decentralization and macroeconomic policy. Musgrave (1959), for example, recognized this problem nearly 50 years ago. He believes it becomes more difficult to coordinate fiscal policy in a counter-cyclical sense under a decentralized fiscal structure. Prud'homme (1995) also considers the possibility that the fiscal behavior of sub-national governments would run counter to fiscal policies of central governments. For example, local governments may try to increase expenditures or raise taxes while the central government is trying to reduce spending or cut taxes. Such unhappy coincidences may jeopardize overall macroeconomic stability. Bogoev (1991) also uses the case study of the former Yugoslavia, one of the most decentralized countries in the world, to illustrate how a federal government can be unable to implement its fiscal policy, simultaneously engendering both high inflation and poor macroeconomic management.

Fourth, fiscal decentralization provides a strong incentive for sub-national governments to borrow, which, in turn, may lead to a national debt crisis. Local governments tend to incur a large number of debts when they are convinced that the central government will bail them out in a crisis. Tanzi (2002) indicates that in past years these fiscal crises have loomed large in some developing countries, such as Argentina and Brazil.

2. Measurements and typology of fiscal decentralization

We can conclude from the discussion in the previous section that there are a considerable number of controversies brewing in the literature over the issue of the relationship between fiscal decentralization and economic performance. Moreover, the empirical analyses regarding fiscal decentralization are under serious attack. The most apparent flaw in these empirical analyses is the measurement of fiscal decentralization.

These measurements of fiscal decentralization, used by the majority of empirical studies as an explanatory variable, are mainly from the dataset Government Finance Statistics Yearbook (GFS), published by International Monetary Fund. These measurements are defined on the basis of a single dimension of decentralization: expenditures going through sub-national budgets, and revenues raised by sub-national governments. In other words, the share of sub-national governments' expenditure or revenue over the total government's expenditure or revenue has been regarded as the indicator of fiscal decentralization. Despite the dataset's wide usage in empirical

studies, there are several limitations on this measurement, as explained by Ebel & Yilmaz (2002, pp. 6):

- Although GFS provides a breakdown of expenditure by function and economic type, it does not identify the degree of local expenditure autonomy.
- GFS does not distinguish the sources of tax and non-tax revenues, intergovernmental transfers, and other grants.
- GFS does not disclose what proportion of intergovernmental transfers is conditional, as opposed to general-purpose, and whether transfers are distributed according to an objective criteria or a discretionary measure.

Suffering from such limitations, the GFS fiscal decentralization measurements, although widely used, are problematically deficient in measuring the accuracy of fiscal decentralization because the sub-national expenditure/revenue calculation includes conditional transfers from the central government. As a consequence, the indicator ends up as an overestimate of fiscal decentralization, to varying degrees. Musgrave (1959) has also properly pointed out that "local governments which act as central expenditure agents do not reflect expenditure decentralization in a meaningful sense, just as centrally collected but shared taxes do not constitute true revenue decentralization" (Musgrave 1959, pp. 342).

In addition to the problem of overestimating fiscal decentralization, there exists the problem of comparing "apples to oranges" in cross-country empirical studies. Bahl & Nath (1986) argue that two countries may have the same sub-national share of expenditure/revenue but the number of participating

sub-national governments may in fact be quite different. Under these circumstances, the country with more sub-national governments is supposed to be more decentralized than the country with fewer sub-national units. But it is difficult to distinguish the true differences between these two countries given this inherent limitation in the data from these studies.

As a result of these shortcomings, the actual relationship between fiscal decentralization and economic performance may be difficult to estimate based on the currently used indicator since we are unable to unequivocally identify which country is more fiscally decentralized. Many scholars, therefore, are beginning to take the view that the current empirical studies are problematic and their resulting estimations are specious and biased (Bahl & Nath 1986; Ebel & Yilmaz 2002; Martinez-Vazquez & McNab 2003).

The foregoing arguments reveal an Achilles' heel in the most widely-used measurement with GFS data; that is, it does not adequately reflect the true multi-dimensional nature of fiscal decentralization. Consequently, not only quantitative data, but also some qualitative indicators of fiscal decentralization from GFS (such as whether the sub-national government is empowered to adjust the tax rate and the tax base), must be considered.

There have been a number of efforts made to clarify this pressing issue. Recognizing that fiscal decentralization has many dimensions, OECD (2002) has embarked upon the task of constructing more detailed definitions of sub-national government revenue as follows:

(a) SNG sets tax rate and tax base;

(b) SNG sets tax rate only;

(c) SNG sets tax base only;

(d) SNG sets tax base for SNG and central government tax;

(e) Revenue sharing arrangement;

(e.1) Revenue-split can only be changed with consent of SNG;

(e.2) Revenue-split fixed in legislation, may unilaterally be changed by central government;

(e.3) Revenue-split determined annually by central government as part of the budget;

(f) Central government sets rate and base of SNG tax.

Despite having further refined the categories of sub-national revenue sources and taking into consideration fiscal autonomy, the OECD documentation does not contain the cross-country, time-series dataset, resulting in continuing difficulties in conducting empirical analyses using OECD datasets.

Following OECD's work, the World Bank (2004) has also attempted to create comprehensive qualitative indicators for more accurate measurements of fiscal decentralization. Their goal is the availability of data on key fiscal, political and administrative variables at the national and sub-national level. In this way, decentralization policy and outcomes can be assessed more effectively and accurately.

The World Bank's measurements are comprised of two main groups: a quantitative indicator and a qualitative indicator. The quantitative indicator is

currently used throughout the literature dealing with fiscal decentralization. As for the qualitative indicator, the World Bank is currently constructing a qualitative indicator as follows:

- Expenditure assignment;
- Revenue assignment;
- Regulatory framework for sub-national borrowing; and
- Characteristics of the transfer system.

The cross-country dataset is used with the investigation of institutional arrangements for fiscal decentralization for the most recent year available. . The World Bank's dataset has made a breakthrough on the measurement of qualitative dimensions of fiscal decentralization. Taking the assignment of revenue, for example, the data display which government levels are responsible for the different functions: setting the instrument, setting the tax rate, and administrating the tax.

Based on the OECD and the World Bank's study, research is focusing more and more on the qualitative dimensions of fiscal decentralization in different regions. Brosio (2000) investigated the decentralization efforts of various African countries. He looked at the reform of the political and fiscal institutions in selected countries on that continent.. Dabla-Norris & Wade (2002) focus their studies on transition economies. They first examine the context and experience of fiscal decentralization efforts in transition economies and then identify three critical principles of sound, desirable decentralization. Ebel & Yilmaz (2003) have cited the four pillars of an intergovernmental fiscal system: expenditure assignment, revenue assignment,

intergovernmental transfers, and sub-national borrowing. These four guidelines are used to analyze the institutional design present indifferent countries, divided into unitary states and federal states.

The aforementioned studies are based on the institutional approach, a useful way to understand the given arrangements within a fiscal decentralization system. Notably, these studies solve the problem of inaccurate measurements of multi-dimensional fiscal decentralization. However, they fail to find a link between fiscal decentralization and economic performance.

Taking a different tack, one more similar to the approach followed here, Schneider (2003a, 2003b) has attempted to identify three different types of decentralization: (1) fiscal decentralization; (2) political decentralization; and (3) administrative decentralization. However, he is not been able to measure the qualitative aspects of fiscal decentralization. Daniel Treisman (2000b) defines five types of decentralization, which are structural, decision-making, resource, electoral, and institutional decentralization. This definition has yielded a number of implications for fiscal decentralization.

Bahl (1999b) regards fiscal decentralization as a comprehensive system with many components. Working with Bahl, the World Bank has identified four dimensions of fiscal decentralization. These are: expenditure responsibility, revenue assignment, intergovernmental fiscal transfer, and sub-national borrowing.

3. Tools for empirical work

The procedure of this dissertation involves placing countries into groups based on common characteristics of their fiscal decentralization system, followed by an institutional analysis of each group. Here, cluster analysis becomes a useful research tool. Currently, various social science studies have been undertaken with cluster analysis. Dabrowski (1996) and Zinnes, Sachs & Eilat (2000) undertake research based on the pattern of economic development in transition economies. Zinnes (1987) depicted a framework for fisheries industries in developing countries by recognizing nine components. Each component was given several variables to capture the dimension. The cluster analysis categorized the 64 countries into 10 groups based on their development pattern. This research has proved to be a great innovation in this work because the typology is able to distinguish the least favored type of fisheries industry, which has proven to be highly successful in policy analysis.

II: Arrangement of the dissertation

As seen in previous sections, each country under study has a customized fiscal decentralization system. Some emphasize tax autonomy while others stress the importance of expenditure autonomy. With all these features and characteristics, we can assign countries with similar fiscal decentralization systems together. This allows the use of a cluster analysis approach as a reliable way to examine patterns of fiscal decentralization.

1. Chapter III: A typology of fiscal decentralization system

The major focus in Chapter III concerns the typology of fiscal decentralization.

The ideal sample size for this analysis is around 100 countries. We anticipate that for some countries more than one observation will be included if there is a significant change in their fiscal decentralization systems. However, due to an insufficiency of data, it may be necessary to reduce the sample size to approximately 60 countries. The purpose of this particular technique, on the one hand, is to expand the sample observation for the analysis. On the other hand, in consideration of the changing nature of fiscal decentralization systems, particularly for the developing countries, we take the viewpoint that panel data would more adequately address this issue.

This chapter begins by building upon past research to argue for a limited but comprehensive set of dimensions for fiscal decentralization. It proceeds to identify the variables which capture each dimension. Combining the World Bank's dimensions with the viewpoints of other scholars who emphasize the importance of political decentralization, it is possible to tentatively capture the features of fiscal decentralization systems with the following variables:

1. Political structure: possible measures of supranational government, federal state or non-federal state, numbers of tiers in sub-national government.
2. Intergovernmental transfer: possible measures of sub-national government revenue transfer as a percentage of sub-national government total revenue.
3. Tax autonomy: possible measures of sub-national government tax revenue as a percentage of sub-national government total revenue, that is, their taxing power.
4. Expenditure assignment: possible measures for sub-national government expenditures as a percentage of total government expenditure.

5. Revenue assignment: possible measures of sub-national government revenue as a percentage of total government revenue.
6. Borrowing power: possible measures for determining whether the sub-national government has the power to borrow.
7. Political decentralization: possible measures for state elections, municipal elections.
8. Hard budget constraints: possible measures of whether the sub-national government's borrowing activities are guaranteed.

We would expect to identify 6 to 8 types of fiscal decentralization systems on the basis of these known components of fiscal decentralization policy.

2. Chapter IV: Inter-cluster comparison

After completing the cluster analysis, the clusters will be further investigated to identify inter-cluster performance and the presence of behavioral differences. The panel dataset will be used to advantage in these investigations. Each country will be further examined to determine whether there is any difference in its fiscal decentralization system.

The most important indicator for performance is the economic growth rate determined primarily from 1990 to 2004. The reason this time period was chosen is that characteristics and features of fiscal decentralization system for various countries were collected between 1998 and 2002. The performance of economic growth between 1998 and 2004 can be more properly associated with the types of fiscal decentralization systems. Nevertheless, to avoid the short-term spike of economic

performance, we extend the time period of economic performance to the early 1990s. The results are inconclusive as to whether fiscal decentralization leads to economic growth; it would be problematic to conclude prematurely whether fiscal decentralization is positively or negatively associated with economic growth.

Another performance indicator that may be connected to fiscal decentralization would be the level of government revenue deficits. Based on the theoretical arguments of fiscal decentralization, the distribution of public resources is more effective and efficient under a decentralized fiscal system. As a result, fiscal deficit is a reasonable indicator for performance differences.

The quality of government is also observed by investigating indicators of corruption and of government effectiveness. As seen in the section on the literature review, fiscal decentralization is also said to promote better governance of a country. Therefore, based on this theoretical argument, we may regard the corruption indicator and government efficacy as areas with considerable implications for this analysis. In brief, the test of performance can be summarized as follows:

- Economic performance: economic growth rate, inflation rate, and level of income, mainly the GDP per capita in PPP value.
- Fiscal performance: levels of budget deficit, government debt/GDP.
- Governance performance: corruption; government effectiveness.

3. Chapter V: Empirical model analysis

In the previous chapter preliminary observations were made by employing inter-cluster comparisons regarding the relationship among different types of fiscal

decentralization systems as well as several indicators of performance. The inter-cluster comparison, however, is limiting in its ability to provide us with a significant viewpoint on this relationship because it is limited to descriptive statistical analysis rather than the more accurate inferential statistical analysis. In this chapter, we employ an empirical model to further explore and identify the relationship between different types of fiscal decentralization systems and their economic performance.

4. Chapter VI: Conclusions and policy implications

The analysis in previous chapters provides the basis for developing specific conclusions and policy recommendations in this chapter. These recommendations carry implications for current debates in the literature and for the interpretations of our results.

In this chapter, we expect to answer the following questions:

1. What type of fiscal decentralization system is currently being implemented?
2. What are the performance strengths and weaknesses of various types of fiscal decentralization system?

These findings could prove potentially significant and far-reaching in their implications for the direction of future reform of fiscal systems in developing countries, as well as serve to strengthen the institutional arrangements of fiscal decentralization policy in developed countries. .

Chapter III: A typology of fiscal decentralization systems

I. Identifying the dimensions of fiscal decentralization systems

In chapter II, it was established that each country has its own customized fiscal decentralization system. Some emphasize tax autonomy while others stress the importance of autonomy in expenditures. Having identified these various features and characteristics, we now group countries with similar fiscal decentralization systems together. In addition, the OECD (2002) and the World Bank (2004) each proposed a different method of measuring fiscal decentralization, which provide a useful tool to capture the significant dimensions of fiscal decentralization. These dimensions and characteristics, mentioned in the previous chapter, will be used to categorize the different types of fiscal decentralization systems.

Currently, the most systematic and logical construction of a fiscal decentralization system is proposed by Bahl (1999). In his pioneering theory of fiscal decentralization systems, he proposed 12 implementation rules for fiscal decentralization:

Rule #1: Fiscal decentralization should be viewed as a comprehensive system,

Rule #2: Finance follows function,

Rule #3: There must be a strong central ability to monitor and evaluate decentralization,

Rule #4: One intergovernmental system does not fit both the urban and the rural sectors of a country,

Rule #5: Fiscal decentralization requires significant local government taxing powers,

Rule #6: Central governments must adhere to the fiscal decentralization rules they make,

Rule #7: Keep it simple,

Rule #8: The design of the intergovernmental transfer system should match the objectives of decentralization reform,

Rule #9: Fiscal decentralization should consider all three levels of government,

Rule #10: Impose a hard budget constraint,

Rule #11: Recognize that intergovernmental systems are always in transition and plan for this,

Rule #12: There must be a champion for fiscal decentralization.

Although these 12 implementation rules do not specify the dimensions and characteristics of an FDS, they do constitute alternative thinking on fiscal decentralization. In later work, Bahl, along with Martinez-Vazquez (2005), has further argued for normative dimensions of fiscal decentralization theory. In their paper, "Sequencing Fiscal Decentralization," they have identified the components of a fiscal decentralization system as follows:

Table 3.1: Fiscal decentralization components by Bahl and Martinez-Vazquez

Component	Desirable Feature
Representation	Popular election of executive and legislative branches
Chief Officers	Locally appointed
Expenditure Discretion	Significant control over how money is spent
Budget	Local approval; hard budget constraints
Revenue	Significant local power; discretion to change rates in a closed list of taxes
Intergovernmental equalization transfers	Unconditional and formula driven
Conditional grant	Block grants using formulas or other objective allocations; matching
Borrowing power	Broad borrowing powers and hard budget constraints
Civil service	Local governments hire, fire and determine compensation

These components are of great value in identifying the dimensions of fiscal decentralization; but, these indicators are all qualitative in nature. The qualitative components may be either hard to quantify or may prove to be equally difficult to substitute with proxy variables. Therefore, even though the components of fiscal decentralization have been identified, more efforts are still required to quantify the qualitative dimensions of fiscal decentralization.

On the other hand, Treisman (2000) also contends that there are five definitions of decentralization that also contributes to identifying their dimensions. The first is what he calls *structural decentralization*, which refers to the number of tiers present in forms of government. The more tiers there are, the more decentralized is the system. The second definition is *decision decentralization*, which focuses on the scope of issues about which sub-national governments can make autonomous decisions. The third is *resource decentralization,* which refers to how government resources are distributed between central and sub-national governments. The fourth is *electoral decentralization,* which refers to the method by which sub-national officials are selected. Decentralization is greater with locally elected officials than when local officials are appointed by the central government. Last is *institutional decentralization,* concerning the degree to which sub-national governments or their representatives have formal rights within the procedures for central decision-making.

Treisman's work is intended to define political decentralization; however, several of his definitions prove to be a great help in analyzing the various dimensions of fiscal decentralization. For instance, resource decentralization is the main spirit of fiscal decentralization theory, while decision and electoral decentralization have also been emphasized in the literature.

Lastly, Schneider (2003) takes a different view by separating fiscal decentralization from administrative decentralization and political decentralization. He defines three dimensions for decentralization that are fiscal, administrative, and

political decentralization. He also assigns two indicators to capture each dimension of decentralization as follows:

Table 3.2: Fiscal decentralization dimensions by Schneider (2003)

Dimensions	Indicator
Fiscal decentralization	1. Sub-national expenditures as a percentage of total expenditures 2. Sub-national revenues as percent of total revenue
Administrative decentralization	1. Taxation as a percentage of sub-national revenues 2. Non-transfer income as a percentage of sub-national revenues
Political decentralization	1. Municipal elections 2. State elections

Judging from Schneider's indicators, we find that the dimensions of administrative decentralization and political decentralization are also essential for the dimensions of fiscal decentralization systems. We can, therefore, encompass the administrative and political decentralization elements into the fiscal decentralization system.

Therefore, based on previous arguments and propositions, it is possible to draw conclusions regarding the features of a fiscal decentralization system. Unlike the traditional method for measuring fiscal decentralization, that is, the ratio of sub-national government expenditures to revenue, experts in public finance have been more concerned with qualitative aspects of fiscal decentralization, including political decentralization, the power to tax and borrow money as measures of the level of fiscal decentralization. Bahl and Martinez-Vazquez (1999; 2005), for example, both

emphasized the importance of an independent local official. The independent local official should not only be elected by local people, but also possess the power of appointing local officials.

Meanwhile, along with political decentralization, Treisman (2000) further stressed that the political structure of a country as well as its decision-making process is important to the success of decentralization. He argued, for example, that the federal state is inherently more decentralized than the unitary state in terms of its decision-making process. On the other hand, supra-national governments have been positively viewed as wielding sufficient constraints over the fiscal policies and practices of a given country, much like the relationship that exists between the European Union and its member countries. Therefore, the existence of a supra-national government[1] regime also plays an important role for the implementation of fiscal decentralization.

