Does decentralization increase responsiveness to local needs? Evidence from Bolivia

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Abstract

Bolivia's recent decentralization involved the creation of hundreds of new municipalities, devolution of substantial resources from central agencies to local governments, and the development of innovative institutions of local governance. Detailed study of investment sector-by-sector shows that objective indicators of need are the most important determinants of the changes in investment patterns that ensued throughout the country.

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1. Introduction

The wisdom of decentralizing government has become popular currency in our time. At the end of a century that witnessed the sustained growth of the central state in both the developed and developing worlds, reformers and idealists have turned to decentralization as an antidote to ills as varied as governmental corruption, autocracy and repression, and public-sector inefficiency. But the public discussion of decentralization is often confusing, assuming the character of sweeping, cross-disciplinary claims about the effects of administrative measures on the quality and efficiency of both government and social interaction. Competing proposals, expressed in a lexicon that spans economics, political science, sociology and public administration are often hard to compare either as policy instruments or in terms of the effects they are designed to produce. Unfortunately, much of the empirical literature on decentralization is similarly messy and inconclusive, simultaneously examining issues as diverse and ill-defined as access to resources, participation, administrative capacity, employment, growth, and local and national development strategies. Having cast such a wide net, such studies subsequently fail to ground their research theoretically, and their empirical approach often descends into description and anecdote from selected cases of decentralization in very different countries.

The radical and well-documented experience of Bolivia offers us the opportunity of conducting a methodologically rigorous study of decentralization, where we focus on a few questions which are among the most contentious in the field but have not been answered adequately in the literature. Restricting our scope to decentralization in one country allows us to control for external shocks, political regime, institutional and cultural effects, and other exogenous factors in a more systematic way than cross-country studies can. Furthermore, the Bolivian reform coincided with a huge upsurge in the generation of local-level and national data. These data are of surprising scope and quality (especially compared to Bolivia's national-income cohort) and include not only the usual information on fiscal flows and investment sums, but also numerous variables covering political, institutional, administrative and even procedural (good-government type) indicators for all of Bolivia's 311 municipalities. Our use of such variables constitutes an innovation of this paper.

The central question that we seek to answer is does decentralization increase the sensitivity of public investment decisions to local needs. Secondary questions include: (i) Under what conditions do the various effects we posit (local knowledge, central government's technical and organizational advantages, political weight) dominate? and (ii) What are the welfare implications of different levels of public goods provision under a variety of assumptions? In addition, this paper seeks to make a case by example of how to approach such questions empirically. We argue that locally specific economic and political decisions by local government and local civil society are important, and even defining,

characteristics of decentralization which must be studied if the phenomenon is to be properly understood.

Before continuing, it is important to discuss precisely what we mean by "decentralization," a word used in the policy literature to refer to everything from the administrative deconcentration of executive agencies in autocratic regimes to privatization in democracies. For the sake of focus, this paper will concentrate on decentralization under democratic regimes. We shall see that the presence and nature of democratic controls play a large role in our ability to theorize about decentralization. We define decentralization as follows:

> **Decentralization** is the devolution by central (i.e., national) government of specific functions, with all of the administrative, political and economic attributes that these entail, to local (i.e., municipal) governments which are independent of the center within a legally delimited geographic and functional domain.

The two reasons for choosing this usage are both powerful and fortuitous. First, the clarity of the proposition greatly simplifies analysis, allowing it to focus on discrete, well-defined decentralizing measures and exogenous variables in order to gauge the empirical effects of each on policy outputs. Second, the case of Bolivia involves precisely this form of decentralization (see section 2.1 below), implemented uniquely and vigorously.

The remainder of the paper is organized as follows. Section 2 discusses Bolivia's decentralization program, and then examine in detail the changes in national resource flows which it brought about. Section 3 reviews the literature and then develops a model to analyze the tradeoff between local government's knowledge of local needs v. central government's technical and organizational advantage in the provision of public services in districts with heterogeneous preferences. We use a simple model of decentralization defined by two equations to examine the welfare implications of central v. local goods provision under different assumptions. Section 4 discusses our empirical methodology and then presents three sets of econometric results: two tests of whether decentralization changed public investment patterns across Bolivia's 311 municipalities, and a set of sectoral models of this change centered on objective variables of need. Conclusions and suggestions for further research along this path are in section 5.

2. Decentralization in Bolivia

2.1 Popular Participation and the Decentralization Reform

On the eve of the 1952 revolution, Bolivia was a poor, backward country with extreme levels of inequality, presided over by a "typical racist state in which the non-Spanish speaking indigenous peasantry was controlled by a small, Spanish speaking white

elite, [their power] based ultimately on violence more than consensus or any social pact."[1] The nationalist revolution which followed expropriated the "commanding heights" of the economy, and laid the foundations for the development of one of the most centralized state apparati in the region. The ruling Nationalist Revolutionary Movement embarked upon a state-led modernization strategy in which governing elites in La Paz directed a concerted drive to erase the social relations of the past and create a new, more egalitarian society.[2] Political power was concentrated in the hands of the president, who directly appointed departmental governors and heads of the regional development corporations, among many others, and the legal and political instruments of local governance were by and large given little chance to develop. As a result, beyond the nine regional capitals (including La Paz) and an additional 25-30 cities, local government existed in Bolivia at best in name, as an honorary and ceremonial institution devoid of administrative capability and starved for funds. And in most of the country it did not exist at all (see point 4 below). This, very generally, is the background against which the Bolivian decentralization reform was announced in 1994. The genesis of the reform, along with the origins of the decentralization idea in Bolivia and the interest groups ranged for and against it, are treated in much detail in Faguet (2000b). The scale of the change in resource flows and political power that this law brought about make it a fascinating social experiment in decentralization, worthy of study.

The core of the decentralization reform consists of four points:[3]

1. The share of all national tax revenues devolved from central government to the municipalities was raised from 10 percent to 20 percent. More importantly, whereas before these funds were apportioned according to *ad hoc*, highly political criteria, after decentralization they are allocated strictly on a per capita basis (see below).

2. Title to all local infrastructure related to health, education, culture, sports, local roads and irrigation was transferred to municipalities free of charge, along with the responsibility to administer, maintain and stock this with the necessary supplies, materials and equipment, as well as invest in new infrastructure.

3. Oversight Committees *(Comités de Vigilancia)* were established to oversee municipal spending of Popular Participation funds, and propose new projects. These are composed of representatives from local, grass-root groups within each municipality, and are legally distinct from municipal governments. Their power lies in the ability to suspend all disbursements from the central government to their respective municipal governments if they judge that such funds are being misused or stolen, as well as the natural moral authority which they command. When suspension occurs, the center undertakes no arbitration, but simply waits for the two

[1] Klein, H., p.237. Author's translation. Klein is one of the classical authorities on Bolivian history.
[2] Klein, H., pp.236-240.
[3] *Ley de Participación Popular, Reglamento de las Organizaciones Territoriales de Base*, Secretaría Nacional de Participación Popular, Ministerio de Desarrollo Sostenible y Medio Ambiente, 1994.

sides to resolve their dispute, relying on economic incentives to speed their agreement. Oversight Committees thus comprise a lean (their officials are unpaid), corporatist form of social representation which is parallel to elected municipal legislatures and serves somewhat like an upper house of parliament, as a check on the power of mayors and municipal councils.[4]

4. One-hundred ninety-eight new municipalities – 64 percent of the total – were created, and existing ones were expanded to include suburbs and surrounding rural areas, to the point where the 311 municipalities exhaustively comprise the entire national territory.