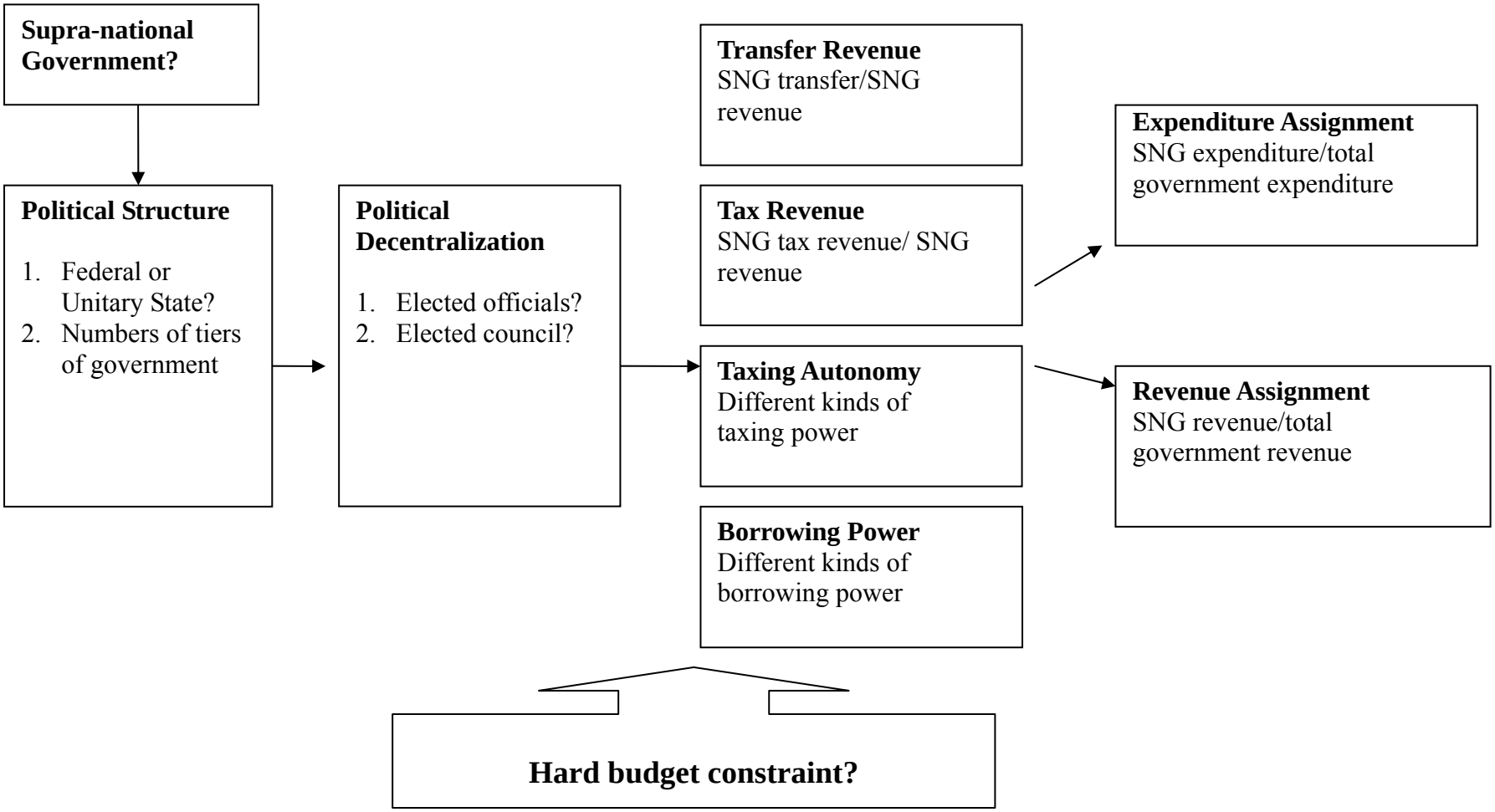
Lastly, a hard budget constraint is identified by many scholars as important to the success of fiscal decentralization. Argentina is extremely fiscally decentralized in many aspects of its institutional arrangements. Nevertheless, without proper hard budget constraints on its sub-national governments' borrowing activity, the fiscal decentralization policy resulted in serious financial crises in the early 1990s and 2000s (Mussa, 2002).

In other words, many aspects of qualitative indicators are proposed that are

[1] Supra-national government is commonly abbreviated "SNG.". However, in this dissertation, SNG always refers to sub-national government. Supra-national government will be abbreviated as SUPRA, when mentioned.

relevant to the proper functioning of fiscal decentralization. Along with the widely used quantitative indicators, i.e., the SNG share of expenditure/revenue to the total government's expenditure/revenue, it is possible to build upon past research to argue for a limited yet comprehensive set of dimensions to identify fiscal decentralization systems. As a result, an attempt is made to depict a framework for the function of fiscal decentralization systems as in the following figure 3.1.

Figure 3.1: Framework for Fiscal Decentralization System



II. Variables for the dimensions of a fiscal decentralization system

The preceding theoretical arguments and contentions lead to the conclusion that the dimensions for a fiscal decentralization system would be numerous and diverse. Recognizing the dimensions of fiscal decentralization is not difficult when they are viewed as a comprehensive system. The challenge of fiscal decentralization system theory is determining the means of discovering all the relevant and available variables in order to accurately capture each dimension of the system. Some dimensions may be difficult to quantify while others may have problems with data availability. To conduct this analysis, feasible and practical variables are required.

Taking these difficulties into consideration, several criteria have emerged for selecting the dimensions and characteristics important for the use of cluster analysis.

1. Quantifiability: the dimensions should be quantifiable;
2. Feasibility: the variables used to capture the dimensions should be relevant;
3. Credibility: the variables should be objective and credible;
4. Availability: data availability for the variables is essential.

Based on these criteria, several temporary components and relevant variables are identified in the following table.

Table 3.3: Components of a fiscal decentralization system

Component	Variable	Description
Supranational Government Regime	Supranational government?	A supranational government, such as the EU, may constrain the fiscal policy of a country. Thus, fiscal decentralization policy may be hampered. 1 is for yes; 0 is for none.
Political Structure*	Federal or unitary state?	The federal state is generally more decentralized than a the unitary state. 1 is for federal; 0 is for unitary.
	Numbers of tiers of sub-national government	The greater the numbers of tiers of sub-national government, the more decentralized the country.
Transfer Revenue**	SNG transfer revenue/SNG total revenue	Sub-national transfer revenue as a percentage of total sub-national government revenue. The higher the ratio, the more decentralized the country.
Tax Revenue**	SNG tax revenue/SNG total revenue	Sub-national government tax revenue as a percentage of total sub-national revenue. The higher the ratio, the more decentralized the country.
Revenue Assignment**	SNG revenue/ total government revenue	Sub-national government revenue as a percentage of total government revenue. The higher the ratio, the more decentralized the country.
Expenditure Assignment**	SNG expenditure/total government expenditure	Sub-national government expenditure as a percentage of total government expenditure. The higher the ratio, the more decentralized the country.
Tax Autonomy***	Taxing Power	Whether sub-national government has the following taxing power: 3-tax base and tax rate; 2-only tax rate; 1-none.
Borrowing Power***	Borrowing power	Whether the sub-national government has the power to borrow money: 5-market discipline; 4-cooperative control; 3-administrative control; 2-rulebased control; 1-borrowing prohibited.
Political Decentralization****	Municipal elections	Is the local official popularly elected? 1 is for yes; 0 is for none.
	State elections	Is the state official popularly elected? 1 is for yes; 0 is for none.
	Democracy	With the democratization degree as an indicator, from 0 (least democratized) to 10 (most democratized).
Hard Budget Constraint	SNG borrowing activities guarantee	Does the national government explicitly or implicitly guarantee the borrowing activity of sub-national government: 3-no; 2-implicitly; 1-explicitly.

*Source: Treisman (2000b)

**Source: IMF GFS Yearbook (2005)

***Source: World Bank (2004) www1.worldbank.org/publicsector/decentralization/data.htm

****Source: Marshall et. al (2000) Polity IV Project.

While these components and variables are ideal, not every one of them is

feasible. Among these variables, the "ratio" variables, such as SNG tax revenue over SNG total revenue, are easily available. They are also credible because they can be directly derived from GFS data published by the IMF. As for the "institution" variable, such as supranational government, federal or unitary state, taxing power, and borrowing power, they are also available from websites and the World Bank database.

Other variables, however, do suffer from problems relating to objectivity or credibility, or both. For instance, the hard budget constraint, with the proxy variable of SNG borrowing activity guaranteed, is controversial. The controversy lies in the source of the variable which comes from the OECD website which provides survey questions for countries all over the world. There are two main problems here. First, to date, only 40 countries have responded to the survey questions. Among the 40 respondents, some did not answer all the survey questions. Therefore, the data samples are incomplete and therefore insufficient.

Additionally, the survey questions, usually answered by the finance department of the respective country, may not be consistent with the objective criteria. For instance, the question, "Does the national government explicitly or implicitly guarantee the borrowing activity of sub-national governments," may elicit different answers from different institutions or individuals. Some may regard the country as explicitly guaranteeing the borrowing activity of the sub-national government while others may take the viewpoint that the borrowing activity is not guaranteed. Consequently, the credibility of the variable source may be problematic. Although the hard budget constraint is considered essential to the success of fiscal decentralization systems, the foregoing limitations may force the omission of this component along with its associated

variables.

III. Cases and data

The research applies cluster analysis to decentralization data collected from 54 countries for the most recent year available. The data include fiscal indicators from Government Financial Statistics Yearbook (GFS) published by the IMF. The qualitative decentralization data are derived from the World Bank website. Other data have been obtained from the Database of Political Indicators collected by the World Bank and the Government of Switzerland. Several missing data were filled in based on information found on the websites of different countries. The details of the data sources are depicted in the following paragraphs.

For the *Supranational Government* component, the variable refers primarily to whether the country is a member of the EU or not, with the dummy value of 1 and 0. The variable can be collected easily from the official website of the EU.

For the *Political Structure* component, two variables are assigned, including federal state or not, and numbers of tiers of government. The first variable can be readily found on the EU website, with the dummy values of 1 and 0. The second variable, numbers of tiers of government, can be obtained from decentralization indicators constructed by Daniel Treisman, Associate Professor of Political Science at the University of California, Los Angeles. The value of this variable ranges from 2 (the lowest) to 5 (the highest).

To quantify the *Transfer Revenue* component, we used sub-national government transfer revenue as a percentage of total sub-national government revenue. The average figure derived from the most recent four years of data is calculated to prevent possible

distortions arising from spikes in transfer revenue during a given one-year period. To simplify the data variations, the ratio figure is further classified into different categories. For instance, the ratio of 10% or below is categorized as 1, transfer ratio figures between 11% and 20% are categorized as 2, and so on. The highest level of ratio is 9, which means the transfer revenue of the sub-national government accounts for more than 80% of the total revenue of the sub-national government. The major reason for transforming numerical data into categorical data is that we assume the existence of a non-linear relationship among these continuous data. Therefore, categorical variables would allow for more to capture non-linearities in the variable. A linear single continuous variable presentation is not going to capture these variations. In addition, we want to tabulate two different formatted variables, e.g. taxing power and revenue assignment, one in the format of continuous data and the other in the format of categorical. We would derive cross tabulation results with 3 columns and a large number of rows. This is clearly not the best approach for displaying the statistical data. Therefore, based on the foregoing arguments, we transform the numerical data into categorical data.

Potentially, there are problems of over-diversification in this format. For example, countries with a transfer ratio of 10% and 11% may be placed differently in category 1 and 2. This situation is rare in our data set and would not impact the results of our cluster analysis unless there were too few categories for these numerical variables. This explains the reasoning behind transforming the variable value in *Tax Revenue* and *Revenue and Expenditure Assignment* components.

In the *Tax Revenue* component, the variable that is assigned is the sub-national government's tax revenue as a percentage of the sub-national government's total revenue.

As with the calculation of the intergovernmental transfer revenue variable, the average figure derived from the most recent four years' data is employed and based on the same rationale. After the calculation of the four-year average figure, the scale of 1 to 9 is assigned to each country's level.

In the *Revenue and Expenditure Assignment* components, sub-national government revenue/expenditure as a percentage of total government revenue/expenditure is used to capture the dimension. The calculation is similar to that of intergovernmental transfer and tax revenue where the four-year average figure is calculated and scales assigned. However, there is a slight difference in the scales of the revenue/expenditure assignment variable. The scale ranges from 1 to 5 with category 5 being the ratio of 41% and above.

For the *Tax Autonomy* component, the types of taxing power the sub-national government possesses will be demonstrated. The types of taxing power employed are three, as identified by the World Bank: 3 - adjusting tax base and tax rate; 2 – the tax rate only; 1 - none.

The *Borrowing Power* component depicts the types of borrowing power that sub-national governments possess; the World Bank has identified five of them as follows: 5 - market discipline; 4 - cooperative control; 3 - administrative control; 2 – rule-based control; 1 - borrowing prohibited.

Finally, in the *Political Decentralization* component, three variables were intended for use. However, the variable for state and municipal elections is problematic in terms of cluster analysis due to the number of missing values in this category. The DPI (Database on Political Institutions) database includes incomplete and obsolete data

on state and municipal elections worldwide. The latest data are from 1997, too old to be used in the analysis for this dissertation. Moreover, there are countries which do not have state-level government, a circumstance which makes it impossible to capture the state election variable for this dimension.

The second argument against the use of state or municipal elections variable is that some countries may have locally elected officials, but actual executive power is arrogated by the local assembly, which could be either appointive or locally elected. This means that 8 different kinds of political decentralization are possible, (executive v. assembly) and (elected v. appointed) and (real power v. puppet). In the latter circumstance, the locally elected official may in reality be nothing more than a figurehead in local affairs, undermining the concept of decentralization because the *de jure* elected official does not actually have the power normally associated with elected office.

The DPI has been criticized not only for its simplicity, but also for lacking credibility. Here, we reserve skepticism about the credibility of the dataset, due to the fact that the level of political decentralization in some countries is not adequately captured in the database. As an example, China, coded PRC in DPI, has been categorized as a state having elected governors in the database. China, however, remains an authoritarian state under which all vestiges of political power are controlled by a single party. This is in direct opposition to the concept of a *de facto* locally elected official. Moreover, if there were a locally-elected governor, he or she would be only a nominal leader, acting as an agent of the central government. It is logical to conclude, therefore, that the dimension of political decentralization is particularly complicated and difficult to measure in a single variable based on the current database.

A possible alternative for measuring political decentralization would be using a credible proxy variable, that of democratization, which is more complete, accurate, and usable, to capture the dimension of political decentralization. Currently, the most credible data source for this variable is from Polity IV, collected by the University of Maryland. Critics of this approach may contend that the relationship between democratization and political decentralization is problematic. The question is whether the democratization variable is adequate to capture the dimension of political decentralization. We find that democratization is positively correlated with political decentralization. The broadening of democratization results in an environment where the local official or assembly may accrue more freedom and breadth of power. Aside from the correlation arguments, the spirit of fiscal decentralization may also play a significant part in justifying the use of the democratization indicator. A major element of decentralization is that it is local governments who can best respond to the needs of the jurisdictional people. Consequently, a more democratized country would allow its people the freedom of speech, while a less-democratized nation would attempt to restrain speech. It is a straightforward conclusion that a more democratized country will, by definition, be more decentralized.

The Polity IV database is panel data covering the period from 1800 to 2002, and represents countries worldwide. This database divided countries into 11 categories, from 0 (the least democratized) to 10 (the most democratized). In our analysis,data was extracted from the most recent year available, 2002 democratization, as an indicator for political decentralization.

As a result of the abovementioned arguments and examples, we summarized the

variable code and components for cluster analysis as follows:

1. *Supra-national Government*: supranational government (SUPRA),

2. *Political Structure*: federal state (FED); numbers of tiers of government (NUM)

3. *Transfer Revenue*: SNG transfer revenue/SNG total revenue (TRANS)

4. *Tax Revenue*: SNG tax revenue/SNG total revenue (TR)

5. *Revenue Assignment*: SNG total revenue/total government revenue (REV)

6. *Expenditure Assignment*: SNG total expenditure/total government expenditure (EXP)

7. *Tax Autonomy*: types of taxing power (TP)

8. *Borrowing Power*: types of borrowing power (BP)

9. *Political Decentralization*: democratization indicator (DEMO)

There are 9 components and 10 variables for cluster analysis. Among the 10 variables, TRANS and TR are highly correlated. One of them must be eliminated, leaving 9 variables to be used for cluster analysis in the following section.

IV. Clustering countries by components of a fiscal decentralization system

In this section, the cluster analysis method is employed to group countries with similar fiscal decentralization systems and characteristics together. Lorr (1983) stipulates that cluster analysis refers to the technique used to group entities into homogeneous subgroups on the basis of their similarities across several observed characteristics. In a more precise way, we can say that cluster analysis enables us to partition a data set into subsets (cluster), so that the data in each subset ideally share some common traits. Cluster analysis is widely used in the field of medical science (Aldenderfer & Blashfield, 1984). For example, Goldstein & Linden (1969), two

clinical psychologists, used cluster analysis to build a classification of alcoholics. In the application of social science, cluster analysis is also popular in the field of marketing, archaeology, and education as well (Bartholomew et. al. 2002). These studies usually involve coping with partitioning data sets into mutually exclusive subsets. Our research regards fiscal decentralization as a system composed of different components (as measured by several variables); cluster analysis is thus a useful as well as feasible way of identifying a typology of fiscal decentralization systems.

Plentiful literature regarding the application of cluster analysis in social science, particularly in economics, is recognized. Some economists attempt to interpret the economic reform in transition economies using cluster analysis (Dabrowski 1996, Zinnes, Sachs, and Eilat 2000). Dabrowski (1996) clustered the transition economies based on a country's policy orientation, primarily on three aspects: the speed of action, the comprehensiveness and consistency of policy, and cumulative progress.

Arguing against these approaches to cluster analysis, Zinnes, Sachs, and Eilat (2001), on the other hand, clustered these transition economies based on their initial conditions. There are 12 categories of initial conditions identified in their analysis: Physical geography, macroeconomics variables, demographics/health, infrastructure, industrialization, wealth, human capital, market memory, physical capital, culture, and political conditions. This seems to be the most complete and appropriate approach for investigating the economic pattern of these transition economies, enabling the cluster of these countries.

Aside from economic patterns of transitional economies, cluster analysis is used to study the fishery industries of developing countries. Zinnes (1987) depicted a

framework for fishery industries in developing countries by recognizing nine components. Each component was assigned several variables to capture the dimension. The cluster analysis categorized the 64 countries into 10 groups based on their development pattern. This research proves instructive in that the typology is able to distinguish the least-favored type of fishery industry, which is rare in policy analysis.

All the aforementioned studies provided inspiration for this dissertation. Cluster analysis, however, has never been used heretofore in a study of fiscal decentralization. As the first to apply cluster analysis to the topic of fiscal decentralization, we attempt here to determine the parameters of the least-favored fiscal decentralization system, as well as the most advantageous system.

As discussed in the previous section, the use of cluster analysis allows us to identify the underlying issues in an economical way that merely assessing cross-country fiscal decentralization systems could do. In this dissertation, we employ two types of cluster analysis—clusters based on means and clusters based on medians. The basic operation of the cluster kmeans and kmedians is relatively simple: given a fixed number of (desired or hypothesized) *k* clusters, assign observations to those clusters so that the means or medians across clusters (for all variables) are as different from each other as possible. In other words, cluster analysis seeks to identify a set of groups which both minimize within-group variations and maximize between-group variations.

In this dissertation, both cluster means and cluster medians are used to categorize the 54 countries into k groups with k ranging from 5 to 10. The results of all our cluster analysis are included in Appendix I, for kmeans, and Appendix II, for kmedians. In both cases, we run the cluster analysis with nine selected variables. These variables include

SUPRA (the existence or non-existence of supra-national government), FED (federal state or not), NUM (numbers of tiers of SNG), TR (SNG tax revenue/SNG total revenue), REV (revenue assignment), EXP (expenditure assignment), TP (taxing power), BP (borrowing power), and DEMO (political decentralization). Limitations exist in this cluster analysis, as suggested by Lorr (1983), in that the number of clusters is smaller than the number of variables used to identify clusters. We thus empirically rule out the possibility of grouping countries into 9 or more clusters. As a result of these self-imposed limitations, the cluster classifications range from 5 to 9 groups.

The determination of the numbers of cluster analysis is a fundamental problem yet unsolved due to the lack of an appropriate null hypothesis as well as to the complex nature of multivariate sampling distributions (Everitt, 1979). Despite endeavoring to justify the determination of the number of clusters, many of them remain heuristically understood. Aldenderfer & Balshfield (1984) indicate two basic approaches to determining the number of clusters which are present in dendrograms and how they have evolved, heuristic procedures and formal tests (the latter are mainly the examination of the values of fusion coefficients). STATA (2003) also suggests the solutions of Calinski & Harabasz pseudo-F index, which is a stopping-rule value computed for each cluster solution. Larger values indicate more distinct clustering.

In this dissertation, we employ the Calinski & Harabasz pseudo-F test suggested by STATA (2003). This test is used to determine the distinction of each cluster number, a useful way to determine the appropriate number of clusters. In table 3.4, we find that the five-group solution with pseudo-F value of 27.78 is the largest, indicating that the five-group solution is the most distinctive, compared with other group solutions. It has

been determined that five types of fiscal decentralization systems would be insufficient to reflect the multi-dimensions of fiscal decentralization systems. The second largest pseudo-F, six- group solutions were therefore employed. The expectation is that 54 countries will be the most similar within cluster and the most different inter cluster. Table 3.6 displays the mean and the standard deviation for each cluster on nine variables employed to delineate each fiscal decentralization cluster.

Table 3.4: Calinski/Harabasz pseudo-F test for each number of clusters

Number of cluster (median)	C/H pseudo-F	Number of cluster (mean)	C/H pseudo-F
5	23.51	5	27.78
6	24.33	6	24.00
7	24.06	7	23.69
8	17.93	8	20.58
9	20.33	9	16.35

Analysis of the application of the above-mentioned method suggests that clustering the countries into six groups, which results in six types of fiscal decentralization systems, is the most appropriate. Each type of fiscal decentralization system contains nine variables, including the mean value and the standard deviation. With the mean and the standard deviation, we can standardize the variables value (convert to mean zero and variance one) of each cluster. The method of standardization enables us to distinguish inter-cluster differences.

Each cluster is assigned a name based on the standardized value of variables, which is the distinct character of the cluster. If there is no distinguishing value for the variable, the cluster may be named according to the countries included in it. A brief description and list of country members for each cluster is provided before discussing the relevant details on how the clusters scored for each type of fiscal decentralization system.

Table 3.5: Summary of six types of fiscal decentralization systems (FDS)

Cluster name	Country member
High Expenditure/Revenue assignment FDS (HERA)	Austria, Bolivia, Brazil, Germany, India, Italy, Korea, Mexico, Mongolia, Norway, Poland, Russia, Spain, Taiwan
Low Expenditure/Revenue assignment FDS (LERA)	Belgium, Czech Republic, France, New Zealand, Portugal
Revenue transfer FDS (TRAN)	Albania, Guatemala, Hungary, Indonesia, Netherlands, Peru, South Africa, United Kingdom
Most complete FDS (COMP)	Argentina, Australia, Canada, Demark, Japan, Finland, Sweden, Switzerland, United States
Politically centralized FDS (POCL)	Azerbaijan, Belarus, China, Kazakhstan, Kyrgyzstan, Tajikistan
Unitary State FDS (UNIS)	Bulgaria, Croatia, Estonia, Georgia, Latvia, Lithuania, Nicaragua, Romania, Thailand, Ukraine, Colombia, Costa Rica

High-Expenditure/Revenue Assignment FDS (HERA): includes Austria, Bolivia, Brazil, Germany, India, Italy, Korea, Mexico, Mongolia, Norway, Poland, Russia, Spain, and Taiwan. HERA FDS demonstrates a robust expenditure and revenue assignment. In terms of traditional fiscal decentralization indicators, the countries in this group would be regarded as the most decentralized. However, in the new measurements of fiscal decentralization, HERA FDS lacks qualitative fiscal decentralization including: taxing power, taxing revenue, and borrowing power.

Low-Expenditure/Revenue Assignment FDS (LERA): includes Belgium, Czech Republic, France, New Zealand, and Portugal. The countries in this cluster

display a strong similarity in the variable of supra-government structure which indicates that, except New Zealand, they are regulated by the EU government. It should be noted that LERA FDS has the lowest score on the variable of expenditure/revenue assignment. The possible explanation for this phenomenon is the 3% ceiling on budget deficits that is imposed on these countries. As a result, the national government is more frugal in local spending, fearing that irresponsible spending behavior by a sub-national government could increase the national deficit. Additionally, LERA FDS possess a relatively benign taxing power, along with generous borrowing power.

Revenue Transfer FDS (TRAN): includes Albania, Guatemala, Hungary, Indonesia, Netherlands, Peru, South Africa, and the United Kingdom. TRAN FDS exhibited a very discernible low level of tax revenue. Previously, we have mentioned that the variables of tax revenue and transfer revenue are inversely correlated. Therefore, a low level of tax revenue is equivalent to a high level of transfer revenue from the national government. This explains why the group is named transfer revenue FDS. In addition to the conspicuously low ratio of tax revenue, some indicators also exhibited relatively poor taxing power and borrowing power.

Most Complete FDS (COMP): includes Argentina, Australia, Canada, Denmark, Japan, Finland, Sweden, Switzerland, and the United States. COMP FDS demonstrate very strong similarities among its member countries. This group is mainly composed of the world's most developed countries, with the exception of Argentina. A possible explanation for the inclusion of Argentina is that the financial crisis in this country is primarily generated from undisciplined spending behavior by the sub-national government and this cluster analysis does not include the hard budget constraint variable

over the local government, due to the lack of credible data sources. It should also be noted that countries in this cluster present high scores on almost all the variables. The sub-national governments in this group possess a high degree of taxing revenue, taxing power, borrowing power, expenditure/revenue assignment and independence in local affairs. All these characteristics are consistent with the desirable framework for the fiscal decentralization system proposed by Bahl and Martinez-Vazquez (2005). Therefore, the cluster is considered the most complete FDS.

Politically Centralized FDS (POCL): includes Azerbaijan, Belarus, China, Kazakhstan, Kyrgyzstan, and Tajikistan. Contrary to the COMP FDS, POCL FDS is composed of developing countries, without exception. Although the sub-national governments in this group enjoys a high degree of tax revenue and expenditure/revenue assignment, their taxing and borrowing powers are actually quite constricted. The sub-national governments here are likely to play the role of agents of the central government rather than possessing independent discretionary powers to deal with local affairs. This argument can also be supported by their lowest scores on the democracy variable, which reflects their extremely limited political decentralization. To summarize, the countries in this cluster have a high enough number of unfavorable institutional arrangements in political decentralization to be described as politically centralized fiscal decentralization systems.

Unitary State FDS (UNIS): includes Bulgaria, Croatia, Estonia, Georgia, Latvia, Lithuania, Nicaragua, Romania, Thailand, Ukraine, Colombia, and Costa Rica. None of the countries in UNIS FDS is a federal state, which suggests that all of them are a unitary state. UNIS FDS also assign little taxing power and borrowing power to their

sub-national governments. The sub-national governments in this cluster also enjoy limited local independence as well as expenditure/revenue assignment. One distinguished institutional arrangement for this type of system is the high level of tax revenue. In many ways, UNIS FDS bears a striking resemblance to POCL FDS: a non-federal state, with limited taxing and borrowing powers, a low level of political decentralization, and a high ratio of tax revenue in the SNG. Yet the relatively high degree of political decentralization puts these countries in the cluster of UNIS FDS. In addition to the similarity in fiscal decentralization systems, one should take note that the POCL FDS and UNIS FDS are mostly composed of the countries of the former Soviet Union and Eastern Europe Communist Bloc.

V. Limitation of Cluster Analysis

It should be noted that no single typology can perfectly describe and categorize all countries' fiscal decentralization systems. Therefore, it is necessary to identify the problematic countries where there is controversy regarding their placement in a designated cluster. The controversial placement may result from either the timeliness and accessibility of datasets or the incomplete performance of a single indicator. For example, the placement of Argentina in the most complete FDS is controversial due to that country's well-known fiscal problems which arose from inadequate fiscal discipline in the sub-national government. Nevertheless, owing to the lack of a proxy variable for the hard budget constraint on sub-national government borrowing, it would be hard to exhibit the effects of this component on fiscal decentralization systems. Under this circumstance, Argentina would still be placed in the most complete FDS, considering its

quantitative fiscal decentralization indicators as well as the qualitative fiscal decentralization indicators. Taking China as another example, this country has made progress in its decentralization efforts. However, considering the fact that China is still acting as an authoritarian state, independence for local officials is still highly constrained. It can, therefore, be placed in POCL FDS. The relevant information is displayed in Table 3.5 as follows.

Another difficulty of cluster analysis is the determination of the number of clusters. Everitt (1979) regards this fundamental step as among the as yet unsolved problems of cluster analysis. He argues that the two most important reasons that little progress has been made toward a solution are the lack of a suitable null hypothesis as well as the complex nature of multivariate sampling distributions. Even though some tests are proposed to justify the number of clusters, most of these methods are poorly understood or are heuristics (Aldenderfer & Blashfield). As a result, without a proper test method, the determination of the number of clusters may fall into subjective conjecture.

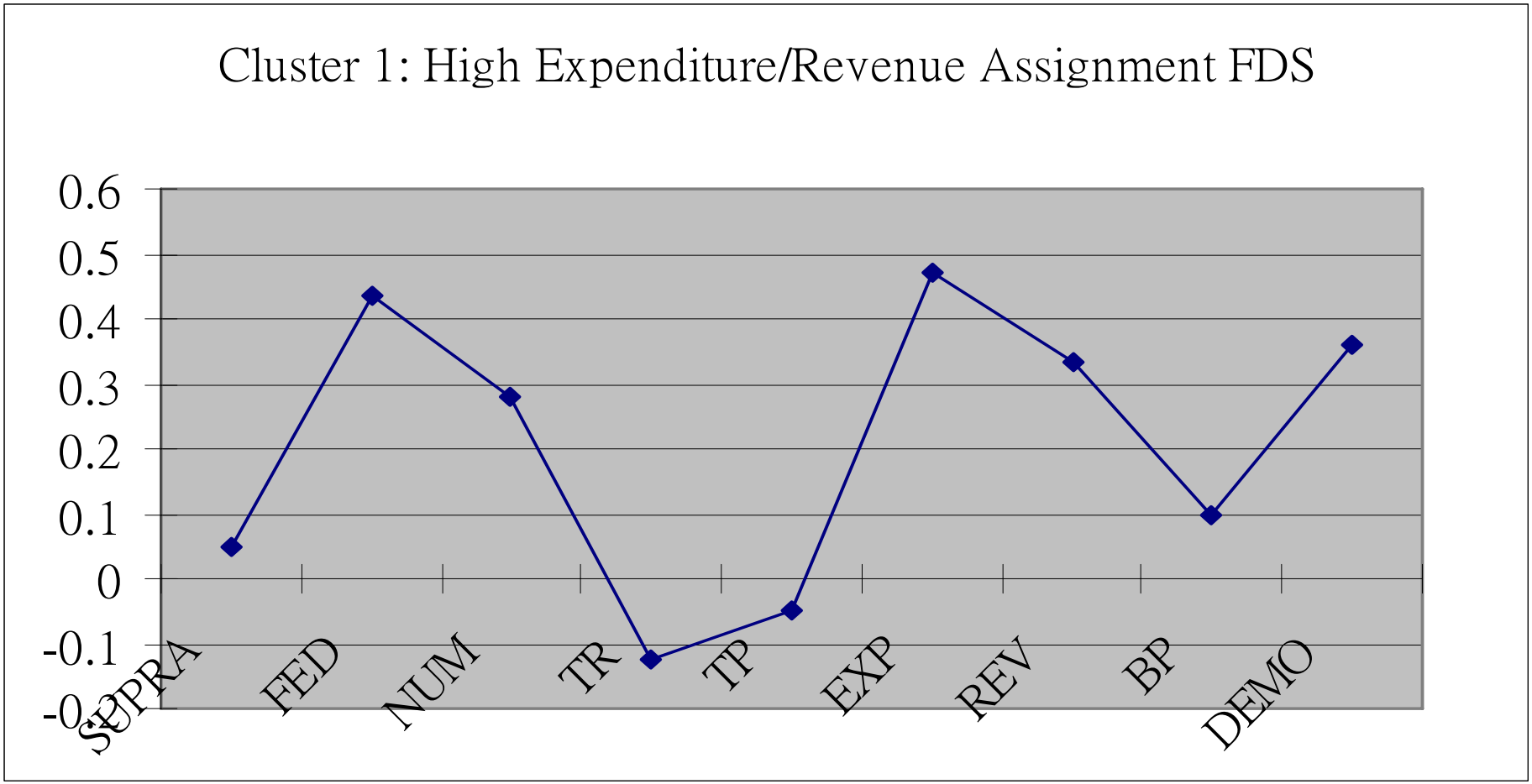
Table 3.6: Controversial countries in each cluster

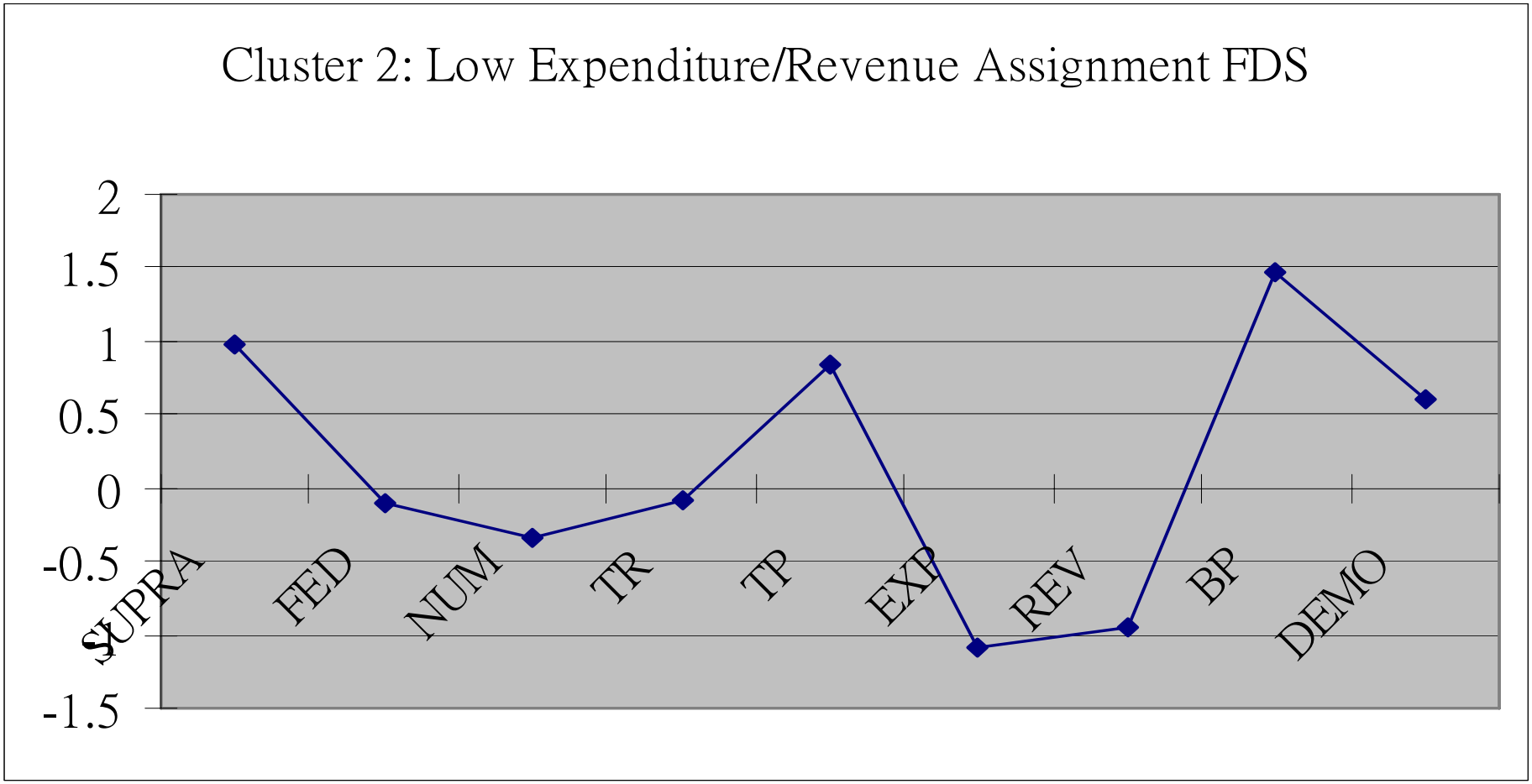
Cluster	Countries member	Least-fitting countries
High-Expenditure/Revenue Assignment FDS (HERA)	Austria, Bolivia, Brazil, Germany, India, Italy, Korea, Mexico, Mongolia, Norway, Poland, Russia, Spain, Taiwan	Germany, Norway
Low-Expenditure/Revenue Assignment FDS (LERA)	Belgium, Czech, France, New Zealand, Portugal	
Revenue Transfer FDS (TRAN)	Albania, Guatemala, Hungary, Indonesia, Netherlands, Peru, South Africa, UK	UK, Netherlands
Most Complete FDS (COMP)	Argentina, Australia, Canada, Denmark, Japan, Finland, Sweden, Switzerland, US	Argentina
Politically Centralized FDS (POCL)	Azerbaijan, Belarus, China, Kazakhstan, Kyrgyz, Tajikistan,	China
Unitary State FDS (UNIS)	Bulgaria, Croatia, Estonia, Georgia, Latvia, Lithuania, Nicaragua, Romania, Thailand, Ukraine, Colombia, Costa Rica	

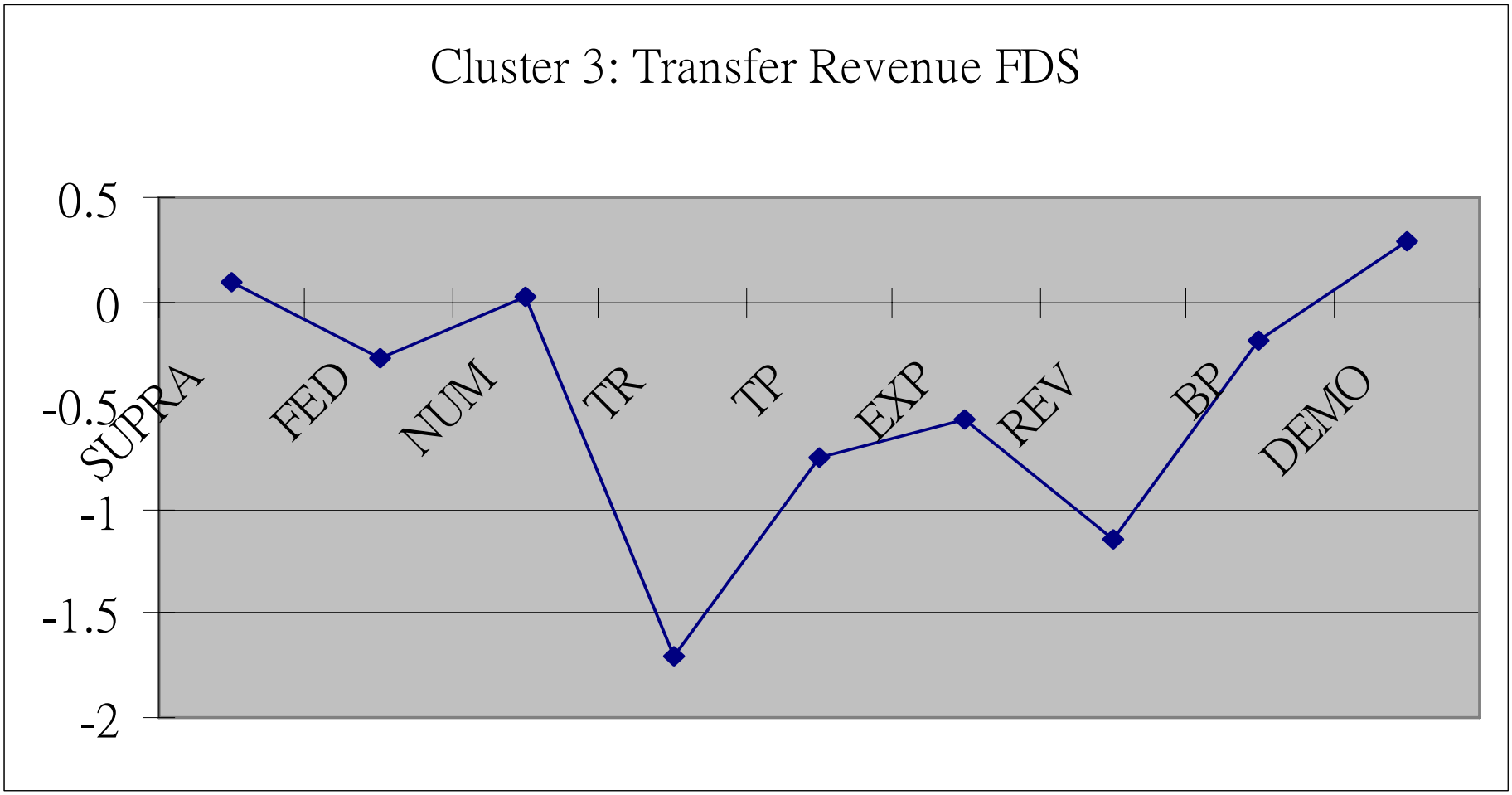
Table 3.7: Cluster means and standard deviations of FDS