The law heralded a new era of municipal government for the overwhelming majority of Bolivian towns and cities. In many parts of Bolivia where before the state was present, if at all, in the form of a local schoolhouse, health post and, perhaps, a military garrison or customs office, each reporting to its respective ministry, there was now for the first time elected local government accountable only to local voters.

2.2 Descriptive Statistics

The extent of the change is perhaps best appreciated by examining the changes in resource flows that it catalyzed. Decentralization multiplied municipalities' share of public investment 17 times, from 0.7 to 12 percent of the total, and significantly altered its distribution. Consider figure 1, showing revenue-sharing between central and local governments for 1993, the last year prior to decentralization, and 1995, the first full year it was in effect, for the capital and second city of each of the country's nine departments. Total resources devolved from central to local governments increased by 72 percent. Though this is certainly significant, much more impressive is the change in the distribution of these funds. Before decentralization the nine departmental capitals shared 93 percent of all funds devolved from the center, leaving 7 percent for Bolivia's other 302 municipalities; the three leading cities, La Paz, Cochabamba and Santa Cruz, alone accounted for 86 percent of the total. After decentralization their shares fall to 38 percent and 27 percent respectively. The per capita criterion results in a massive shift of resources in favor of the smaller, poorer municipalities in Bolivia. Starting from a tiny or nonexistent base, these districts see enormous increases in their transfers, collectively exceeding 15,000 percent in Oruro, 43,000 percent in Chuquisaca, and 63,000 percent in distant Pando. The larger cities listed see more modest gains, [5] and only La Paz suffers a net reduction in transfers, itself a sign of how disproportionately it benefited under the old system. Within-department breakdowns similarly show movement from extreme skewing of resources in favor of the capitals to a more equitable distribution.

[4] I am indebted to Dr. Teddy Brett for this insight.
[5] This is possible only because of the large increase in total devolved funds.

Figure 1. Decentralization and the Regional Distribution of Public Funds

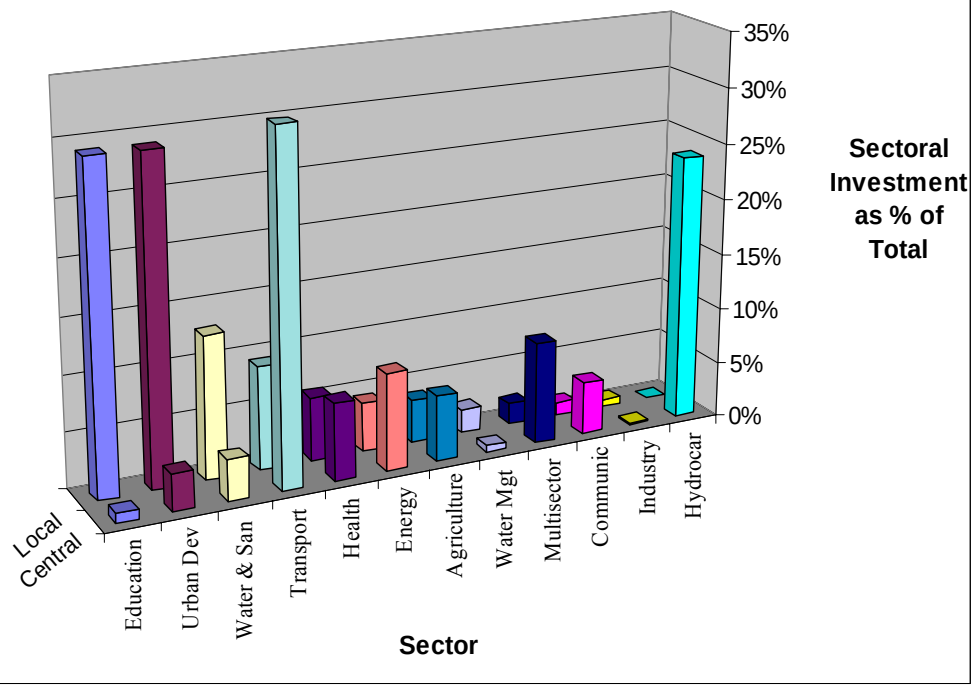
City	Central-to-Local Revenue Sharing (Bs'000) 1993	1995	% Change	% of Departmental Total 1993	1995
La Paz	114,292	61,976	-46%	95%	34%
El Alto	5,362	46,326	764%	4%	25%
ROD	1,120	76,170	6704%	1%	41%
total	*120,774*	*184,472*	*53%*		
Santa Cruz(*)	51,278	63,076	23%	95%	51%
Montero	1,106	5,306	380%	2%	4%
ROD	1,774	56,012	3058%	3%	45%
total	*54,157*	*124,394*	*130%*		
Cochabamba(*)	25,856	38,442	49%	88%	34%
Quillacoto	1,315	2,471	88%	4%	2%
ROD	2,108	73,688	3396%	7%	64%
total	*29,279*	*114,601*	*291%*		
Oruro	6,969	15,925	129%	99%	56%
Challapata	29	1,090	3687%	0%	4%
ROD	74	11,198	15022%	1%	40%
total	*7,072*	*28,213*	*299%*		
Potosi	1,208	13,990	1058%	66%	24%
Villazon	233	3,543	1420%	13%	6%
ROD	394	39,813	10009%	21%	69%
total	*1,835*	*57,346*	*3026%*		
Sucre	4,581	21,202	363%	94%	44%
Camargo	244	2,214	809%	5%	5%
ROD	56	24,374	43540%	1%	51%
total	*4,881*	*47,790*	*879%*		
Tarija	3,219	10,063	213%	68%	35%
Yacuiba	648	4,743	632%	14%	17%
ROD	841	13,893	1552%	18%	48%
total	*4,708*	*28,699*	*510%*		
Trinidad	480	4,892	920%	67%	22%
Riberalta	87	6,599	7501%	12%	30%
ROD	154	10,393	6645%	21%	47%
total	*721*	*21,884*	*2937%*		
Cobija	99	502	408%	99%	57%
ROD	1	379	63067%	1%	43%
total	*99*	*881*	*787%*		
Total	**223,525**	**608,280**	**172%**	-------	-------

Sources: Ministry of Finance, Ministry of Social Communication

* 1995 totals estimated due to incomplete reporting of budget data by both cities.
ROD = Rest of Department

The most important change wrought by decentralization, however, is to the composition of investment. In our results in section 3 below, local government provides a level of public goods different from central government due to its more accurate detection of local preferences. Figure 2, which shows the investment priorities of central and local government before and after decentralization, provides initial evidence in support of these results. The front row corresponds to central government investment during 1991-93, and the rear row to local government investments during 1994-96. The differences are quite significant. In the years leading up to 1994 central government invested the largest sums in transport, followed by hydrocarbons, multisectoral (a hodgepodge of projects difficult to categorize), and energy. Together these four sectors account for 73 percent of total public investment during 1991-93. But after decentralization local governments invest most heavily in education, urban development, and water & sanitation, together accounting for 79 percent of municipal investment during this period. Of the sectors accounting for roughly three-quarters of total investment in both cases, central and local government do not have even one in common. Indeed, we have to descend to fourth place in the rear row to find a sector – transport – that ranks highly in the front row as well, and even so it's share of the total has fallen by five-sixths. Thus, we find evidence that local and central government have very different investment patterns.