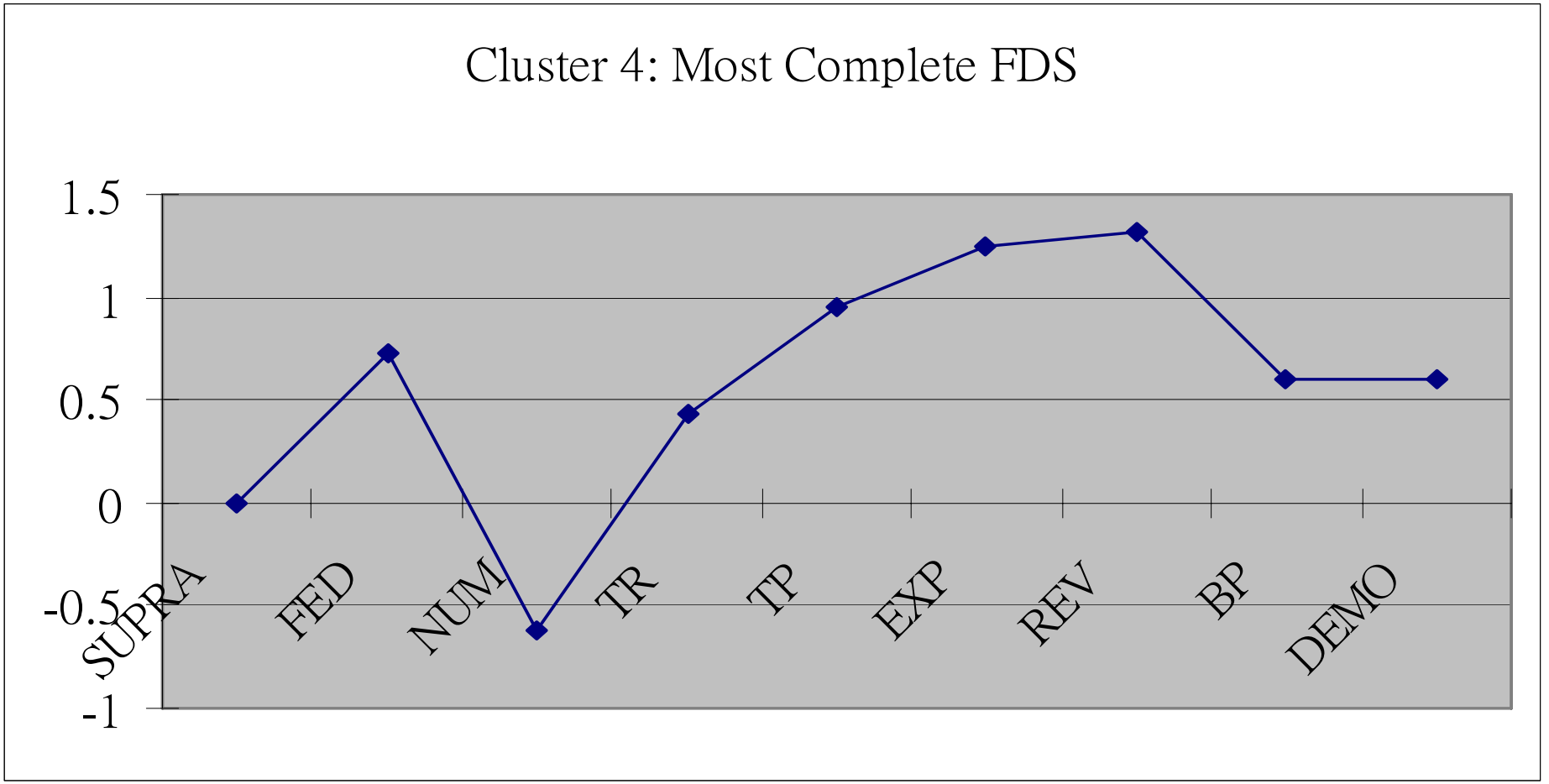
	HERA FDS	LERA FDS	TRAN FDS	COMP FDS	POCL FDS	UNIS FDS	Total
SUPRA	0.357	0.8	0.375	0.333	0	0.25	0.333
	(0.497)*	(0.447)	(0.518)	(0.5)	(0)	(0.452)	(0.476)
FED	0.429	0.2	0.125	0.556	0	0	0.241
	(0.514)	(0.447)	(0.354)	(0.527)	(0)	(0)	(0.432)
NUM	3.786	3.4	3.625	3.222	4	3.583	3.611
	(0.579)	(0.548)	(0.744)	(0.441)	(0.632)	(0.669)	(0.627)
TR	4.929	5	1.875	6	6.5	6.417	5.167
	(1.207)	(1)	(0.641)	(1.323)	(1.517)	(1.443)	(1.930)
TP	2.071	2.8	1.5	2.889	1.333	2.083	2.111
	(0.829)	(0.447)	(0.535)	(0.333)	(0.516)	(0.793)	(0.816)
EXP	3.857	2	2.625	4.778	3.833	2.25	3.296
	(0.535)	(0.707)	(0.916)	(0.441)	(0.753)	(0.866)	(1.192)
REV	3.214	1.6	1.375	4.444	3.333	2.25	2.796
	(0.699)	(0.548)	(0.518)	(0.527)	(1.211)	(0.866)	(1.25)
BP	3	4.8	2.625	3.667	1.667	2.083	2.87
	(1.301)	(0.447)	(0.916)	(1.225)	(1.033)	(0.669)	(1.318)
DEMO	9.071	9.8	8.875	9.778	0.333	7.917	8
	(0.997)	(0.447)	(1.126)	(0.667)	(0.816)	(1.443)	(2.984)

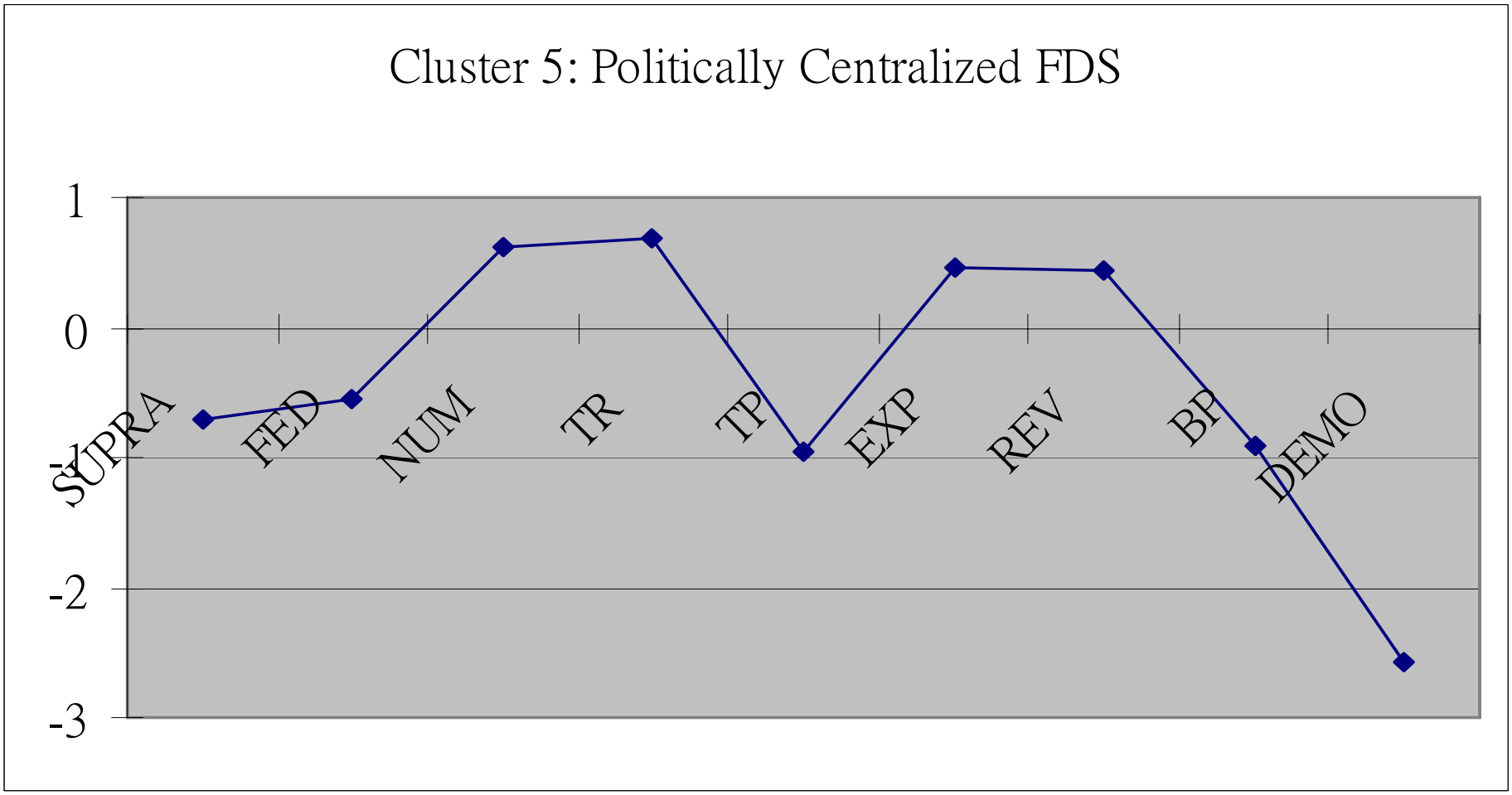
*The value in the parenthesis is standard deviation.
HERA FDS (High Expenditure/Revenue Assignment)
LERA FDS (Low Expenditure/Revenue Assignment)
TRAN FDS (Transfer Revenue)
COMP FDS (Most Complete)
POCL FDS (Politically Centralized)
UNIS FDS (Unitary State)

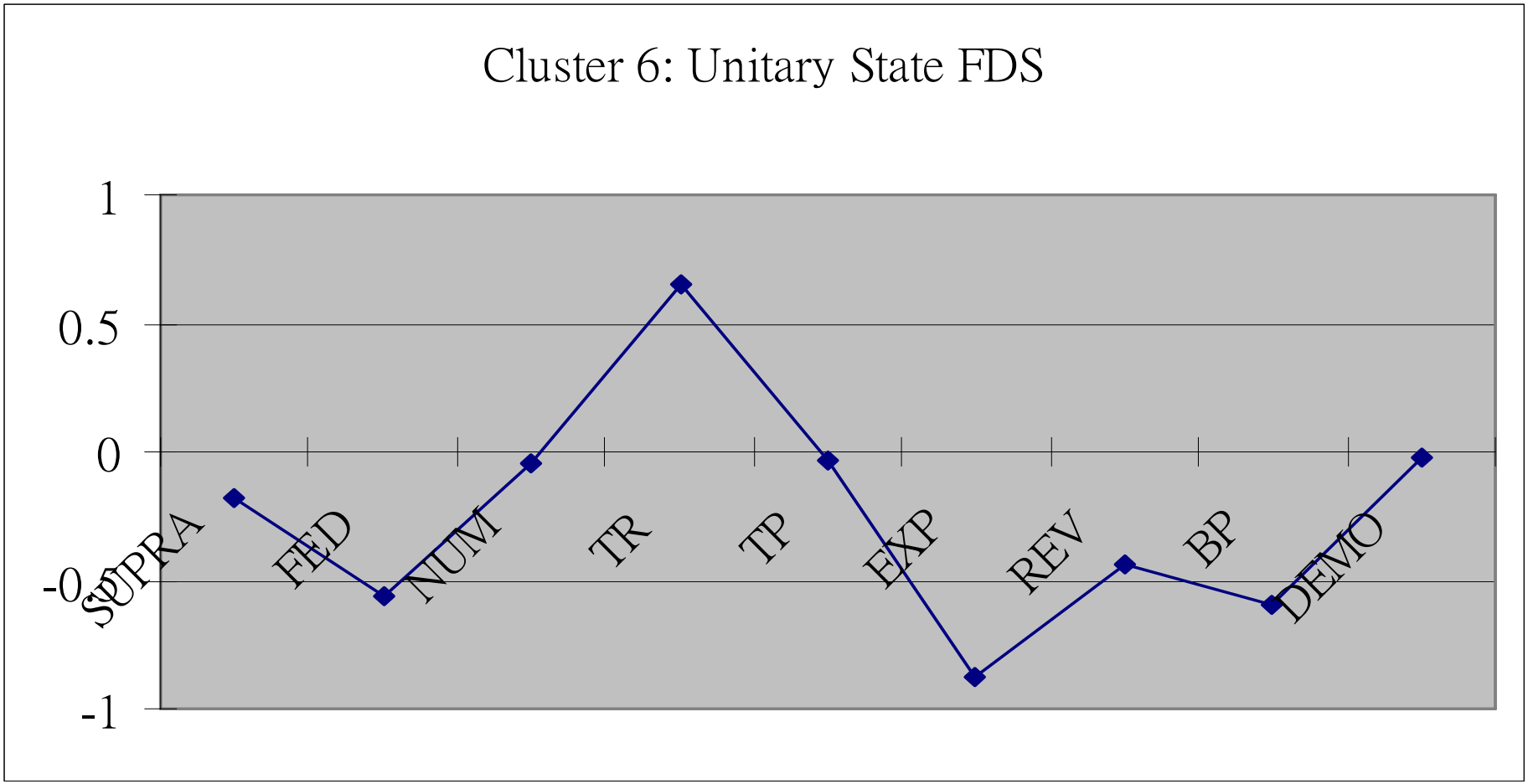

Cluster 1: High Expenditure/Revenue Assignment FDS
0.6
0.5
0.4
0.3
0.2
0.1
0
-0.1
-0.2
SUPRA
FED
NUM
TR
TP
EXP
REV
BP
DEMO


Cluster 2: Low Expenditure/Revenue Assignment FDS
2
1.5
1
0.5
0
-0.5
-1.5
SUPRA
FED
NUM
TR
TP
EXP
REV
BP
DEMO


Cluster 3: Transfer Revenue FDS
0.5
0
-0.5
-1
-1.5
-2
SUPRA
FED
NUM
TR
TP
EXP
REV
BP
DEMO


Cluster 4: Most Complete FDS
1.5
1
0.5
0
-0.5
-1
SUPRA
FED
NUM
TR
TP
EXP
REV
BP
DEMO


Cluster 5: Politically Centralized FDS
1
0
-1
-2
-3
SUPRA
FED
NUM
TR
TP
EXP
REV
BP
DEMO


Cluster 6: Unitary State FDS
1
0.5
0
-0.5
-1
SUPRA
FED
NUM
TR
TP
EXP
REV
BP
DEMO

Chapter IV: Inter- and intra-cluster comparison

In the previous chapter, six types of fiscal decentralization systems were identified that are currently implemented in countries worldwide. This chapter explores how different types of fiscal decentralization systems perform through comparison of several performance indicators among the six identified clusters.

I. Inter-cluster comparison

Several performance indicators will be used to compare each cluster's strengths and weaknesses. The inter-cluster comparison enables us to take a broad view of the six types of fiscal decentralization systems. First, three kinds of performance dimensions were employed, specifically, economic performance, governance performance and fiscal performance. Each performance is analyzed using two sub-indicators. In studying the economic performance, the two sub-indicators used for comparison were annual GDP growth rate and the rate of inflation. Also included is the GDP per capita (PPP) as one of the sub-indicators of economic performance; this was included because of the rapid rate of growth in emerging markets during this period. In governance performance, an index of corruption and an index of government effectiveness are employed to compare six types of fiscal decentralization systems. In the area of fiscal performance, government debt figures and fiscal deficit statistics are utilized in the comparison. All performance indicators contain time-series data from 1996 to 2004, depending on the availability of datasets. The year range chosen was primarily because the data for

institutional arrangements of fiscal decentralization systems were usually collected during this time period. Consequently, the performance data during this collection period may prove to be closely associated with the institutional arrangements of fiscal decentralization systems. However, on the inter-cluster economic performance comparison, we extend the data back to early 1990s to avoid the extreme volatility of economic performance in emerging markets.

Table 4.1: Contents of performance indicator

Performance	Indicator	Source
Economic performance	GDP growth rate	World Economic Outlook Database, IMF
	Inflation rate	World Economic Outlook Database, IMF
	GDP per capita, PPP (LOI)	World Economic Outlook Database, IMF
Governance performance	Corruption index	Governance III 2002
	Government Effectiveness	Governance III 2002
Fiscal performance	Government debt/GDP	OECD; CIA World Factbook
	Fiscal deficit/GDP	World Development Indicators, World Bank
		OECD website

These seven performance indicators were chosen based primarily on previous empirical studies investigating the relationship between fiscal decentralization and its relevant performance. For example, previous studies have attempted to find a relationship between GDP growth and fiscal decentralization, while others have tried to identify the relationship between governance and fiscal decentralization. These empirical studies remain inconclusive; however, these studies capture a snapshot of the relevance of fiscal decentralization. In addition, we conduct pairwise correlations in STATA on these performance variables to determine how they are correlated. The

results are presented in table 4.2. Based on the time series data from 1996 to 2004, the variable of income level is highly correlated with government effectiveness and corruption control. Further, the variable of GDP growth rate is inversely correlated with governance performance and fiscal performance.

Table 4.2: Pairwise correlation for performance variables

	GDP	Inflation	INC*	Effect	Corrupt	Deficit	Debt
GDP	1.000						
Inflation	0.268	1.000					
	(0.05)						
INC*	-0.57	-0.34	1.000				
	(0.00)	(0.01)					
Effect	-0.56	-0.46	0.94	1.000			
	(0.00)	(0.00)	(0.00)				
Corrupt	-0.54	-0.38	0.93	0.98	1.000		
	(0.00)	(0.01)	(0.00)	(0.00)			
Deficit	-0.07	0.01	0.38	0.38	0.39	1.000	
	(0.60)	(0.96)	(0.00)	(0.01)	(0.00)		
Debt	-0.24	-0.15	0.07	0.01	0.02	0.04	1.000
	(0.11)	(0.31)	(0.66)	(0.96)	(0.89)	(0.82)	

*INC: level of income, GDP per capita (PPP)
Value in parenthesis is the t-test probability for the null hypothesis that each individual correlation equals zero.

A. Economic Performance

Three economic performance indicators are assigned in this category: GDP growth rate, inflation rate, and GDP per capita (PPP). The time series data range from 1990 to 2005. The data for these three indicators are less controversial than others because the definition is widely accepted. They are readily available from *World*

Economic Outlook Database created by IMF.

In terms of GDP growth rate, POCL FDS and UNIS FDS exhibit the most volatile GDP growth rate during this time period (figure 4.1). This trend is particularly apparent prior to1997. It should be noted that countries in POCL FDS expedite their GDP growth rate after 1997. Furthermore, COMP FDS displays the steadiest economic performance during this time period. This is explained by noting that cluster 4 is composed primarily of industrialized countries, which usually exhibit slow but steady economic growth. LERA FDS, with the similar composition of countries as COMP FDS, demonstrates this same economic growth pattern.

Analysis of data back to the early 1990s shows the inflation rate has greater variation compared to GDP growth rate (figure 4.2). TRAN FDS, POCL FDS, and UNIS FDS all exhibit highly volatile inflation rate patterns during the early 1990s. POCL FDS displays the highest inflation rate as well as the most irregular inflation pattern during this period. Volatility, however, steadies after 2000. LERA FDS and COMP FDS, with their slow but steady economic growth, are expected to demonstrate a low and regular inflation rate during this period. HERA FDS, with its intermediate GDP growth rate, also display an intermediate inflation rate.

In examining GDP per capita performance (figure 4.3), the graph provides explanations of the fast growing of GDP growth rate in POCL FDS and UNIS FDS. Countries in these clusters are largely states with low levels of income. Conversely, countries in COMP FDS are primarily states with high income levels. From this it can be concluded that the fast paced GDP growth rate is associated with low levels of income in POCL FDS and UNIS FDS.

Generally speaking, POCL FDS and UNIS FDS exhibit the highest levels of GDP growth rates and rates of inflation, while LERA FDS and COMP FDS display the lowest levels of GDP growth and inflation rates. From the perspective of fiscal decentralization, the economic performance pattern seems to suggest that well-designed institutional arrangements for a fiscally decentralized system do not necessarily help in stimulating GDP growth but it does appear to offer some support in holding the inflation at stable levels.

B. Governance Performance

Two indicators of governance performance are examined in this category: the corruption indicator and the government effectiveness indicator. These indices are chosen from the governance III database. The governance indicators are measured in units ranging from approximately -2.5 to 2.5, with the higher values corresponding to better governance outcomes. Governance III provides time series data across countries worldwide (Kaufmann et. al. 2003). The time span ranges from 1996 to 2004, in a format using bi-annual data.

There are six governance indicators in the governance III database. Corruption and government effectiveness indicators are chosen because previous empirical studies have investigated their relationship with fiscal decentralization (Huther & Shah 1998; Fishman & Gatti 2000; DeMello & Barenstein 2001; Gurgur & Shah 2002;). For example, Fishman & Gatti (2000) and Gurgur & Shah (2002) all agree on the inverse association between fiscal decentralization and corruption. They find that higher

degrees of fiscal decentralization yield lower levels of corruption. Nevertheless, as we have argued in the previous chapter, the traditional thinking in fiscal decentralization that focuses on the ratio of SNG expenditure/revenue as to total government expenditure/revenue is problematic and controversial; it would thus be unable to reflect the real correlation between fiscal decentralization and corruption. As a consequence of this argument, this study takes a fiscal decentralization system approach that serves as complementary knowledge in this field of research.