Figure 2: Local v. Central Government Investment



Lastly, it is instructive to examine how investment was distributed geographically among Bolivia's municipalities before decentralization, and compare that to the current regime. Although detailed maps of project locations and types are not currently available, we can get a very rough sense of the distribution behind the sums by examining figures 3-5 below. These place all of Bolivia's municipalities in a row on the horizontal axis and measure investment per capita as vertical displacement. If the allocation of investment were extremely skewed in favor of a few municipalities, we would expect to see most values lying near the bottom of the graph and a few points strewn high above them. If the distribution of investment were reasonably equitable across space, we would expect to see most points in a broad band at some intermediate level.

Figure 3, per capita investment before decentralization, seems to conform to the first pattern. It is certainly skewed, with investments in one district[6] of over Bs.50,000 per head, and two more[7] in the neighborhood of Bs.20,000 per head, while the vast majority seem to sit on or near zero. Compare this to the national average for this period of Bs.1,400 per head and we see the extent of the imbalance. But the degree of skewing itself distorts the vertical axis and compresses the lower range, where most of the values are. We turn to Figure 4, which excludes the upper twelve observations and shows only those below Bs.2,000 per capita, in order to examine these more carefully. Though the distribution now appears less unequal, there is still monotonically increasing density as we move downwards, and a preponderance of observations on or near the horizontal axis – 146 in fact, or half of the 298 in the plot. Our initial impression is confirmed. Investment under centralized government was terrifically skewed in favor of a few municipalities that received enormous sums, a second group where investment was significant and the bottom half of districts that received nothing. Compare this with figure 5, which shows municipal investment after decentralization. This chart shows no district over Bs.700 per capita, a broad band with greatest density between Bs.100-200, and only a few points touching the axis. Average municipal investment for this period is Bs.208 per capita, and thus our band contains the mean. (The investment sums here are much lower because they exclude central government funds.) The overall distribution is thus much smoother and more equitable than figure 4. Although these are crude indicators, it would seem that central government, with a much larger budget and free rein over all of Bolivia's municipalities, chose an unequal distribution of investment across space, while decentralized government distributes public investment more evenly throughout the country.

[6] Sabaya, Oruro, population 2,074.
[7] Chimoré, Cochabamba, site of major highway works, and Ascención de Guarayos, Santa Cruz.

Figure 3: Investment Per Capita, 1991-93

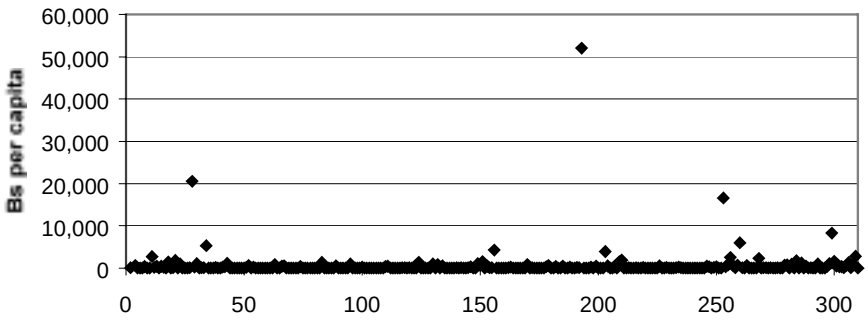


Figure 4: Investment Per Capita, 1991-93

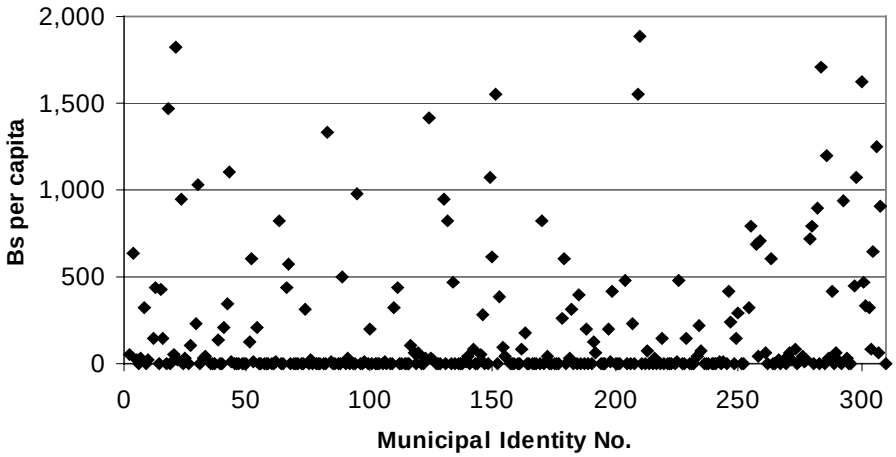
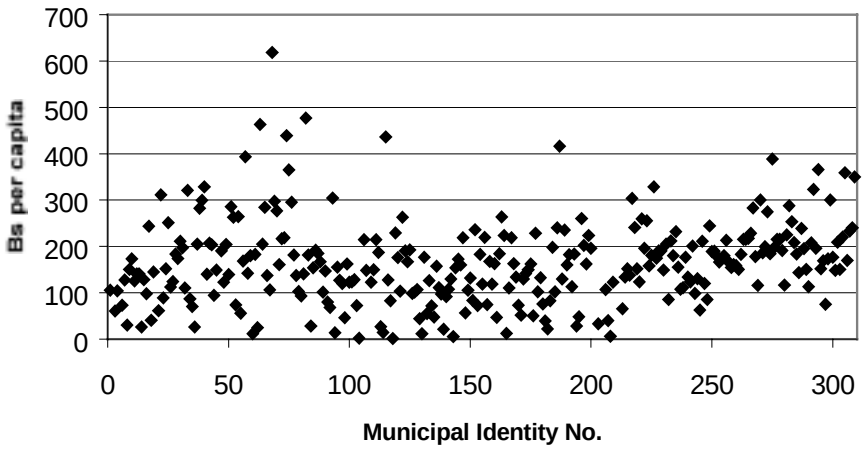


Figure 5: Local Investment Per Capita, 1994-96



3. Theory

3.1 The Literature

Economists and political scientists have often disagreed on the question of the needs-responsiveness of central v. local government. This is largely due to the focus that each discipline gives to the problem. Economists such as Oates and Besley and Coate (see below) tend to assume a better match between local government outputs and local preferences, and accordingly find local government preferable when this advantage is not outweighed by spillovers or inefficiencies in central government provision of public services arising from distortions in their financing or production and allocation. Economists do not agree on how this better matching come about, however, with some ascribing it primarily to the character of the information involved, and others to local elections or institutions. Political scientists, on the other hand, (see for example Crook and Sverrisson (1999) and Smith (1985)) tend to concentrate more on interest group capture of the local political process, and the distortions of political representation in small electoral environments. When these phenomena exist, interest groups will gain a decisive influence over local government, and decentralization will tend to favor these small local groups disproportionately over everyone else. In this context, centralization can be preferable, as interest groups which are sufficiently big locally to distort the local political process will tend to be small in comparison to national government, which can then match policy to (general) local needs in a disinterested fashion. We incorporate specific forms of these insights into our model and then test them below.