Another issue regarding the governance dataset collected by Kaufmann et. al. (2003) is that the data set is compiled on the basis of polls by experts and of cross-country surveys of residents. In other words, the data set is quite a subjective perception of general government rather than of objective differences in institutions across countries. Moreover, the data set does not specify whether this perception falls into the category of central government or of local government. Therefore, in the present research, the governance performance is based on the perception of general governments of a country.

From figure 4.4, we see that COMP FDS has the highest score on government effectiveness, followed by LERA FDS. POCL FDS and UNIS FDS rank the lowest among all clusters on government effectiveness. Figure 4.5, the trend of corruption indicator, also depicts a similar pattern. This result seems to imply a connection between a well-designed fiscal decentralization system and governance performance. In the previous literature review section, the empirical studies have suggested consistent results in this relationship. Almost all the empirical results indicated a positive relationship between fiscal decentralization and governance performance.

C. Fiscal Performance

Two major fiscal performance indicators are investigated: fiscal balance and government debt performance. The fiscal balance indicator is utilized by observing the central government's overall budget balance as a percentage of GDP. The data is available from *World Development Indicators*, published by the World Bank. All other missing data are complemented by other sources, such as the OECD website, and the Economist Intelligence Unit.

The accessibility of the fiscal balance database is not difficult in light of the fact that its simple and clear definitions are commonly accepted. However, there are differences between the fiscal balance of the general government and of the central government. This research employed the data of the central government fiscal balance as observed indicators because of the availability of the database.

Data on debt performance, on the other hand, is controversial owing to the diverse definitions of public debt. According to Reinhart, Rogoff, and Savastano (2003), debt can be defined in four categories. *External debt*: the total liabilities of a country with foreign creditors, both official (public) and private. *Total government (public) debt*: the total debt liabilities of a government with both domestic and foreign creditors. *Government domestic debt*: all debt liabilities of a government that are issued under, and subject to, national jurisdiction, regardless of the nationality of the creditor. *Government foreign currency domestic debt*: debt liabilities of a government that are issued under national jurisdiction but expressed in a currency different from the national currency. Among these four definitions, external debt and total government debt are the most widely used indicators. Different kinds of debt may pose different threats to the debtor

country. For example, developing countries are constantly plagued by heavy external debt while industrialized nations, usually free from external debt, are swamped with national debt, such as Japan and Italy.

In addition to inconsistencies in defining government debt, a major obstacle to analyzing government debt is the absence of databases. As in all large sample data analysis, the completeness of the data signifies the accuracy and robustness of the empirical results. While an extensive effort has been made to incorporate the most complete and respected datasets available, some deficiencies remain.

Currently, OECD, the World Bank, and the IMF are working together to establish a database of external debt across countries. However, despite these efforts, only external debt for developing countries has been completed. External debt in industrialized countries has yet to be established; therefore, the total government debt indicator in the OECD database will be employed as the proxy indicator to compare with the external debt in developing countries. As a result, LERA FDS and COMP FDS in figure 4.7 uses a different definition of debt performance.

Generally speaking, there are several difficulties in the collection of data on debt performance. While attempts are made to ensure consistency in cross-country data, the quality and therefore credibility of data may vary given the variations among database sources, as well as the data collection techniques employed by the respective national entities, partner agencies, and international organizations.

In terms of fiscal balance, it can be seen that LERA FDS and COMP FDS exhibit a higher level of performance with respect to their government budget balance. Conversely, data reveal deterioration in fiscal balance in HERA FDS. In HERA FDS,

four countries, Brazil, India, Mongolia, and Taiwan, exhibit an average fiscal balance over GDP lower than -5% from 1997 to 2001. Generally speaking, all six clusters demonstrate an upward trend, i.e., an improving sign of fiscal balance during this time frame.

In terms of debt performance, COMP FDS, composed of mostly developed countries, exhibits the highest debt level, as expected. LERA FDS and UNIS FDS, on the other hand, also display high levels of debt along with COMP FDS. HERA FDS and TRAN FDS demonstrate the lowest level of debt to GNI among the six clusters. In addition, they also exhibit a downward trend, indicative of lower debt levels.

It should be noted that, as previously shown, the debt level in LERA FDS and COMP FDS is the measurement of general government debt to GDP while the other four clusters are measured by the indicator of external debt to GNI. Inconsistencies in measurements may result in skewed investigations of debt performance among the six clusters. However, in light of the fact that some developed countries may possess zero external debt while carrying high levels of government debt, it would be a contingent method to use different yet closely related debt measurements among the six clusters. Furthermore, LERA FDS and COMP FDS are composed primarily of developed countries, which are usually plagued by domestic debt rather than external debt. A measurement of general government debt can more appropriately reflect the debt performance of these industrialized countries.

Figure 4.7 reveals that COMP FDS exhibits the greatest debt burden, followed by LERA FDS and UNIS FDS. Like the countries in COMP FDS, countries in LERA FDS are mainly composed of industrialized nations. It is not surprising, therefore, to find a

high debt burden in these two clusters. UNIS FDS, on the other hand, is primarily composed of the countries formerly within the Soviet Union. Accordingly, they display a similar performance pattern to the countries in POCL FDS.

II. Intra-cluster comparison

Intra-cluster comparisons were conducted in order to further distinguish within-cluster variations. These comparisons were based on indicators of previous performance as presented in the inter-cluster comparison, with the exception that the debt performance graph was excluded as the many missing variables cast doubt on the reliability of the conclusions drawn from findings in this category. Intra-cluster comparisons convey at glance information about center, spread, and outliers among six clusters. Methodology for the intra-cluster comparison utilized the calculation of the average figures of GDP, inflation, government effectiveness, corruption levels, and fiscal balance over a 5-7 year period for each country. The box plot was then drawn to display the distribution of countries within each cluster.

A. Economic Performance

Figure 4.8 displays variations in the growth rate of GDP in six clusters. There are two outliers in HERA FDS and POCL FDS. In HERA FDS, Russia does not align with the rest of the countries, while China is completely different from the remaining countries in POCL FDS in terms of GDP growth rate. Countries in LERA FDS exhibit the most consistency in GDP growth rate, while the countries in UNIS FDS exhibit the most variability. Additionally, the median proportion of GDP growth rate tends to be

highest in COMP FDS, and lowest in POCL FDS.

With respect to the inflation rate, there is evidence of tighter clustering. There are huge variations in the inflation rate across the six clusters. There are outliers in COMP FDS. Two outliers are found in COMP FDS. Argentina exhibits the highest inflation rate when compared to the rest of the countries in COMP FDS. Japan, on the other hand, displays a deflationary trend in COMP FDS. Among the six clusters, POCL FDS conveys the greatest degree of variability in the rate of distribution of inflation.

The intra-cluster comparison in GDP per capita indicates the highest level in COMP FDS among the six types of FDS. Nevertheless, there are two outliers in this COMP FDS, which are US and Argentina respectively. Meanwhile, HERA FDS and TRAN FDS both exhibit the most variable distributions in the comparison of income level.

B. Governance Performance

The intra-cluster comparison in government effectiveness and corruption seems to display the same box pattern. With respect to government effectiveness, COMP FDS exhibits the most consistency and the highest median value among the six clusters, with the exception of Argentina which has the lowest score in government effectiveness. Japan (lower score) and Switzerland (higher score) also play the roles of outlier in COMP FDS in terms of government effectiveness. POCL FDS, on the other hand, has the lowest median value, with the exception of China. China is the only country with a positive score for government effectiveness in POCL FDS. Countries in HERA FDS and TRAN FDS exhibit the most variable distributions.

The intra-cluster comparison in corruption conveys the same distributions as in government effectiveness. For instance, COMP FDS still has the highest median value while POCL FDS has the lowest median value in corruption index. LERA FDS, however, rather than COMP FDS, exhibits the most consistency. Again, Argentina does not fit in well with the other countries in COMP FDS in terms of the corruption index. Two outliers, Czech Republic and New Zealand are also found in LERA FDS. Costa Rica, with the highest score in the corruption index, is the outlier in UNIS FDS.

C. Fiscal Performance

In terms of fiscal deficit performance, the data reflect consistency across the six clusters. They have roughly the same median value, with the countries in COMP FDS displaying a slightly higher fiscal surplus. New Zealand, again, is the only country to exhibit a fiscal surplus in LERA FDS. Albania (TRAN FDS) and Japan (COMP FDS) are both outliers, exhibiting the worst fiscal deficit while Bulgaria (UNIS FDS) is the best fiscal surplus outlier.

As for debt performance, POCL FDS demonstrates the most variations, ranging from Belarus (7.14%) to Kyrgyzstan (123.92%). Nicaragua (184.64%) is an extreme outlier in UNIS FDS. Countries in LERA FDS and COMP FDS both display higher than average median values, which is consistent with findings that industrialized countries are plagued by national debt.

Based on the abovementioned analysis, we can then create a table for the outlier country on each intra-cluster comparison category as follow:

Table 4.3: Outlier country in each performance comparison

Performance	Outlier country in each cluster
GDP growth rate	HERA FDS: Russia
	POCL FDS: China
Inflation rate	COMP FDS: Argentina, Japan
GDP per capita, PPP	COMP FDS: Argentina, US
Government Effectiveness	COMP FDS: Argentina, Japan, Switzerland
	POCL FDS: China
Corruption control	LERA FDS: Czech, New Zealand
	COMP FDS: Argentina
	UNIS FDS: Costa Rica
Fiscal balance	LERA FDS: New Zealand
	TRAN FDS: UK
	COMP FDS: Japan
	UNIS FDS: Bulgaria
Debt performance	LERA FDS: Belgium
	COMP FDS: Japan
	UNIS FDS: Nicaragua

Even though we have identified the outlier country in each cluster, we still concern with the possibility of one single country may drive the behavior of the cluster. This situation is particularly possible in inter-cluster comparison. As a result, we would recommend a more thorough and complete outlier analysis in the future research.

III. Preliminary findings

Countries in POCL have high performance indicators of GDP growth rate and the inflation rate. It can be contended, however, that the high GDP growth rate may be

associated with low levels of income. These countries also indicate a lowered quality of government effectiveness and corruption. On the other hand, countries in COMP FDS, display totally different patterns. They have the steadiest performance in GDP growth rate, and the highest level of debt-to-GDP ratio. These countries also have the best performance on inflation control, government effectiveness, the corruption index, and fiscal balance.

Contrary to the commonly accepted notion that fiscal decentralization can facilitate or otherwise promote economic growth, the present findings suggest that even the most complete FDS would not necessarily exhibit the best GDP growth; however, the proffered relationship still needs further empirical experiments to conclusively prove or disprove. Meanwhile, a well-designed FDS, e.g., the COMP FDS, indicates better governance performance, consistent with the results of most empirical studies.

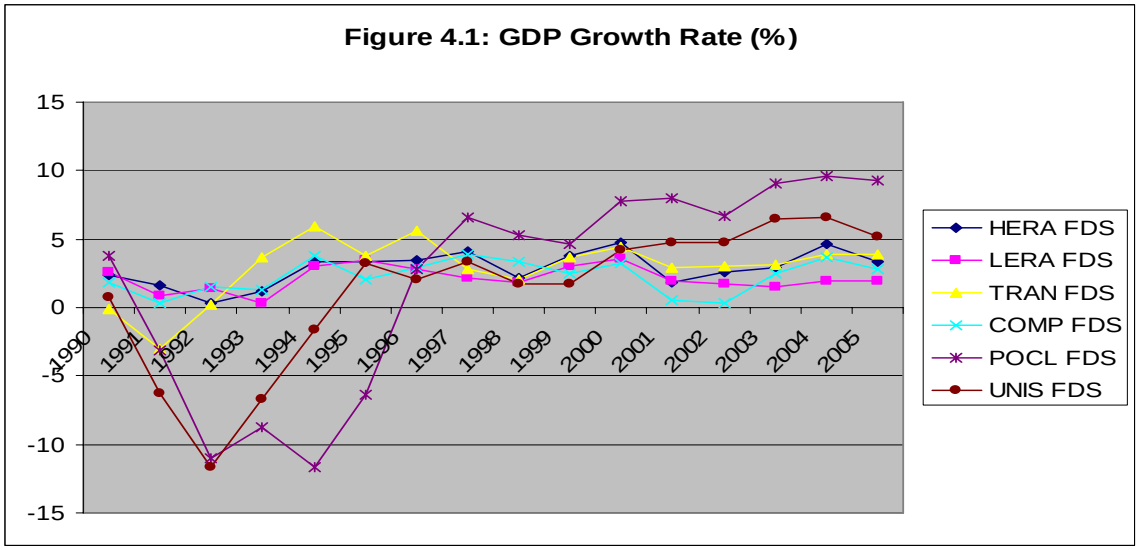
As for the countries in HERA FDS and TRAN FDS, their performance is the most average among six clusters. That is, these countries are neither the best nor the worst in their performance with respect to GDP growth rate, inflation rate, government effectiveness and corruption indicators.

Like the countries in POCL FDS, countries in UNIS FDS demonstrate the same tendency in several performance indicators. For example, they tend to exhibit both high GDP growth rates as well as high inflation rates. They also display worse levels of performance with regard to government effectiveness and corruption indicators, but rate slightly better than countries in POCL FDS.

The relationship between countries in LERA FDS and COMP FDS is identical to that in the countries of POCL FDS and UNIS FDS. Countries in LERA FDS also

developed a similar performance pattern as the countries in COMP FDS, such as lower levels of GDP growth rate and the inflation rate and better performance on governance indicators. There are several explanations for this phenomenon. In addition to the similar composition of member countries, which are mostly industrialized, LERA FDS and COMP FDS display one commonality. Both types have higher scores in the variables of qualitative dimensions of fiscal decentralization, such as taxing power, borrowing power, and political decentralization. In brief, the relationship between the qualitative dimensions of fiscal decentralization and all other performance indicators would require a further empirical model to either prove or disprove, which will be undertaken in the next chapter.

HERA: High Expenditure/Revenue Assignment FDS	COMP: Most Complete FDS
LERA: Low Expenditure/Revenue Assignment FDS	POCL: Politically Centralized FDS
TRAN: Revenue Transfer FDS	UNIS: Unitary State FDS



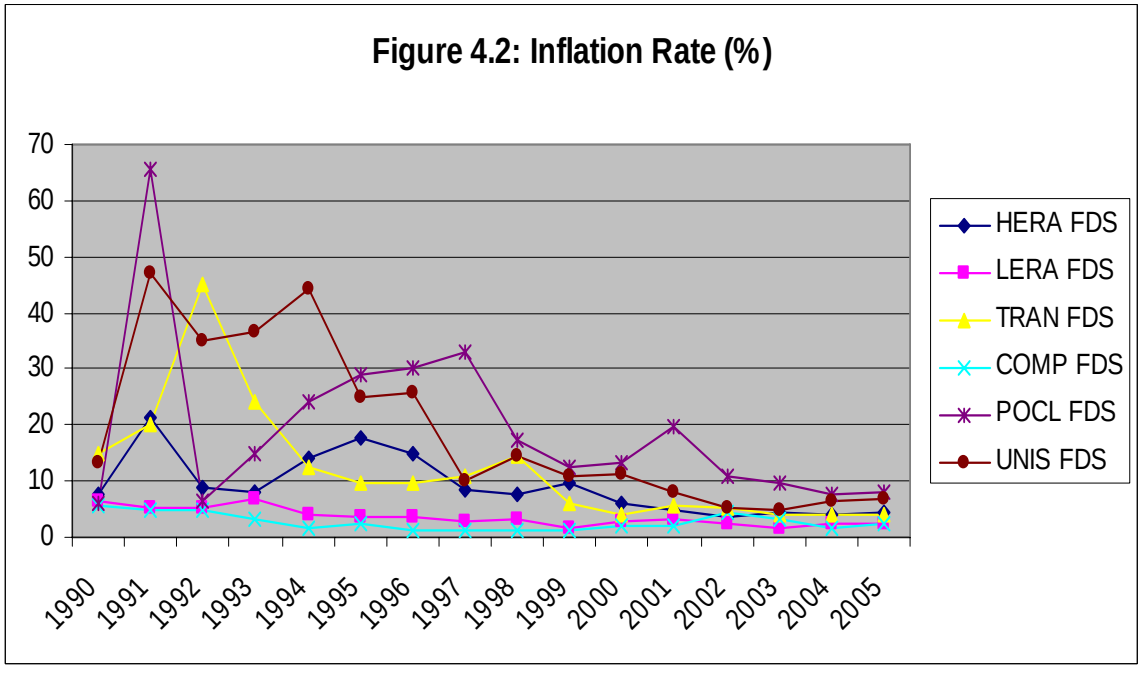


Figure 4.3: GDP per capita (PPP)

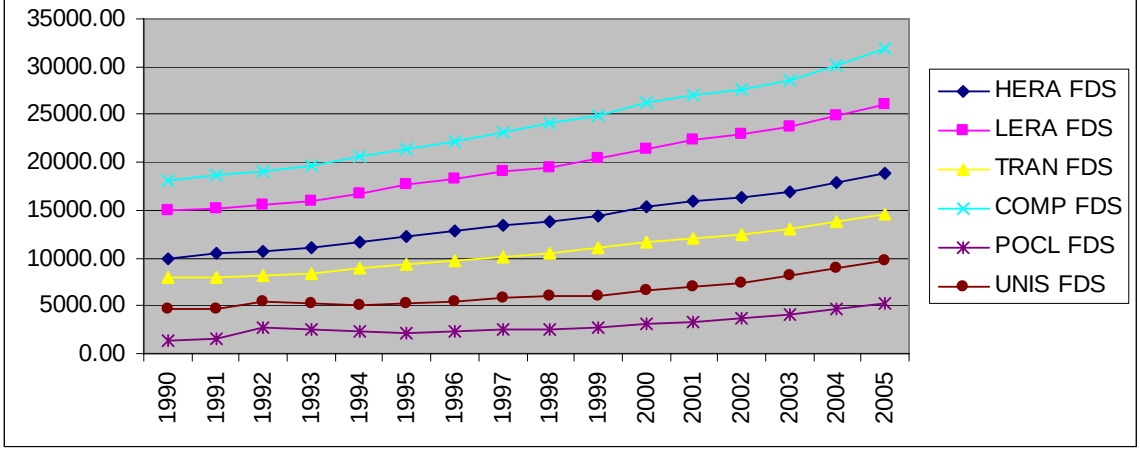
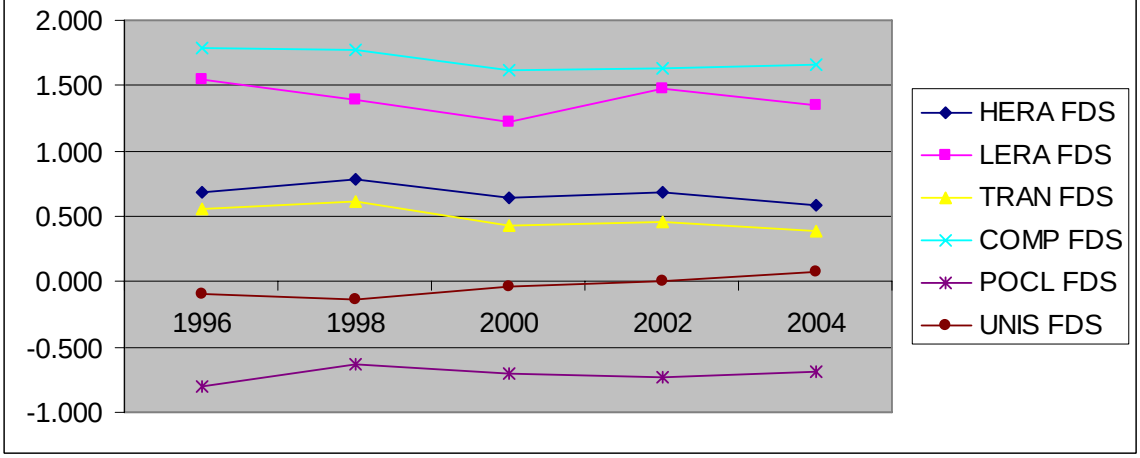