We first examine the empirical literature on decentralization, and then turn to theory. A large part of the empirical work on decentralized provision of public services reports mixed results which, taken together, are inconclusive. Much of this literature approaches the subject from a very broad perspective, examining such issues as fiscal flows, taxation, expenditure and investment alongside very different questions such as managerial efficiency, government responsiveness and political representativeness. The breadth of these studies' scope combined with their and small sample size make controlling empirically for all the exogenous economic, social and institutional factors involved in decentralization impossible. They also generally fail to specify a coherent theoretical framework which credibly links all of the phenomena in question to specific decentralization measures in very different national and cultural contexts. Attempting to summarize such work can be a frustrating task as its findings are both numerous and diverse, and isolating cause-and-effect relationships is difficult. Examples of the results in Andersson, Harsman and Quigley, (1997), Bennet (1993), Cheema and Rondinelli (1983), Rondinelli *et al.* (1984), Rondinelli (1981), and Veira (1967) include:

1. The performance of decentralized administrative units in Algeria, Libya and Tunisia has been positive in some cases, but has not always met the original goals of policy reformers.
2. Decentralization and privatization of state activities have a tendency to create greater inequities among communities and regions with different levels of organizational capacity, opening the door for local elites to play a disproportionate role in the planning and management of projects.
3. Devolution in Papua New Guinea increased popular participation in government, and has improved the planning, management and coordination capacity of provincial administrators, but has added to government bureaucracy and so weakened it's ability to attract foreign investment and stimulate long-term economic growth.
4. Decentralization has increased the access of people in previously neglected rural regions and local communities to central government resources, if only incrementally, in most of the developing countries where it has been tried.
5. The administrative and technical capacity of local organizations is said to be slowly improving, and new organizations have been established at the local level to plan and manage development.
6. National development strategy now increasingly takes account of regional and local level planning.
7. The absence of or weakness in supporting institutions needed to complement the managerial capacity of local governments, as well as weaknesses in the linkages and interaction between local and central administrations, have led to disappointing results from decentralization in Africa and Asia.

Such studies tend to show that decentralization has achieved moderate success in some countries, moderate failure in others, and both in many, with the underlying reasons poorly identified. It is, as a result, difficult to judge whether specific decentralization "failures" were due to inappropriateness of the policies implemented or weaknesses in their implementation, and more difficult still to recommend improvements.

The theoretical debate on the effects of decentralization on social welfare and efficiency is of higher quality. In terms of productive efficiency, central government should be naturally superior so long as returns are at least slightly increasing. Any economic case for decentralization must therefore invoke a counterbalancing source of efficiency in which local government has an advantage. Different authors have approached the problem in different ways. Tibet's (1956) seminal work, reviewed in Rubinfeld (1987), posits a world where individuals move costlessly among localities that offer different levels of provision of a public good, and finds that the competitive equilibrium in locational choices which results provides an efficient allocation of local public goods. Though the starting-point for many

analyses of decentralization, this work ignores central-government provision of public goods, and is thus an inappropriate foundation for the present empirical study. More importantly, it assumes a highly mobile population and fixed governments, which, more than unrealistic, we consider exactly backwards. It seems self-evident that government is the relatively mobile element in most local democratic systems, changing every electoral period or two, whereas the population is essentially fixed over the 4-5 years that electoral periods typically comprise. By invoking infinitely transportable individuals as the mechanism which joins the supply of public goods to demand, Tiebout fundamentally misses the point. "Voting with one's feet" in this way is undoubtedly a valid mechanism for preference revelation at the margins, and may be more important for particular public goods, such as education. But the principal mechanism for joining demand and supply must involve the political process. Indeed this is arguably why local government exists at all.

Oates (1972) examines heterogeneity in tastes and spillovers from public goods through a model in which local government can tailor public goods output to local tastes, whereas central government produces a common level of public goods for all localities. He finds that decentralization is preferred in systems with heterogeneous tastes and no spillovers; with spillovers and no heterogeneity, centralization is superior on efficiency grounds. But Oates' results rest largely on his assumption of uniform central provision of public goods which, though an empirical regularity, is theoretically ungrounded and problematic when viewed in the Bolivian context. Close scrutiny of the data (see section 2.2 above) shows that central government investment patterns were non-uniform during the period we examine. Investment flows were concentrated in a few municipalities to such an extent that public investment actually became uniform *after* decentralization. We thus require a theory, which does not restrict central government choice so strongly. Besley and Coate (1998) provide a model in which this restriction is lifted. Like Oates, they invoke uniform taxation to finance public goods provision. But they then devise a model of central policymaking in which elected representatives bargain over public goods provision in multiple districts. For heterogeneous districts, they find that decentralization continues to be welfare superior in the absence of spillovers, but centralization is no longer superior when spillovers are present. They also find that higher heterogeneity reduces the relative performance of centralization for any level of spillovers. This model is both more representative of how real central governments operate, and more in keeping with the facts of the Bolivian transition from centralized to decentralized provision. Our results below can be interpreted as an indirect test of their findings, given reasonable assumptions about representative local utility functions. Thus construed our results weakly support their findings.

Bardhan and Mookherjee (1998) develop a model of public service provision which examines the implications of decentralization for the targeting and cost-effectiveness of public expenditure. They find that for provision of a merit good available on competitive

markets to the poor, decentralization dominates with respect to intercommunity targeting and cost-effectiveness, though not necessarily for intracommunity targeting. For the provision of infrastructure, decentralization dominates only if local governments are not vulnerable to capture, local government has adequate financing, interjurisdictional externalities do not exist, and local governments have all the bargaining power vs. public enterprise managers. Somewhat more tangentially, Persson, Roland and Tabellini (1997) examine how the separation of powers can lead to political accountability. They examine how voters can combine incentives produced by elections and the separation of powers to control moral hazard and reduce politicians' rents under a variety of constitutional regimes (presidential, parliamentary, etc). Under appropriate checks and balances, they find that separation of powers helps voters elicit information about both politicians and the state of nature. Though it examines a different question, this paper is highly relevant to our empirical work, as the separation of powers is central to the design of the Bolivian system of decentralization.