Figure 4.4: Government Effectiveness



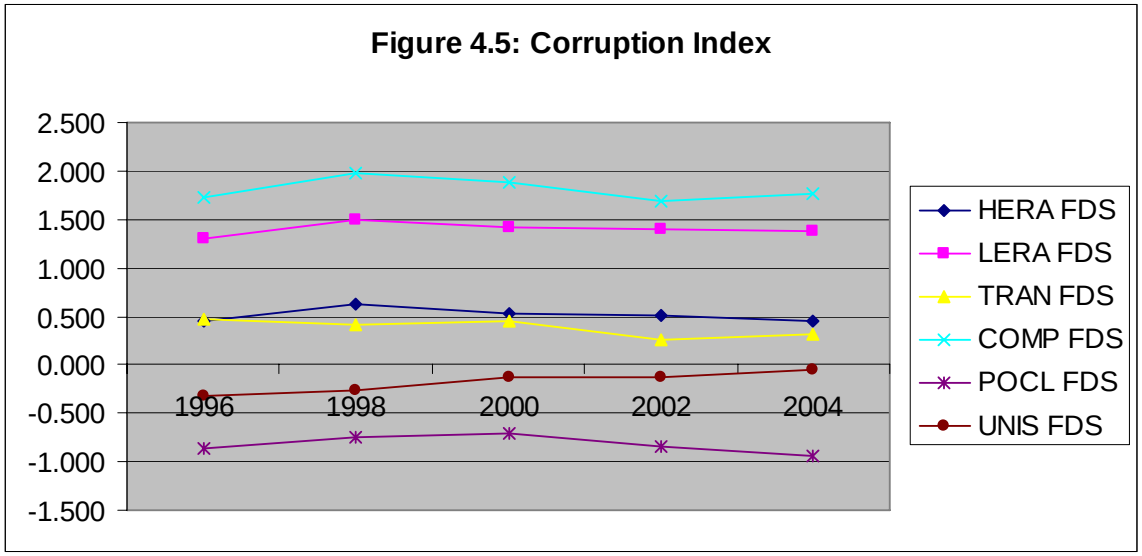


Figure 4.5: Corruption Index
2.500
2.000
1.500
1.000
0.500
0.000
-0.500
-1.000
-1.500
1996
1998
2000
2002
2004
HERA FDS
LERA FDS
TRAN FDS
COMP FDS
POCL FDS
UNIS FDS

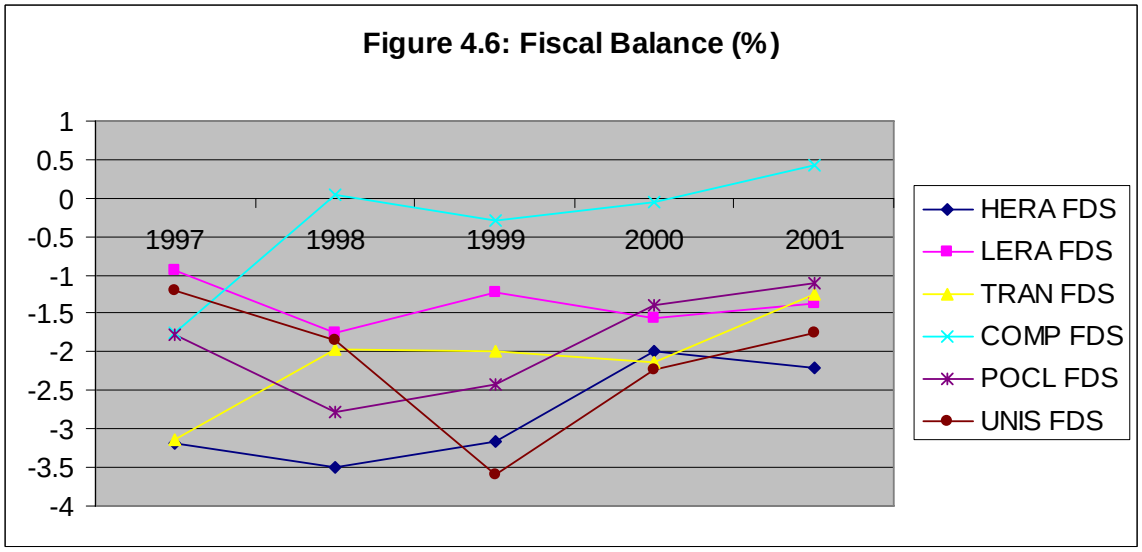


Figure 4.6: Fiscal Balance (%)
1
0.5
0
-0.5
-1
-1.5
-2
-2.5
-3
-3.5
-4
1997
1998
1999
2000
2001
HERA FDS
LERA FDS
TRAN FDS
COMP FDS
POCL FDS
UNIS FDS

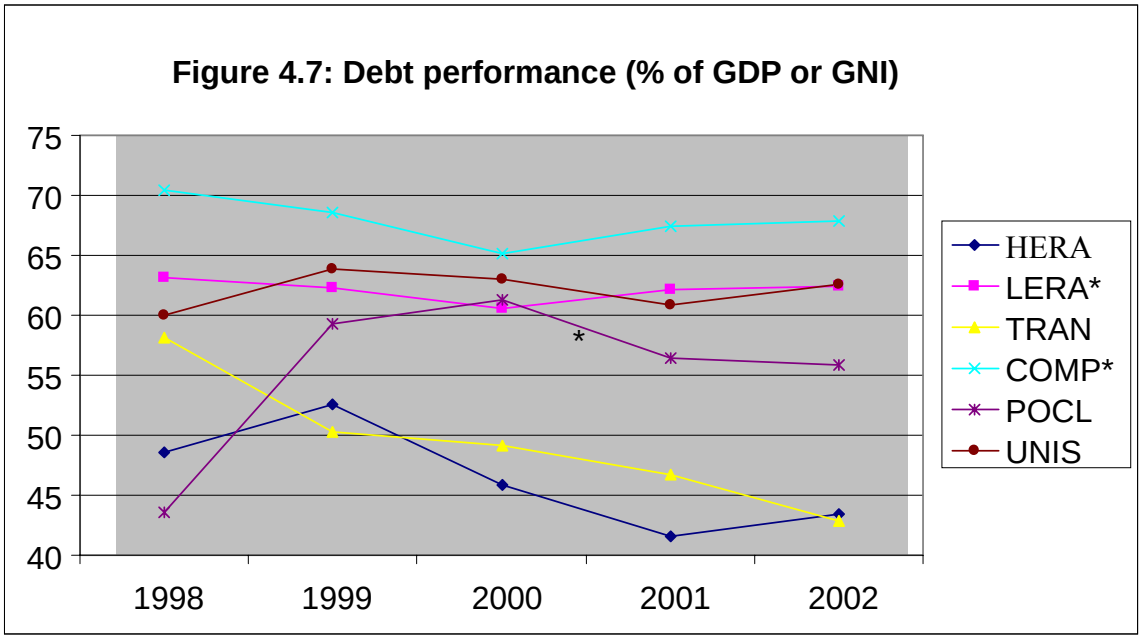


Figure 4.8: Intra-cluster comparison in GDP growth rate

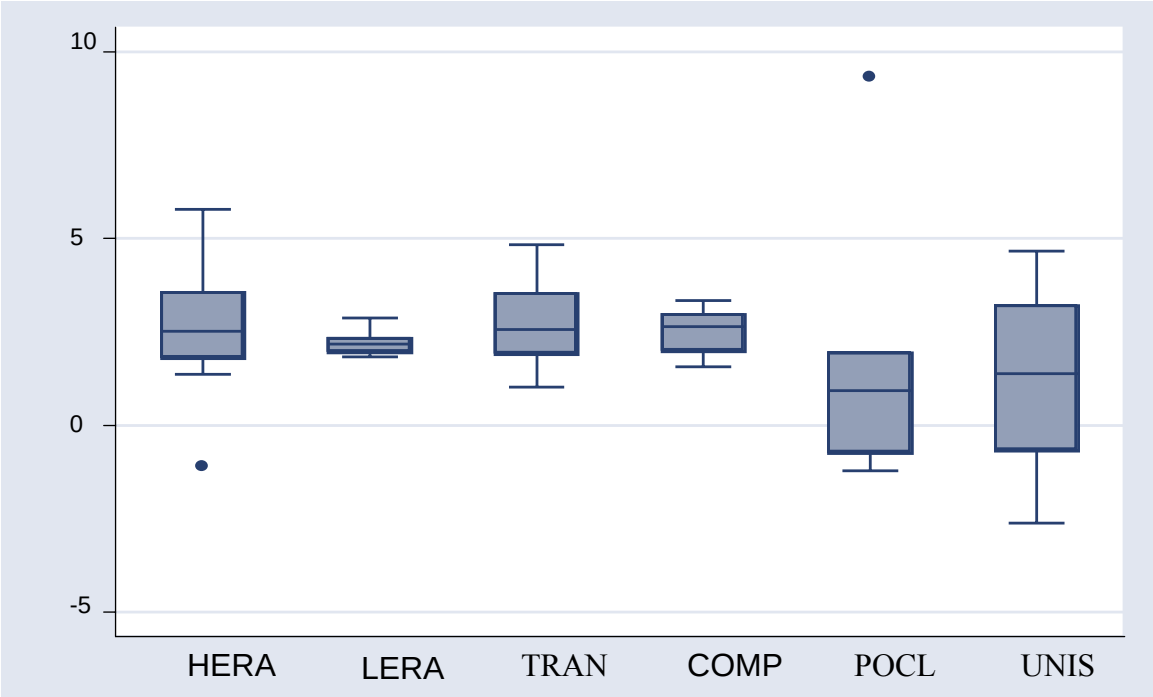


Figure 4.9: Intra-cluster comparison in inflation rate

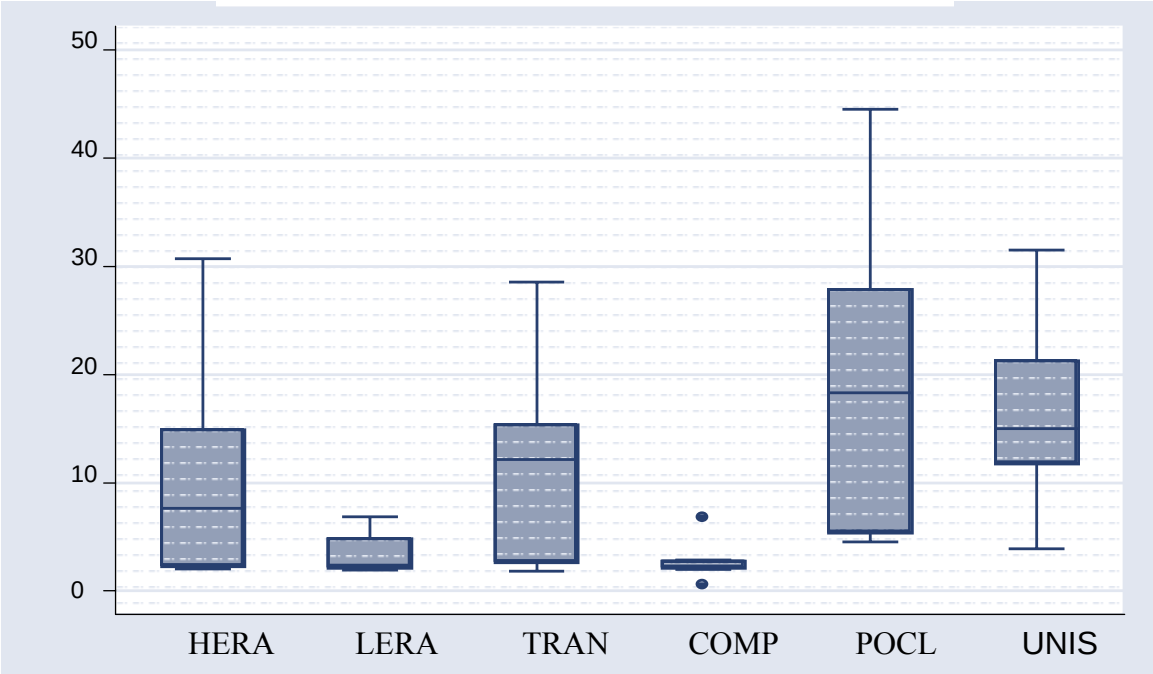


Figure 4.10: Intra-cluster comparison in income level (GDP per capita, PPP)

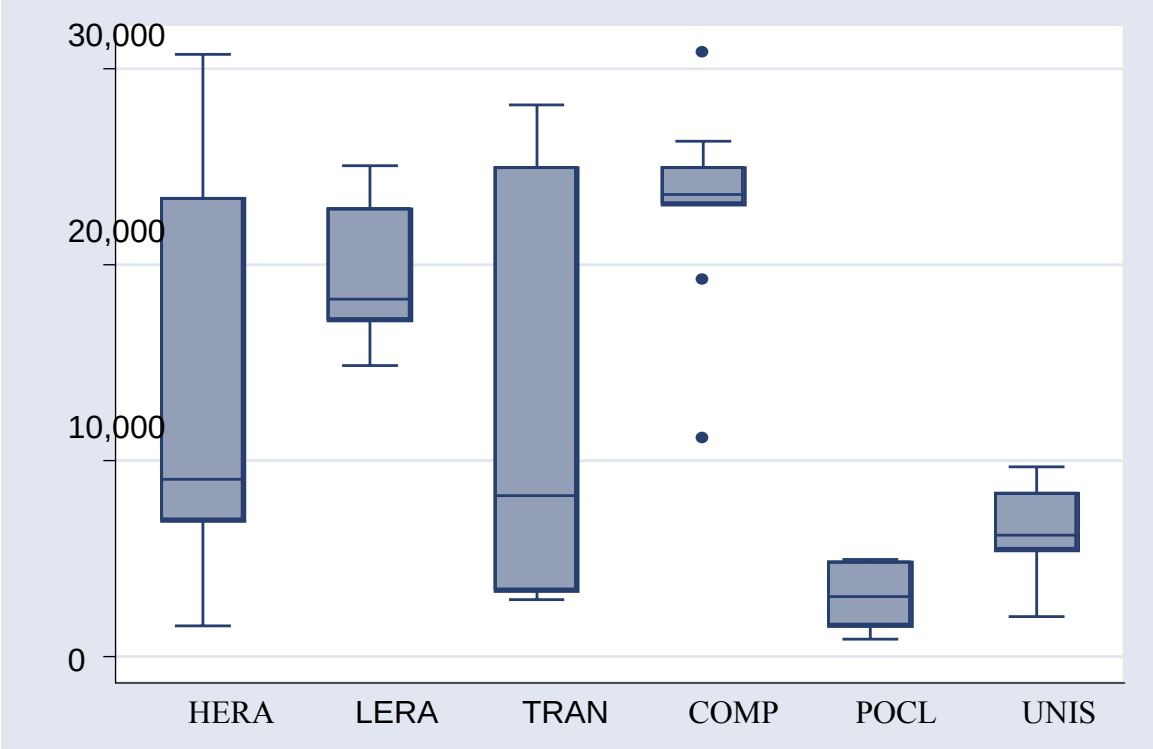


Figure 4.11: Intra-cluster comparison in government effectiveness

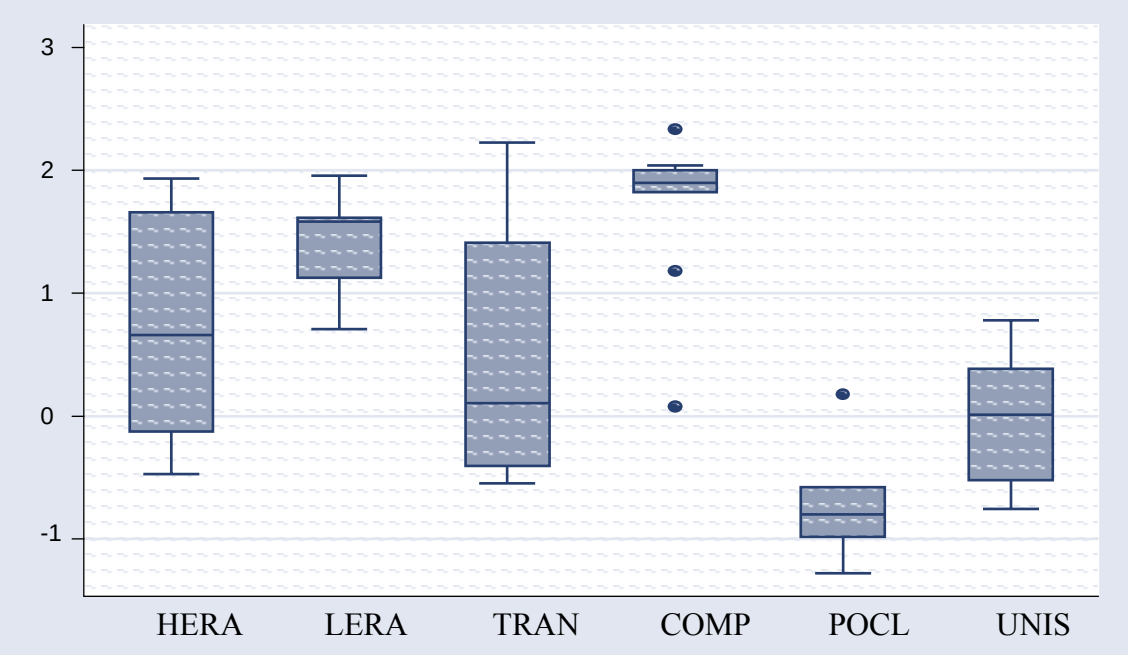


Figure 4.12: Intra-cluster comparison in corruption

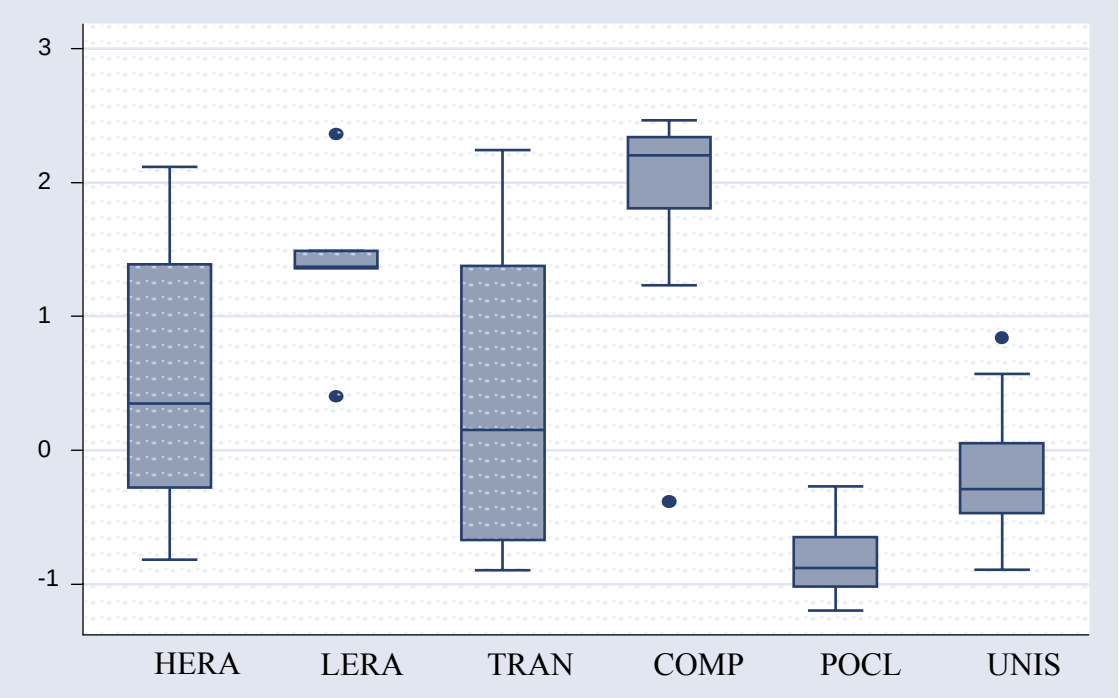


Figure 4.13: Intra-cluster comparison on deficit (% of GDP)

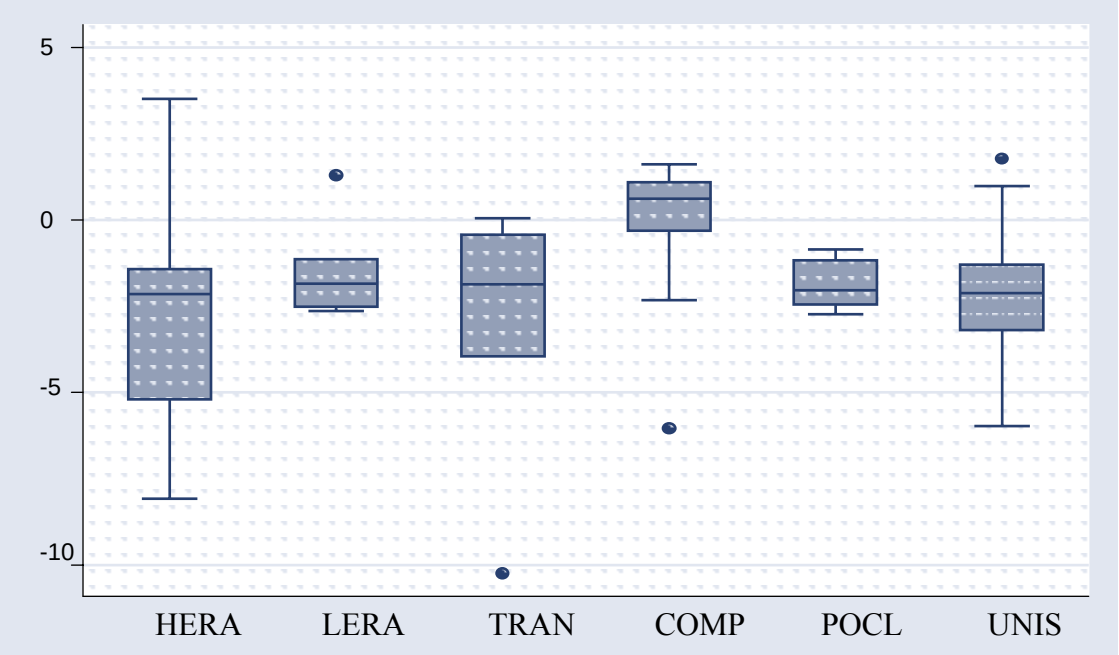
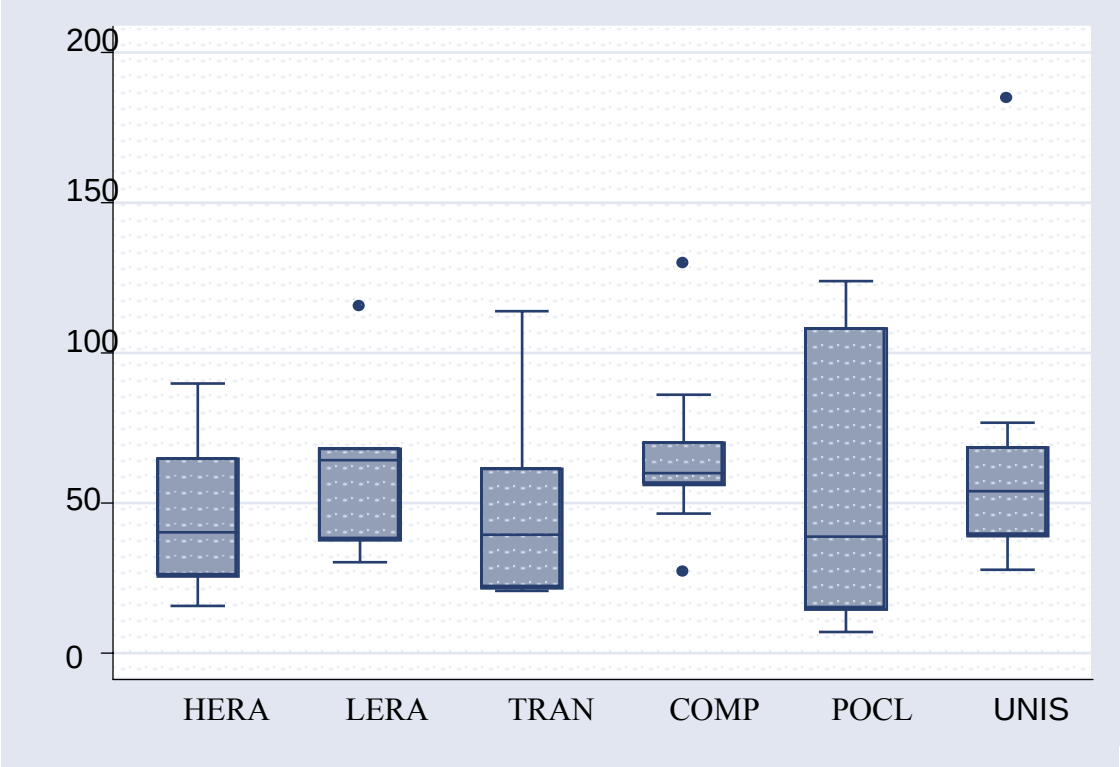


Figure 4.14: Intra-cluster comparison on debt (% of GDP, GNI)



Chapter V: Empirical model

The previous chapter focused on preliminary observations regarding the relationship between different types of fiscal decentralization systems and several indicators of performance by employing the inter- and intra-cluster comparison method. This method revealed a deficit with regard to inter-cluster comparisons which provide an insufficient analysis of the relationship between types of fiscal decentralization and performance since this is only a descriptive statistical analysis rather than an inferential one. This chapter discusses the employment of an empirical model to further identify the relationship between types of fiscal decentralization systems and several indicators of economic performance. The model specifies the ordinary least square (OLS) analysis which treats six types of fiscal decentralization systems as the independent variable to explain the difference in performance indicators.

I. Empirical methodology

Unlike the traditional method of measuring fiscal decentralization, the present method makes the assertion that the universally accepted view that fiscal decentralization should be regarded as a system encounters difficulties when used in conducting empirical studies. The difficulties result primarily from the inaccessibility of time-series data for each country. The present method categorized 54 countries into six types of fiscal decentralization systems which allow little room for expanding sample observations.

To design a more complete empirical model requires the inclusion of other control variables that might also contribute to the differences in economic performance.

Control variables abound to affect economic performance. For example, the new institutional economists emphasize the significance of initial conditions when they make comparisons of performance across countries. They assert that a country's performance is affected by the initial conditions present at the start of the transition period (Zinnes et al, 2000). A country that is isolated geographically or politically has a low level of human capital.

Currently, three types of initial conditions are recognized (Zinnes et al, 2000). First, "fixed" initial conditions refers to those that are invariant and unlikely to change, such as land-locked geography, natural resource endowment, culture, history, and climate. Second, "hard" initial conditions are primarily those that can be changed but in a gradual manner. For example, both demographics and human capital are typically cited as hard initial conditions. Third, "soft" initial conditions refer primarily to government policy, such as the incentives provided by a given tax code.

In our empirical analysis, we identify several categories of initial conditions based on the three abovementioned types. Each category of initial condition is assigned one variable to capture its content. The chosen variable may be collected based on its relevancy or on considerations of its availability. Table 5.1 presents the categories of initial conditions and their relevant variable.

Table 5.1: Categories of initial conditions and their key variables

Categories of initial conditions	Key variable
Physical geography	Agricultural land as a % of total land area
Macroeconomics	Savings rate as a % of GDP
Demographics	Urban population as a % of total population
Globalization	Trade as a % of GDP
Infrastructure	Number of internet users per 1000 population
Wealth	GDP per capita (PPP)
Human capital	School enrollment in tertiary education, % of gross education expenditure as a % of GNI

Source: World Bank World Development Index, www.lib.umd.edu/researchport

Aside from the recognized categories of initial conditions, 1996 was selected as the starting year for all the initial conditions variables because most of the data on performance indicators and variables for cluster analysis are collected from 1997 forward. As a result, it is logical and reasonable to use 1996 as the starting year for all the initial conditions examined herein. Initial conditions for most of the economic and social factors considered in this research are primarily collected from the World Bank World Development Index (WDI) 2006. The WDI is the most widely used economic dataset for cross-country analysis. While we attempt to ensure consistency in data across countries, the missing variable for some countries motivates us to seek alternative sources with which to complement our dataset for analysis.

II. Literature review

Currently, a preponderance of the empirical models has been employed to

investigate the relationship between fiscal decentralization and economic performance. Nevertheless, most of the empirical studies used GDP growth rate as the dependent variable while the ratio of SNG expenditure/revenue over total government expenditure/revenue was employed as the proxy variable for fiscal decentralization. Empirical analyses such as these have been used for many years without further innovation. Our empirical analysis, however, takes a bold but confident step in considering fiscal decentralization as the different types of fiscal decentralization systems. Then we treated different types of systems as the independent variable to explain the dependent variable, primarily the performance indicator.

To quantify the different types of fiscal decentralization systems is not an easy task. Nevertheless, many empirical studies investigate the relationship between the target typology and economic performance. Even though they are not the topic of fiscal decentralization, the methodology empirical studies employs does provide us with some insight into our own empirical model. For example, Siegle (2001) treated two types of countries with dummy variable 1 and 0 by employing a logit model. He investigated the relationship between democratization and economic growth by dividing the countries into prospering democratizer countries and lagging democratizer countries. Then, Siegle treated the prospering democratizer countries as dummy variable 1 while the lagging democratizer countries as 0 to run the logit analysis. The results of his research suggest that prospering democratizer countries demonstrate substantially better economic performance than lagging democratizer countries.

Siegle's work is remarkable for its innovation in methodology and quantitative modeling. Nevertheless, we are taking a conservative attitude toward the interpretation

of logit analysis. Strictly speaking, the results of logit analysis actually contend that countries with better economic performance are more likely to be placed in prospering democratizer groups than lagging democratizer groups. Consequently, to conclude that prospering democratizer countries exhibit better economic performance than lagging democratizer countries may pose causal relation problems for that empirical study.

In spite of its controversy in interpreting the results of logit analysis, Siegle's work remains a motivating factor behind the methodology employed by the present research. Reinhart et al (2003) also conducted the typology of countries throughout the world based on credit rating scores. They then categorized countries into club A, club B and club C on the basis of institutional investor rating results, with the intention of investigating the impact of debt on the clubs of different countries. Unlike Siegle's work that uses a logit model, Reinhart et al created the dummy variable for countries in club A with the use of an interacting effect allowing the club A to have a different slope coefficient in the regression results.

III. OLS analysis

Motivated by the aforementioned arguments and methods, we formulated our own model to investigate the relationship between types of fiscal decentralization systems and economic performance. In our cluster analysis, we grouped countries into six types of fiscal decentralization systems. As a result, we created six dummy variables for each type of fiscal decentralization system, with type four as the reference group. In terms of statistical analysis, it is usually desirable to use the type with the most samples as the reference group from which to derive statistical significance. In our analysis, cluster

one is the type of fiscal decentralization system with the most countries in it. Nevertheless, in our cluster analysis, the countries in COMP FDS are placed in the most complete fiscal decentralization system. We would, therefore, like to compare its performance with other types of fiscal decentralization systems. For this reason we have chosen countries in COMP FDS as the reference group in our empirical model. At this point, we should mention that the association does not involve with the concept of causal relationship. In other words, even if we identify the positive association between certain types of fiscal decentralization systems and one performance indicator, it does not necessarily indicate this type of fiscal decentralization system results specifically in a more favorable economic performance.

We report the regression formula as follows:

$$Y_i = \alpha + \beta_1 DV_1 + \beta_2 DV_2 + \beta_3 DV_3 + \beta_4 DV_4 + \beta_5 DV_5 + \beta_6 DV_6 + \beta_i (I.C.)_i + \mu_i$$

The subscript i denotes 54 country observations, and μ_i is the error term.

Y_i: The performance indicator, including GDP growth rate, inflation rate, level of income (GDP per capita, PPP), government effectiveness indicators, corruption indicator, and budget deficit.

DV: Dummy variable from six types of fiscal decentralization system, including: DV1, DV2, DV3, DV4, DV5, and DV6.

I.C.: Initial conditions for each country in 1996, including:

GDP96: GDP per capita in 1996

GDP96PPP: GDP per capita in 1996 with purchasing power parity

Saving96: saving rate in 1996, % of GDP

Internet96: number of internet users per 1000 people in 1996

Enroll96: school enrollment tertiary education in 1996, % of gross

Trade96: trade as a % of GDP in 1996

Urban96: urbanization in 1996

EDUGNI96: education expenditure as a % of GNI in 1996

Land96: agricultural land as a % of total land area in 1996

Table 5.2 demonstrates the OLS regression results. To tackle the potential heteroscasticity problem in cross-sectional data analysis, we conduct OLS regression with the robust standard error.

In terms of GDP growth performance, countries in POCL FDS, UNIS FDS, and LERA FDS apparently exhibit higher performance levels than do countries in COMP FDS, while countries in HERA FDS and TRAN FDS have a lower level of GDP growth performance compared to the countries in COMP FDS. Nevertheless, the coefficient value is minor and insignificant. What we should emphasize is that the countries in POCL FDS and UNIS FDS are those with a low degree of political decentralization. On the other hand, the regression results for level of income tell a totally different story. Countries in COMP FDS exhibit the highest income levels and countries in POCL FDS and UNIS FDS have significantly lower income levels than those in COMP FDS. Taking a look at inflation control performance, our analysis indicates that only countries in LERA FDS have a superior performance in this regard than do those countries grouped in COMP FDS.

As for governance performance, only countries in LERA FDS and TRAN FDS perform better than countries in COMP FDS. The coefficients, however, are minor which may suggest the slight difference that appears over the government effectiveness indicator among countries in different clusters. In terms of the corruption indicator, countries in POCL FDS demonstrate the worst performance compared to countries in COMP FDS. This result is also consistent with the outcome of inter-cluster analysis.

Lastly, the results of fiscal performance indicate that only countries in POCL FDS perform better than countries in COMP FDS. In summary, our OLS analysis suggests that the countries in COMP FDS perform slightly better with respect to inflation control, level of income, government effectiveness, and fiscal deficit.

V. Summary and preliminary findings

Judging from the preceding OLS regression model, we may establish preliminary findings as follows. First, countries with the most complete FDS do not necessarily exhibit the best performance in economic growth during the given time frame as we would have otherwise expected. However, the COMP FDS are associated with most economic performance indicators in many ways, including level of income, inflation control, government effectiveness, corruption control, and fiscal balance, on the basis of our OLS estimation. While most emerging markets with rapid economic growth in recent years are placed in a group other than COMP FDS, this placement may tend to suggest a weaker GDP performance in COMP FDS.

Second, our OLS model also indicates that countries with politically centralized FDS are particularly conducive to enhanced economic growth. These findings may tend

to somewhat minimize the significance – or even necessity -- of having independent officials and an elected governor at the SNG level in order to ensure the success of fiscal decentralization. As a matter of fact, this discovery is not especially unusual because the independence of local officials or elected governors in developed countries is usually constrained by the rule of law while their counterparts in less developed countries might not be so constrained, leading us to conclude that the local officials in less developed countries in actuality possess more authority and discretion than those in more developed countries.

Finally, the traditional thinking on fiscal decentralization, i.e., the ratio of SNG expenditure/revenue over total government expenditure/revenue, finds no cogent expression and support in our OLS analysis, which bolsters the view that countries with high ratios of SNG expenditure/revenue are not necessarily associated with a faster pace of economic growth. Countries in HERA FDS, COMP FDS, and POCL FDS are cluster countries with a high ratio of SNG expenditure/revenue over total government expenditure/revenue but display diversified outcomes of performance while countries in LERA FDS are cluster countries with a low ratio of SNG expenditure/revenue over total government expenditure/revenue but associate with a relatively better performance in inflation control, level of income, and governance performance.

Table 5.2: OLS regression with robust standard error

	GDP	Inflation	INC	LogINC	Effective	Corrupt	Deficit
Constant	1.86	4.19	-4031.34	6.42***	-1.17**	-1.31**	-6.82***
	(2.03)	(10.59)	(4853.35)	(0.48)	(0.50)	(0.52)	(2.64)
DV1	-0.14	1.51	-3841	-0.30	-0.11	-0.18	-1.19
	(0.69)	(2.52)	(2661.15)	(0.22)	(0.20)	(0.26)	(0.85)
DV2	0.08	-3.29	-576	0.17	0.09	0.17	-1.21
	(0.79)	(3.06)	(3535.92)	(0.33)	(0.23)	(0.33)	(1.04)
DV3	-0.21	1.56	-1530	0.04	0.12	0.18	-0.93
	(0.77)	(4.10)	(3726.22)	(0.35)	(0.22)	(0.29)	(1.39)
DV5	0.97	3.29	-7769**	-0.52	-0.38	-0.37	0.61
	(1.19)	(8.66)	(3358.99)	(0.37)	(0.39)	(0.39)	(1.89)
DV6	0.08	1.88	-7109**	-0.15	-0.04	-0.07	-0.60
	(1.08)	(4.76)	(2767.83)	(0.30)	(0.27)	(0.34)	(1.46)
GDP96	-0.000**	0.000			-0.000	0.000	-0.000
	(0.000)	(0.000)			(0.000)	(0.000)	(0.000)
GDP96ppp	0.000**	-0.001***			0.000***	-0.000**	0.000
	(0.000)	(0.000)			(0.000)	(0.000)	(0.000)
Saving96	0.14***	0.07	141.46**	0.03***	0.01	0.00	-0.01
	(0.04)	(0.22)	(68.06)	(0.01)	(0.01)	(0.01)	(0.04)
Internet96	0.01	0.01	102.12***	0.006***	0.00	0.00	0.01
	(0.01)	(0.03)	(18.52)	(0.00)	(0.00)	(0.00)	(0.01)
Enroll96	-0.05**	0.16	30.36	0.005	0.00	-0.00	0.09***
	(0.03)	(0.10)	(59.97)	(0.01)	(0.00)	(0.01)	(0.03)
Trade96	-0.03**	0.05	8.38	-0.002	0.00	0.00	0.02
	(0.01)	(0.04)	(29.24)	(0.00)	(0.00)	(0.00)	(0.01)
Urban96	0.005	0.11	120.82**	0.02***	-0.00	-0.00	0.02
	(0.02)	(0.10)	(53.90)	(0.00)	(0.00)	(0.00)	(0.03)
EDUGNI96	0.05	-0.59	395.13	0.08	0.11***	0.16***	-0.23
	(0.16)	(0.87)	(826.31)	(0.07)	(0.04)	(0.05)	(0.24)
Land96	-0.01	0.05	78.04	0.005	0.00	0.00	0.02
	(0.01)	(0.05)	(46.64)	(0.01)	(0.00)	(0.00)	(0.02)
R-squared	0.53	0.57	0.75	0.76	0.91	0.91	0.50
N of obs	52	52	52	52	52	52	52

*90% statistically significant, **95% statistically significant, ***99% statistically significant.
Value in parenthesis is robust standard error.
Saving96: saving rate in 1996, % of GDP
Internet96: number of internet users per 1000 people in 1996
Enroll96: school enrollment tertiary education in 1996, % of gross
Trade96: trade as a % of GDP in 1996
Urban96: urbanization in 1996
EDUGNI96: education expenditure as a % of GNI in 1996
Land96: agriculture land as a % of total land area in 1996
INC: level of income, GDP per capita (PPP), from 1990 to 2004

Chapter VI: Conclusion and policy implications

I. Conclusion

As more and more countries throughout the world embark upon the road to fiscal decentralization, a comprehensive understanding of the essential elements of this rising phenomenon becomes critical for policy makers. In this dissertation, we explore two related questions. The first question, "What types of fiscal decentralization systems are currently being implemented?" was examined using cluster analysis. The second question we investigated was, "What are the performance strengths and weaknesses of each type of fiscal decentralization system?" for which we employed inter-cluster analysis and one empirical model.

On the basis of normative arguments proposed by Bahl & Martinez-Vazquez (2005), this research begins with the hypothesis that fiscal decentralization should be regarded as a holistic system. With different components and arrangements within the system, each country naturally exhibits its unique approach to fiscal decentralization. We then employ the method of cluster analysis by grouping countries with similar fiscal decentralization systems together. In our research, we identified six types of fiscal decentralization systems based on their idiosyncratic characteristics, which are HERA FDS (high expenditure/revenue assignment) , LERA FDS (low expenditure/revenue assignment), TRAN FDS (transfer revenue), COMP FDS (most complete), POCL (politically centralized), and UNIS FDS (unitary state) respectively.

By using cross-country datasets, we then establish a line of arguments centered on our findings, which resulted in the following observation: countries with the most

complete fiscal decentralization systems (COMP FDS) are associated with relatively better performances in terms of inflation control, level of income, governance and fiscal aspects. Additionally, our inter-cluster analysis cast a clear-cut result that countries with systems exhibiting the highest degree of fiscal decentralization rank high in governance performance. Our empirical analysis reveals that countries whose fiscal decentralization systems are marked by a high degree of political centralization also have high levels of economic growth. Our empirical findings also demonstrate the positive associations between various economic performance indicators and a comprehensive, well-designed plan for fiscal decentralization.

We conclude that the most comprehensive system of fiscal decentralization, i.e., COMP FDS, often shares the following elements: there is (1) a federal state where (2) the SNG has both borrowing and taxing authority, and has (3) a high ratio of SNG expenditure/revenue to total government expenditure/revenue, and where (4) local officials enjoy a high degree of independence and autonomy from the central government. These components are essential for the success of fiscal decentralization but do not seem necessarily relevant at first blush to economic, governance, and fiscal performance. The insufficiency of sample observations, which would naturally affect the accuracy of our empirical analysis, raises the possibility that the conclusions herein might have been somewhat skewed.