3.2 The Model

A country is made up of T districts, each with population n_j where the subscript j denotes district. Individuals, subscripted i, have linear utility $U_i = x_i + \theta_i b(g_j)$ where x_i is the amount of private good consumed by individual i, g_j is the amount of public good available in district j, and θ_i is individual i's preference for public good g_j. We use θ_{mj} to denote the local median preference for the public good in district j. We define local welfare as median utility, $U_{mj} = x_{mj} + \theta_{mj} b(g_j)$. The function of government is to provide public goods, which it finances with a local head tax. We allow central government to have a cost advantage in the provision of public goods, such that the head tax needed to finance a given level of provision under central government is $\alpha g_j/n_j$ with $0<\alpha\leq 1$, whereas the tax under local government is g_j/n_j. This cost advantage can derive from various sources, such as central government's superior technical knowledge or an organizational advantage which lowers the cost of complex public goods, or traditional economies of scale.[8,9] We also assume that local government ascertains θ_{mj} accurately, whereas central government ascertains θ_{mj} with probability p and θ_{-mj} with probability $(1-p)$. Probability varies as $p\in[0,1]$, and we define θ_{-mj} as an unrestricted value of θ other than θ_{mj}.

Under decentralization, local government's problem in district j is

$$\max_{g} \left[\theta_m b(g) - \frac{g}{n} \right] \qquad (1)$$

[8] Certain types of public health interventions, for example, require specialized technical knowledge which central government may be able to obtain more cheaply than local government.

[9] Note that $\alpha=1$ implies no cost advantage.

where for simplicity we drop all subscripts *j*. Local government thus maximizes provision of the public good given median local preference, which it finances with a head tax. Taking first-order conditions and re-arranging, we get

$$b'(g) = \frac{1}{n\theta_m} \tag{2}$$

The level of public good provided by local government is thus an implicit function of θ_m, the median preference for the public good, and of the population *n*. Citizens receive the level of public good that they prefer, which they pay for fully.

Central government's problem is

$$\max_{g_1,\ldots,g_T} \left[\quad_j \left(p\theta_{mj} + (1-p)\theta_{-mj} \right) b(g_j) - \quad_j \alpha \frac{g_j}{n_j} \right] \tag{3}$$

We solve the equation for district *j*. Taking first-order conditions and rearranging we get

$$b'(g) = \frac{\alpha}{n\left(p\theta_m + (1-p)\theta_{-m} \right)} \tag{4}$$

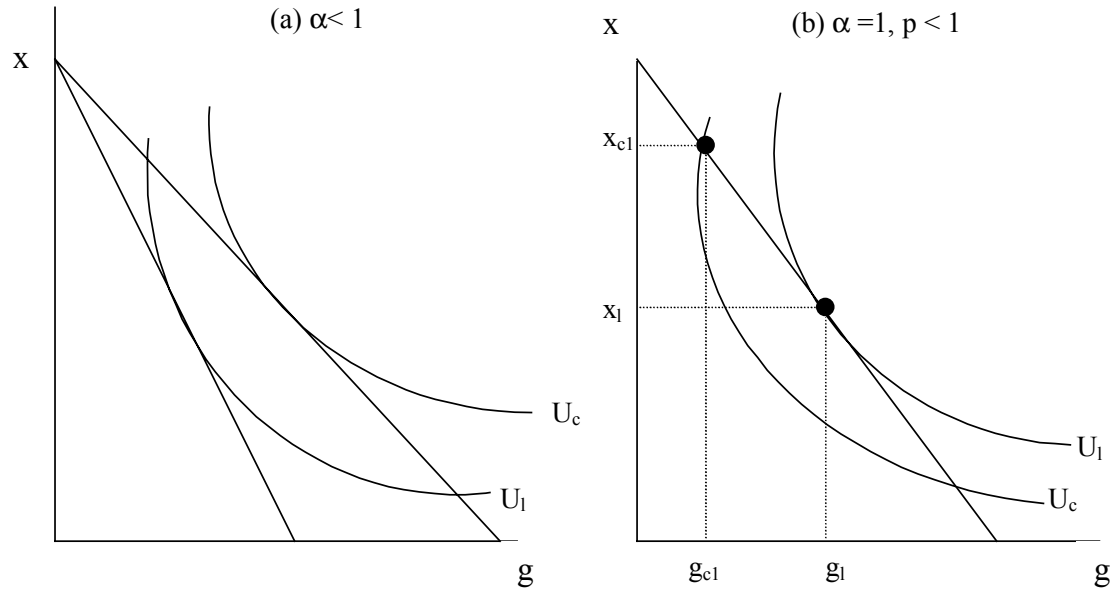
The level of public good provided by central government is thus an implicit function not only of local median preference and population, but also of the probability that central government correctly assesses local preferences, the difference between "true" local preferences and those otherwise ascertained by central government, and central government's cost advantage.

Hereafter we refer to the amounts of the public good provided in equilibrium by local and central governments, defined by equations (2) and (4) respectively, as g_l and g_c. We assume that $b''(g)<0$ and thus that utility is a strictly concave function of g. Comparing the two equations, it is easy to see that, *ceteris paribus,* public goods provision under central government will be higher than under local government when the former has a cost advantage ($\alpha<1$). Citizens will prefer central government which, for a given head tax levied, provides more of the public good than does local government. This is clear from figure 6(a), where central government's cost advantage changes the slope of the budget line, and allows the residents of j to move from a local-government equilibrium on U_l to the new tangency on U_c where $U_c>U_l$.

Athough the symmetric misestimation of local preferences is a desirable feature of the model on grounds of generality, it is not clear that it is relevant to the experience of Bolivia. Section 2 shows that central government ignored one-half of Bolivia's municipalities in the period before decentralization, and qualitative evidence presented in Faguet (2000b) indicates that central underinvestment, not overinvestment, was the persistent complaint from the grass-roots level.

For the sake of simplicity, we assume from this point on that $\theta_{-m} = 0$ and analyze central government's assessment of local preferences via the $p\theta_m$ term. The central government equilibrium is now defined by $b'(g_c) = \alpha/(np\theta_m)$. Where p<1, central government underestimates local preferences, and *ceteris paribus* public goods provision will be lower than under local government. This is equivalent to comparing points 1 and 2 in figure 6(b). Because there is no cost advantage, the budget line remains the same and citizens consume less g but more x. Choosing central government entails moving to a lower indifference curve $U_c < U_l$, and citizens prefer local government provision.[10] When p=1 the center accurately assesses local preferences, provision is equal to that under local government (point 1 below), and citizens are indifferent between the two regimes.

Figure 6: Utility Under Central vs. Local Government



[10] Allowing central government to overestimate local preferences does not substantively change the analysis. In this case the center would overinvest in g_c, and a new equilibrium would occur at the lower intersection of U_c and the budget line in figure 6(b). The restriction limits the scope of our results, but not their substance.

But this analysis begs the question of which effect dominates. By setting $b'(g_c) = b'(g_l)$ we can find critical values for the indifference points at which the countervailing effects are equal. It is straightforward to see that if $\alpha = p$, citizens will be indifferent between central and local government, as the center's inaccuracy in assessing local preferences is counterbalanced by its cost advantage, and provision of $g_c = g_l$. If $\alpha > p$, the cost advantage is dominated by the center's inaccuracy in measuring local preferences, and $g_c < g_l$. Citizens will prefer local government. If $\alpha < p$, then the center's cost advantage outweighs its inability to perceive local preferences accurately, and $g_c > g_l$. Citizens prefer central government. These results are summarized in figure 7.

Figure 7. **Indifference condition:**

$$b'(g_c) = b'(g_l) \qquad \frac{\alpha}{np\theta_m} = \frac{1}{n\theta_m}$$

Assuming	Condition	Result	Preference
$\theta_{-m} = 0$	$\alpha > p$	$g_c < g_l$	Local
	$\alpha < p$	$g_c > g_l$	Central

For simplicity, the analysis above depicts the function of the public sector as the provision of a single public good *g*, and examines the effects of competing political and institutional factors on that provision. In reality, of course, local and central governments provide many public and private goods and services, and perform a large variety of functions which this approach is too simple to capture. Cost advantage and assessment inaccuracies are likely to affect these different activities in different ways. Section 4 examines this question empirically by comparing central and local investment patterns across ten different sectors for Bolivia before and after a radical decentralization reform. We investigate whether public investment patterns were different under local government than under central government, and if so what economic and social factors explain this difference.

4. Empirical Tests: Decentralization and Investment

4.1 Methodology

Our objective is to test whether decentralization changed the pattern of public sector investment in Bolivia, and if so to find the determinants of that change. It is possible that public investment did not change with decentralization. In this case decentralization may be

desirable for political reasons of representation, for example, or undesirable for reasons of administrative effectiveness. But from an economic perspective decentralization and centralization would be largely equivalent. On the other hand, if decentralization did change investment patterns it becomes important to try to characterize this change in terms of welfare and distribution, and determine which social and institutional factors were most important in defining it. Ideally we would measure public goods in quality-adjusted units of output, separated by type. But such information is unavailable for Bolivia, and instead we measure investment inputs in the form of resources expended on public investment projects. This approach has the advantage of using natural, noncontroversial units, and of facilitating comparisons across different sectors. We separate these flows into 13 distinct sectors, Education, Urban Development, Water & Sanitation, Transport, Health, Energy, Agriculture, Water Management, Communications, Industry & Tourism, Multisectoral, Hydrocarbons, and Mining & Metallurgy, and analyze the first ten. We drop Multisectoral because it includes a sufficient diversity of projects as to be functionally meaningless as a category, and thus difficult to interpret. We ignore Hydrocarbons and Mining because almost no municipalities invest in either, rendering comparisons across regimes impossible.

For each of the remaining ten sectors we estimate the model,

$$G_{mt} = \beta_1\alpha_m + \beta_2\alpha^*_m + \beta_3\delta_t + \varepsilon_{mt} \qquad (5)$$

where α_m and δ_t are vectors of state and year dummy variables as per above, and α^*_m is the product of α_m and a decentralization dummy variable which takes the values 0 before 1994 and 1 after (i.e., postdecentralization).[11] We thus decompose investment patterns into three terms: a state effect, α_m, which captures all of the characteristics of a state fixed in time, a year effect, δ_t, which captures year shocks and time-specific characteristics, and a decentralization-interacted state effect, α^*_m, which captures state-specific characteristics commencing in 1994 which were previously absent. As decentralized public goods provision began in 1994, this term will capture the effects of local government, local civic associations and other local institutions that sprang up with the reform, and social and political dynamics more generally that impact upon local government but lay dormant under central rule. Our data cover the period 1987-96.

We then perform three tests:

1. $\beta_1 = \beta_2$ Means test. This is a simple *t*-test to determine whether the means of the α_m and α^*_m coefficients are significantly different for each sector. Significantly different coefficients indicate that decentralization caused a change in national investment patterns in a given sector through the effects and actions of local governments.

[11] Thus α^*_m takes the value 0 for all municipalities and all years before 1994, and is identical to α_m for all years from 1994 onwards.

2. $\beta_{1m} = \beta_{2m}$ Individual tests. This *F*-test checks municipality-by-municipality whether the decentralization-interacted state coefficients are different from the simple state coefficients for investment in a given sector. A significant *F*-test constitutes evidence that decentralization caused a change in local investment patterns in a particular municipality. Significance in many municipalities constitutes strong evidence (stronger than above) that decentralization changed national investment patterns.

3. Lastly, we place the *differences* in state dummy coefficients on the left-hand side (LHS), and estimate the model,

$$\beta_{2m} - \beta_{1m} = \zeta S_m + \eta Z_m + \varepsilon_m \qquad (6)$$

for each of ten sectors, where *S* is a scalar or vector of the existing stock of public services (variously defined, as we will see below) at an initial period, and *Z* is a vector of institutional and civic variables, both indexed by municipality m. This approach allows us to isolate those changes in investment patterns resulting from a move to a decentralized regime, and then find its determinants. Notice that equation (6) is a general-form and not structural model, and hence our results will not be sensitive to specific theoretical assumptions.

Our LHS variable should by construction be unrelated to all factors which remain constant between the two periods, and thus we omit socioeconomic, regional and other variables (used in Faguet 2000a) which do not vary between the centralized and decentralized regimes. We will employ these variables elsewhere to investigate the determinants of public sector investment under each regime separately, where a richer menu of explanatory variables is called for. We assume that the variables in Z, as well as the stock of public services in the ten sectors of interest to us, S, are constant over the period in question. For most of the demographic and socioeconomic variables in question, which tend to show change that is statistically significant only over longer periods of time, this is reasonable. It is less reasonable in the case of the S variable. Unfortunately the data leave us no choice.

The huge number of variables that might enter Z permit literally hundreds of specifications of equation (6) above. To facilitate analysis, and in order to combine very specific variables into more meaningful and conceptually defensible indicators, we characterize these variables according to the following groups:

1. Civil Institutions
2. Private Sector
3. Training & Capacity-Building
4. Information Technology
5. Project Planning

and construct principal component variables (PCVs) for each. Principal component analysis is a data reduction technique in which variables are added together linearly in order to find the unit-length combination which maximizes variance. This is explained in detail in Annex 1 below. Our interpretations of the PCVs is summarized in Figure 8. The PCVs and their

constituent variables, as well as variables of need, are summarized in figure A1.2. Equation (6) can thus be written as

$$\beta_{2m}-\beta_{1m} = \zeta S_m + \eta_1 Z_{1m} + \ldots + \eta_5 Z_{5m} + \varepsilon_m \,, \qquad (7)$$

where subscripts 1 to 5 denote the groups above.