II. Limitations

Although the research is noted for its innovation in methodology, there are constraints placed upon it due to inherent limitations, as we note here. Data

insufficiency is one of these limitations. The limitations are found primarily in one of two ways. First, inaccurate investigations of institutional arrangements are sometimes inappropriate for the type of analysis undertaken here. For example, some developing countries may have been motivated to falsify data in order to receive financial aid from international organizations, including the World Bank, the IMF, and OECD. Given these inherent limitations on credibility, we were constrained to drop certain sample observations from consideration. Second, it is particularly difficult to acquire time series data on the institutional arrangements data. Some institutional data simply do not change from year to year. For example, SNGs are typically granted taxing power once in a given year, and it then resides with the SNG. It is a rare occurrence for the taxing power to be granted for one year, revoked in the following, and then granted again the following year. Consequently, it makes more sense to use the cross-sectional data for a certain period of time as sample observations.

Furthermore, the variance and completeness of variables for cluster analysis also need to be strengthened. Some may question the placement of Argentina, a frequent crisis-stricken country, in the same cluster as those with the most complete FDS. However, the financial crises visited upon Argentina mainly result from the soft budget constraints on the SNG's expenditure. Our cluster analysis, unfortunately, is unable to include the variable capturing the dimensions of hard budget constraints over the SNG, owing mainly to the difficulty of obtaining credible data.

Another possible limitation in our research is also associated with data credibility. In our cluster analysis we assigned variables that are relevant to the components in order to capture each dimension of fiscal decentralization systems. Where we have been

unable to find desirable variables, we opted to use proxy variables instead. For example, to capture the component of "degree of political decentralization," we used the proxy variable of democracy in Polity IV. Some may question the feasibility of using this proxy variable to capture the component of political decentralization. Nonetheless, the Polity IV dataset is the most relevant and complete variable available for the use of cluster analysis. In brief, the attempt to quantify the qualitative dimensions of fiscal decentralization systems is inherently difficult. The aforementioned limitations are inevitable and would require extensive future research to either correct the defects or manage to mitigate its effect on the conclusions drawn therefrom.

III. Policy implication

This research reviews the current body of knowledge in the literature on the measurements and typology of fiscal decentralization and its relationship to economic performance, governance performance, and fiscal performance. We have noted the lack of empirical support for the assertions in the literature that fiscal decentralization can either facilitate or otherwise stimulate economic growth; this is so even if one adopts the concept that fiscal decentralization should be regarded as a holistic system. We have, however, observed that countries with a low degree of political decentralization may still be accompanied by stellar economic growth.

The result of our cluster analysis suggests that COMP FDS is largely comprised of the most advanced economies in the world. Even though countries in COMP FDS are not associated with the best performance in terms of GDP growth rate, they do exhibit the best performance in level of income. This phenomenon may yield some

implications in terms of fiscal decentralization. One possible implication is that decentralization is acting like the role of "superior good" in the economic sense. It is only at relatively high levels of per capita income that decentralization is either demanded by, or becomes sufficiently attractive enough to, taxpayers. That is,its benefits can be more fully exploited without the concomitant problems or disadvantages that tend to plague countries with lower levels of per capita income (Bahl & Lynn, 1992; Tanzi, 2002; Martinez-Vazquez & McNab, 2003).

This assertion appears compatible with the results of our cluster analysis. As a matter of fact, our concept of fiscal decentralization systems consists of several components to supplement the assignment of public revenue. It is challenging for an emerging market - usually associated with deficiencies in human resources and institutional arrangements - to consider the delegation of fiscal power to the SNG while simultaneously trying to formulate an economic development strategy which generally requires coordination and oversight from the central government.

An unexpected phenomenon uncovered by our analysis is that the politically centralized FDS exhibit the best performance in terms of economic growth. Olson (1983) contends that the efficiency of an economy may be increased either by making narrow special-interest groups weaker or by making the government stronger in relation to them. In the context of fiscal decentralization, the relationship between SNG and its central government can be analogous to that between special interest groups and government. Some (Bird 1986; Kim 1995) appear to support this argument by interpreting the increase in the degree of fiscal decentralization as strengthening the hand of special interest groups and thereby resulting in slower economic growth overall.

The analogy between SNGs and special interest groups does seem to find some support in our cluster analysis on politically centralized FDS. While it may be reasonable to assume that there are some local officials and SNG's governors who would spend with unbridled profligacy under circumstances emphasizing their own political interest rather than the welfare of the jurisdictional citizenry, the overall comparison between SNGs and special interest groups is too generalized and amorphous. Furthermore, we are convinced that what makes an SNG efficient and effective is not the centralization of fiscal authority; rather, it is well-developed institutional arrangements, such as adequate budget constraints over the local government, that promote fiscally disciplined behavior and, by extension, the ultimate efficacy of SNGs.

Aside from the previous arguments, we cannot overemphasize another possible counter-intuitive result, that countries with a high degree of political decentralization are usually advanced economies with strict enforcement of the rule of law, while countries with a low degree of political decentralization are usually authoritarian states without adequate institutional arrangements or regulatory frameworks. Accordingly, local officials who enjoy a degree of decentralized fiscal authority as assigned to them by the central government may in fact be hampered by inappropriate regulations that are inadequately enforced through the rule of law. Yet, local officials under more authoritarian regimes may enjoy greater fiscal power or a higher degree of discretionary spending power due to the lack of proper surveillance mechanisms, such as auditing systems or other tools for accountability. This problem, however, requires a massive and thorough survey and investigation across countries all over the world.

Judging from the preceding examples and arguments, policy guidance may be

drawn from this course of research. **First**, we would like to reiterate the important role traditional thinking plays in fiscal decentralization, or the so-called "quantitative" fiscal decentralization which gives emphasis to the assignment of government resources to the SNG. Even though the traditional thinking on fiscal decentralization has been criticized for its limitations in capturing the multi-dimensions of fiscal decentralization, the assignment of expenditure/revenue still plays a crucial and vital role in the implementation of fiscal decentralization. The assignment of expenditure/revenue resources is an essential element of fiscal decentralization, but it is by no means a sufficient one. Also, the assignment of expenditure/revenue can be better accomplished through intergovernmental transfer and delegation of the taxing and borrowing powers that are so relevant to the build-up of qualitative dimensions of fiscal decentralization. Moreover, for an independent local official to function properly in the allocation of public resources to the jurisdiction, rather than playing the role of agent to the national government, the *de facto* assignment of expenditure/revenue resources is particularly salient.

Second, while our empirical evidence indicates the most complete FDS does not necessarily perform the best in terms of economic growth, the qualitative side of fiscal decentralization, i.e. COMP FDS and LERA FDS, remains associated with high scores in governance as well as fiscal performance. Thus, there appears to be no rationale for us to recommend a qualitative side of reform in the fiscal decentralization system. As we have described previously, the institutional reforms that enable the successful implementation of the FDS may be fully attainable only when the economy is fully developed. Nonetheless, we would encourage the enabling of institutional reform for

fiscal decentralization systems throughout developing world as it is undeniably a long-term goal worthy of pursuit. As to the problems relating to the lack of adequate human resources or management skills required for implementing such institutional reforms, we believe this role can be adequately fulfilled by various international organizations. With the development of decentralization strategies, as well as thorough investigations of decentralization practice, international organizations such as the World Bank, IMF, and OECD have specialized expertise in implementing programs for fiscal decentralization with well-established procedures. Accordingly, the emerging markets that are deficient in these areas should be encouraged to seek help from these international organizations.

Third, even if the component of political decentralization does not exhibit an impact on performance indicators, we emphasize the significance of the component. The weak association between political decentralization and performance indicators may result from the existence of "hard budget constraints." As we have pointed out in previous sections, the hard budget constraint (e.g., the 3% ceiling on budget deficit imposed by the EU on member states) and the surveillance mechanism may serve to constrain the independence of local officials and curb their discretionary power over expenditures. Under these circumstances, the elected governor of SNG and local officials may not enjoy an appreciable measure of independence as would have otherwise been expected. Conversely, some countries suffered from the lack of hard budget constraints on the SNG. It is not unusual for irresponsible spending behaviors of some local governments to result in a fiscal crisis for the entire country. Hence, both hard and soft budget constraints exhibit certain drawbacks for the management of political

decentralization.

As numerous countries throughout both the developed and developing world have been plagued by this dilemma, we propose a feasible way in which to facilitate political decentralization and correct the current spate of associated problems at the same time. We propose an evaluation system undertaken by an independent agency which lies outside of a national government and its judicial system. The agency would keep an eye on the fiscal condition of the sub-national government, including fiscal deficit, debt ratings, budget and spending practices, etc. Once the indicators of fiscal condition take a marked turn for the worse, the agency would be obliged to give a pre-warning notification to the designated local government. The concept of this early warning system finds some support from the work by Goldstein, Kaminsky, and Reinhart (2000). Goldstein et al. attempted to establish an early warning system to assess the financial vulnerability of emerging markets after the circumstances of the Asian financial crisis in 1997. They identify several financial indicators and assign the threshold for each indicator as the guideline for the evaluation of financial vulnerability. This principle can be equally applicable in gauging the health of an SNG's fiscal condition provided that the essential components of fiscal conditions for an SNG have been properly identified.

It is essential that all evaluations, information and outcomes, be made available to the public. This requirement ensures and honors the people's right to know. The availability of credit ratings on state and municipal bonds issued by local governments in the United States is an example of how the aforementioned function is adequately served. Nevertheless, the system of credit ratings for state and municipal bonds remains insufficient for the functional establishment of a comprehensive evaluation system. In

sum, political decentralization, along with an early warning evaluation system is much more desirable in the institutional arrangements for enhancing the prospects of an FDS being able to achieve an appreciable level of success.

IV. The need for future research

While we have accomplished the objectives of the dissertation set forth in Chapter I, we believe that this course of research has highlighted the need for future research into the types of fiscal decentralization systems, as noted below.

First, the facilitation of datasets remains the top priority for any future research. Although we have attempted to collect the most readily available cross-sectional dataset around the world, having access to the time series datasets for each country would enable us to observe and better pinpoint the shift in membership from one cluster to another for a specific country. Meanwhile, the time-series dataset would also enable us to undertake empirical analysis with more sample observations and thus enhance the confidence and thereby the significance of our outcomes. It may not be practically possible to construct institutional datasets based on a time-series format due to the fact that some aspects of institutional arrangements for fiscal decentralization system can remain fixed and constant for many years. Bearing this limitation in mind, we can start by turning our focus and efforts on the developed world, e.g., OECD countries, which usually provide a more thorough and comprehensive investigation in institutional datasets.

Finally, we would further suggest the use of variables that can account for or depict the hard budget constraints over expenditure behavior of SNGs. As noted earlier, cluster analysis requires more variables to adequately capture each component of fiscal

decentralization systems. With more relevant variables on hand for each component, we may start from principle component analysis and factor analysis to identify the most relevant variables and then employ cluster analysis to categorize the different fiscal decentralization systems.

Appendix I: Kmeans result

Cluster_5

Cluster	Country
Cluster 1	Azerbaijan, Belarus, China, Kazakhstan, Kyrgyz, Tajikistan,
Cluster 2	Albania, Belgium, Guatemala, Hungary, Indonesia, Italy, Netherland, Peru, Portugal, South Africa, Spain, UK
Cluster 3	Czech, Finland, France, India, New Zealand, Russia, Sweden, Taiwan,
Cluster 4	Bulgaria, Colombia, Costa Rica, Croatia, Estonia, Georgia, Latvia, Lithuania, Nicaragua, Poland, Romania, Thailand, Ukraine,
Cluster 5	Argentina, Australia, Austria, Bolivia, Brazil, Canada, Denmark, Germany, Japan, Korea, Mexico, Mongolia, Norway, Switzerland, US

Cluster_6

Cluster	Country
Cluster 1	Azerbaijan, Belarus, China, Kazakhstan, Kyrgyz, Tajikistan
Cluster 2	Bulgaria, Croatia, Estonia, Latvia, Lithuania, Nicaragua, Romania, Thailand, Ukraine
Cluster 3	Albania, Guatemala, Indonesia, Peru, South Africa, UK
Cluster 4	Austria, Bolivia, Brazil, Germany, Hungary, Italy, Mexico, Mongolia, Norway, Poland, Spain, Switzerland, US
Cluster 5	Argentina, Georgia, Russia
Cluster 6	Canada, Czech, Denmark, France, India, Sweden, Taiwan

Cluster_7

Cluster	Country
Cluster 1	Argentina, Canada, Denmark, Finland, India, Lithuania, Russia, Sweden,
Cluster 2	Australia, Austria, Brazil, Germany, Japan, Mexico, Norway, Switzerland, US
Cluster 3	Bolivia, Colombia, Hungary, Italy, Korea, Netherland, Poland, South Africa, Spain, UK
Cluster 4	Azerbaijan, Belarus, China, Kazakhstan, Kyrgyz, Tajikistan,
Cluster 5	Albania, Guatemala, Indonesia, Peru,
Cluster 6	Belgium, Czech, France, Mongolia, New Zealand, Portugal, Taiwan,
Cluster 7	Bulgaria, Costa Rica, Croatia, Estonia, Georgia, Latvia, Nicaragua, Romania, Thailand, Ukraine,

Cluster_8

Cluster	Country
Cluster 1	Azerbaijan, Belarus, China, Kazakhstan, Kyrgyz, Tajikistan
Cluster 2	Bolivia, Brazil, Hungary, Mexico, South Africa
Cluster 3	Canada, Denmark, Germany, Switzerland, US
Cluster 4	Lithuania, Nicaragua
Cluster 5	Argentina, Georgia, India, Russia, Sweden, Ukrain,
Cluster 6	Albania, Bulgaria, Guatemala, Indonesia, Italy, Mongolia, Peru, Poland, UK
Cluster 7	Croatia, Estonia, Romania, Thailand
Cluster 8	Austria, Czech, France, Latvia, Spain, Taiwan, Norway

Cluster_9

Cluster	Country
Cluster 1	Bulgaria, Colombia, Costa Rica, Estonia, Latvia, Lithuania, Nicaragua, Poland, Romania,

Cluster 2	Kazakhstan, Kyrgyz,
Cluster 3	Argentina, Brazil, Canada, Denmark, Finland, Germany, India, Japan, Sweden, Switzerland, US
Cluster 4	Croatia, Thailand,
Cluster 5	Albania, Belgium, Guatemala, Hungary, Indonesia, Netherlands, Peru, Portugal, South Africa, UK
Cluster 6	Georgia, Russia, Ukraine,
Cluster 7	Azerbaijan, Tajikistan,
Cluster 8	Australia, Austria, Bolivia, Czech, France, Italy, Korea, Mexico, Mongolia, New Zealand, Norway, Spain, Taiwan,
Cluster 9	Belarus, China,

Cluster_10

Cluster	**Country**
Cluster 1	Belgium, Czech, France, New Zealand, Portugal,
Cluster 2	Bulgaria, Colombia, Croatia, Estonia, Latvia, Nicaragua, Romania, Ukraine,
Cluster 3	Albania, Guatemala, Hungary, Indonesia, Netherlands, Peru, South Africa, UK
Cluster 4	Belarus, China, Kazakhstan,
Cluster 5	Costa Rica, Thailand,
Cluster 6	Azerbaijan, Kyrgyz, Tajikistan,
Cluster 7	Canada, Denmark, Finland, India, Japan, Sweden,
Cluster 8	Switzerland, US
Cluster 9	Argentina, Georgia, Lithuania, Russia, Taiwan,
Cluster 10	Australia, Austria, Bolivia, Brazil, Germany, Italy, Korea, Mexico, Mongolia, Norway, Poland, Spain,

Appendix II: Kmedian result

Cluster_5

Cluster	Country
Cluster 1	Argentina, Australia, Austria, Brazil, Canada, Denmark, Finland, Germany, India, Japan, Mexico, Norway, Sweden, Switzerland, US
Cluster 2	Albania, Belgium, Bolivia, Bulgaria, Colombia, Costa Rica, Czech, France, Guatemala, Hungary, Indonesia, Italy, Korea, Latvia, Mongolia, Netherland, New Zealand, Peru, Poland, Portugal, South Africa, Spain, Taiwan, Thailand, UK
Cluster 3	Kyrgyz,
Cluster 4	Croatia, Estonia, Georgia, Lithuania, Nicaragua, Romania, Russia, Ukraine,
Cluster 5	Azerbaijan, Belarus, China, Kazakhstan, Tajikistan,

Cluster_6

Cluster	Country
Cluster 1	Austria, Bolivia, Brazil, Germany, India, Italy, Korea, Mexico, Mongolia, Norway, Poland, Russia, Spain, Taiwan
Cluster 2	Belgium, Czech, France, New Zealand, Portugal
Cluster 3	Albania, Guatemala, Hungary, Indonesia, Netherlands, Peru, South Africa, UK
Cluster 4	Argentina, Australia, Canada, Demark, Japan, Finland, Sweden, Switzerland, United States
Cluster 5	Azerbaijan, Belarus, China, Kazakhstan, Kyrgyz, Tajikistan
Cluster 6	Bulgaria, Croatia, Colombia, Costa Rica, Estonia, Georgia, Latvia, Lithuania, Nicaragua, Romania, Thailand, Ukraine,

Cluster_7

Cluster	Country
Cluster 1	Belgium, Czech, France, New Zealand, Portugal,
Cluster 2	Australia, Canada, Denmark, Finland, India, Sweden, Taiwan,
Cluster 3	Albania, Guatemala, Hungary, Indonesia, Netherland, Peru, South Africa, UK
Cluster 4	Argentina, Croatia, Estonia, Georgia, Latvia, Lithuania, Nicaragua, Romania, Russia, Ukraine,
Cluster 5	Austria, Brazil, Bolivia, Colombia, Germany, Italy, Japan, Korea, Mexico, Mongolia, Norway, Poland, Spain, Switzerland, US
Cluster 6	Bulgaria, Costa Rica, Thailand,
Cluster 7	Azerbaijan, Belarus, China, Kazakhstan, Kyrgyz, Tajikistan,

Cluster_8

Cluster	Country
Cluster 1	Albania, Bulgaria, Costa Rica, Guatemala, Thailand,
Cluster 2	Austria, Bolivia, Brazil, Germany, Japan, Korea, Mexico, Norway, Switzerland, US
Cluster 3	Argentina, Australia, Canada, Denmark, Finland, India, New Zealand, Russia, Sweden, Taiwan,
Cluster 4	Azerbaijan, Kyrgyz, Tajikistan,
Cluster 5	Belgium, Czech, France, Hungary, Indonesia, Italy, Mongolia, Netherland, Peru, Poland, Portugal, South Africa, Spain, UK
Cluster 6	Belarus, China, Kazakhstan,
Cluster 7	Lithuania, Nicaragua,
Cluster 8	Colombia, Croatia, Estonia, Georgia, Latvia, Romania, Ukraine,

Cluster_9

Cluster	Country
Cluster 1	Australia, Canada, Denmark, Finland, India, Japan, Norway, Sweden, Switzerland, Taiwan, US
Cluster 2	Romania, Nicaragua, Estonia, Croatia, Ukraine
Cluster 3	Albania, Guatemala, Indonesia, Peru, South Africa, UK
Cluster 4	Austria, Germany, Hungary, Italy, Mongolia, Netherlands, Poland, Spain
Cluster 5	Bulgaria, Costa Rica, Latvia, Thailand
Cluster 6	Belgium, Czech, France, New Zealand, Portugal
Cluster 7	Argentina, Lithuania, Russia
Cluster 8	Tajikistan, Kyrgyz, Kazakhstan, China, Belarus, Azerbaijan
Cluster 9	Bolivia, Brazil, Colombia, Korea, Mexico

Cluster_10

Cluster	Country
Cluster 1	Austria, Bolivia, Japan, Korea, Mexico, Mongolia, Norway, Spain
Cluster 2	Bulgaria, Colombia, Costa Rica, Croatia, France, Italy, Latvia, Poland, Thailand
Cluster 3	Kyrgyz
Cluster 4	Canada, Czech, Denmark, Finland, India, New Zealand, Sweden, Taiwan
Cluster 5	China
Cluster 6	Argentina, Estonia, Georgia, Lithuania, Nicaragua, Romania, Russia, Ukraine
Cluster 7	Belarus, Kazakhstan
Cluster 8	US, Switzerland, Germany, Brazil, Australia
Cluster 9	Azerbaijan, Tajikistan,
Cluster 10	Albania, Belgium, Guatemala, Hungary, Indonesia, Netherlands, Peru, Portugal, South Africa, UK

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