Figure 8: Interpretation of PCVs

PCV Group	PCV No.	Interpretation - Variable increases in... listed in order of importance, where applicable (see Annex 1 for details)
Civil Institutions	1	Strength of local civil institutions and organizations
Private Sector	1	Dynamism of the local private sector
Training & Capacity-Building	1	Intensity of the local capacity-building efforts undertaken by/for local government
Information Technology	1	IT systems - hardware and software
Project Planning	1	Informed project planning which follows consensual and open procedures

In theoretical terms, the main coefficient of interest is ζ, which we interpret as an indicator of the degree to which investment is based on need. We define "need" as the marginal utility arising from a particular type of public service, $N = U'(g)$, where N is need and utility is defined as in the model in section 3.2. In the language of the model, we can let $\theta_m = U'(g)$. Hence need falls as the stock of g rises, and vice versa. We use two types of information as indicators of the stock of public services: (1) the penetration rates[12] of public services or benefits in the local population, r, or the population without access to the same, 1-*r*,[13] and (2) the initial per-capita stock of infrastructure (at the outset of decentralization). Examples of these are: (1) the literacy and illiteracy rates, the share of population without water or sewerage; and (2) the number of sports facilities and markets per capita in 1994. Of these we consider type 1 variables to be truer indicators of need, as they better capture the criterion of public service use by the population, and are likely to be better measures of the flow of benefits produced by public investments. Type 2 variables indicate existence more than exploitation by the local population, and hence should be less accurate indicators of need. We use type 2 variables in our regressions when type 1 variables are unavailable. It is also important to note that need for us is a relative concept, rising and falling with $U'(g)$. This is an important distinction, as the semantics of its common usage imply that need is an absolute, and even discrete, concept, existing in some places (at some times) but not in others. By contrast, "need" for us is a continuous function, present in different degrees in all places always.

[12] Note that "rate" here denotes a stock and not flow concept.
[13] We use both for education, and obtain the expected variation in sign in our results (see below).

Following the argument in section 3.2, we expect ζ to be negative and significant when S_m is measured by the penetration rate r, and positive and significant when S_m is measured by (1-*r*). In the analysis that follows we assume S_m is measured by r. A negative coefficient suggests that decentralized government invests more heavily in a type of public good where it is scarce, and hence presumably where it is more strongly preferred. Decentralization would thus lead to a more progressive investment pattern in terms of objective need than obtained under centralized government. A positive coefficient implies that decentralized government behaves regressively, accentuating the preexisting differences in public goods endowments. We interpret this as evidence that the relationship we posit in 3.2 is exactly backwards, and central government allocates public investment with more sensitivity to need than local government. A coefficient equal to zero suggests that local government does not take the existing stock of public goods into account at all in making its investment decisions, implying that our theory is misguided and local preferences should not appear in the model.

The variables in Z are not included as mere controls, however. We are interested in their coefficients, η, insofar as they help explain the institutional, civic and procedural determinants of decentralized investment decisions, and so constitute indirect tests of our theoretical argument above. The arguments put forward by political scientists[14] for local government's superior assessment of local preferences and needs include greater sensitivity to grass-roots demand, greater accessibility of local lobby groups to local government, and greater political accountability to the local populace. Some of the ways in which this can happen include the use of participative planning techniques, and the existence of private sector and civic organizations that are strong and dynamic. Remember that these factors were not relevant to central decisionmaking, which occurred in the center. Hence we interpret positive coefficients on these PCVs as weak evidence that local government assesses preferences more accurately than central government, implying that the value of p is less than 1 and the difference between real preferences and those perceived by the center (θ_m-θ_{-m}) is high.

4.2 Results

Figure 9 shows our results from the means test $\beta_1 = \beta_2$. Mean values are significantly different at the 0.1 percent level for education, water & sanitation, agriculture, transport, urban development and communication, and at the 1 percent level for industry & tourism and water management. In health, values are significantly different at only the 13 percent level, and even worse for energy. The evidence is that decentralization changed national investment patterns in each of the first eight sectors. Examination of the β_2 values indicates that the effect of local government on average investment under decentralization was to increase investment in education, urban development, water management and

[14] See for example Wolman in Bennet (1990).

perhaps health, no change in energy, and decrease investment in agriculture, transport, communication, industry and tourism, and (puzzlingly given the increase in water management) water & sanitation. But figure 10 shows that the number of municipalities investing in these sectors increased for all except agriculture. This implies that the concentration of investment fell, as more municipalities invested in a large number of (often-smaller) projects in nine sectors.

Figure 9.
Test 1: Coefficients Equal? Test $\beta_1-\beta_2 = 0$

Sector	Variable	Mean	Std Error	Test t-statistic	Test P Value
Education	β_1	0.00128	0.00032	-22.798	0.0000
	β_2	0.01685	0.00042		
Water & Sanitation	β_1	0.00374	0.00043	17.343	0.0000
	β_2	-0.01174	0.00049		
Agriculture	β_1	0.00867	0.00080	8.667	0.0000
	β_2	-0.00535	0.00086		
Transport	β_1	0.05464	0.00890	5.967	0.0000
	β_2	-0.05152	0.00890		
Urban Development	β_1	0.00307	0.00049	-5.324	0.0000
	β_2	0.00791	0.00053		
Communication	β_1	0.00191	0.00032	4.011	0.0001
	β_2	-0.00055	0.00031		
Industry & Tourism	β_1	0.00101	0.00023	3.768	0.0002
	β_2	-0.00071	0.00023		
Water Management	β_1	0.00075	0.00018	-2.932	0.0034
	β_2	0.00182	0.00020		
Health	β_1	0.00258	0.00038	1.540	0.1238
	β_2	0.00141	0.00041		
Energy	β_1	-0.00489	0.00185	1.281	0.2004
	β_2	-0.00963	0.00186		

Figure 10: Number of Municipalities Receiving Investment, by Sector

(in municipality-years)

Sector	Before	After	% Change
Urban Development	66	675	923%
Education	75	685	813%
Health	95	484	409%
Water Management	46	175	280%
Communications	38	97	155%
Water & Sanitation	202	506	150%
Energy	180	259	44%
Industry & Tourism	44	60	36%
Transport	357	444	24%
Agriculture	343	309	-10%

Figure 11 shows the number of municipalities where we can reject the hypothesis $\beta_{1m} = \beta_{2m,}$ that is, the number of municipalities where decentralization changed investment patterns significantly during the first three years. As we might expect, decentralization did not change investment equally in all sectors. The test is significant in about ¾ of municipalities for water & sanitation and education, and in $^1/_3$ of municipalities for urban development and water management, but in only $^1/_5$ of municipalities for agriculture and health and fewer in other sectors. This test suggests that investment patterns changed significantly for water & sanitation, education, urban development and water management, did not change for industry & tourism, energy, communication and transport, with agriculture and health on the border between significantly different and not. It is notable that the only sector which fails both tests is energy. Taking into account our results from test 1, we conclude that agriculture spending did change significantly between the two periods, while for health it may have but the evidence is inconclusive. Thus we add two sectors to the two above for which decentralization did not significantly change investment patterns across Bolivia's 311 municipalities. From this point we focus our analysis on water & sanitation, education, urban development, water management, agriculture and (marginally) health.

Figure 11: Test 2: Coefficients Equal?

Test $\beta_{1m} - \beta_{2m} = 0$

Sector	No. Significant	% Significant
Water & Sanitation	224	76%
Education	209	71%
Urban Development	107	36%
Water Management	105	36%
Agriculture	65	22%
Health	49	17%
Transport	29	10%
Communication	7	2%
Energy	7	2%
Industry & Tourism	7	2%

We can best understand this result by considering the following:

1. One-half of all municipalities in Bolivia received no public investment at all during the three years before decentralization, and these are for the most part the poorest municipalities. As all municipalities have funds to invest postdecentralization, the most pronounced changes in investment patterns are accounted for by the poorest municipalities.
2. Given high levels of poverty and low levels of public investment before decentralization, poor municipalities have a need for investment in more than one sector.
3. Rather than spread resources around thinly, most reasonably choose to concentrate investment in a few, high-priority sectors during the initial years of decentralization.

Hence our results are driven by investment by the poorest districts responding to their greatest needs. By revealed preference we can infer that local administrations in these areas prioritize basic social services projects above productive projects, and productive (i.e., income-enhancing) projects in turn above economic infrastructure. Hence they will tend to invest in education and water before agriculture, and agriculture before transport or communication. Because only a few years of post-decentralization data are available, we expect the *F*-test to fail in low-priority sectors, as poor municipalities received little or no investment under central government and continue to invest little under decentralization. In high-priority sectors, however, investment will leap upwards from a very low base if decentralization matters. This is indeed what happens. Decentralization leads to an increase in investment in water & sanitation and education in ¾ of all municipalities, and urban

development and water management in $^1/_3$. There are moderate changes in investment patterns in agriculture and health, and very little change in transport, communication, energy and industry & tourism. We conclude that decentralization did change the pattern of Bolivian public investment, and this difference was strongest in the social services and urban development.

Test 3 investigates the determinants of the difference in dummy state variables, $\beta_2 - \beta_1$, equivalent to the increase in investment due to decentralization. We examine our results sector-by-sector, beginning with education.

Education

Figure 12:
Test 3: $\beta_{2m} - \beta_{1m} = \zeta S_m + \eta_1 Z_{1m} + \ldots + \eta_5 Z_{5m} + \varepsilon_m$

	Model*				
Independent Variable	I	II	III	IV	V
Private Sector PCV1	-0.000983	-0.00121	-0.00106	-0.0003	-0.00056
	(-2.466)	(-3.004)	(-2.689)	(-1.004)	(-1.619)
Project Planning PCV1	-0.000538	-0.00049	-0.00055	-0.00037	-0.00052
	(-0.919)	(-0.830)	(-0.925)	(-0.703)	(-0.879)
Civil Institutions PCV1	0.000973	0.00101	0.00103		
	(1.752)	(1.774)	(1.839)		
Training & Capacity Building PCV1				-0.00063	
				(-0.591)	
Information Technology PCV1					0.00118
					(1.010)
Illiteracy Rate (Adult)	0.000173			0.00019	0.0002
	(2.906)			(3.116)	(3.306)
Illiteracy Rate (Over-6's)			0.00018		
			(2.505)		
Literacy Rate		-0.00011			
		(-1.844)			
Local Education Authority	0.005603	0.00534	0.00543	0.0053	0.00479
	(1.421)	(1.356)	(1.378)	(1.354)	(1.379)
_constant	0.0075759	0.02037	0.00806	0.00722	0.00704
	(1.814)	(3.728)	(1.816)	(1.862)	(1.731)
R-square	0.0176	0.0136	0.0162	0.0155	0.0172
Prob>F	0.001	0.0025	0.0016	0.0128	0.0104

* OLS regressions reported with robust standard errors t-stats in parentheses; PCV1 = 1st principal component variable.

All of our models for education are jointly significant at the 2 percent level or higher. We see that investment rises under decentralization where the illiteracy rate is higher, and investment is thus progressive in terms of need. This implies that local government is more sensitive to local need than central government. This finding is not sensitive to specification or to the measure of illiteracy used, as we see in Figure 12, where the literacy rate is significant and negative. In terms of the model of section 3.2, our results imply that p<1, and hence that the center assesses local preferences less accurately than local government. Educational investment falls where the private sector is stronger, a finding which is again insensitive to specification. This is most likely because private firms lobby for resources to flow to other sectors where they stand to profit more. Our results for urban development (below) support this interpretation. Civil Institutions, by contrast, lead to an increase in investment after decentralization, suggesting grass roots support for education (i.e., parents worried about their children). Participative planning methodologies have no effect on investment, nor do information technology or local training and capacity-building activities.

Water & Sanitation

Figure 13:

Test 3: $\beta_{2m} - \beta_{1m} = \zeta S_m + \eta_1 Z_{1m} + \ldots + \eta_5 Z_{5m} + \varepsilon_m$

	Model*			
Independent Variable	I	II	III	IV
Private Sector PCV1	0.000123		-0.000856	-0.000712
	(0.130)		(-1.265)	(-1.058)
Project Planning PCV1	-0.003165		-0.003322	-0.003517
	(-2.002)		(-2.237)	(-2.205)
Civil Institutions PCV1	-0.001227			
	(-1.230)			
Training & Capacity Building PCV1			-0.001129	
			(-1.161)	
Information Technology PCV1				-0.000196
				(-0.163)
% Pop. w/out Sewerage	0.000194		0.000170	0.000180
	(1.881)		(1.768)	(1.756)
% Pop. w/out Water		0.000157		
		(1.791)		
_constant	-0.030616	-0.027167	-0.028461	-0.029259
	(-3.324)	(-4.492)	(-3.348)	(-3.217)
R-square	0.0323	0.0064	0.0320	0.0302
Prob>F	0.0000	0.0743	0.0000	0.0000

* OLS regressions reported with robust standard errors t-stats in parentheses; PCV1 = 1st pricipal component variable.

All multivariable models for water & sanitation are jointly significant beyond the 0.1 percent level, and even the univariable model is significant at the 10 percent level. Investment rises under decentralization where more people have no sewerage. It also rises where the percent of the population without access to drinking water increases, though this finding is sensitive to specification and drops out when other variables are included in the model. Thus local governments invest more where need is greatest, and investment is progressive in terms of need. This implies that $p<1$ in the model above. Participative planning methodologies are significant and negative, thus decreasing investment, and the private sector and civil institutions are both insignificant. This last result is surprising given the positive effect of civil institutions on investment in education.

Water Management

Figure 14:
Test 3: $\beta_{2m} - \beta_{1m} = \zeta S_m + \eta_1 Z_{1m} + \ldots + \eta_5 Z_{5m} + \varepsilon_m$

	Model*			
Independent Variable	I	II	III	IV
Private Sector PCV1	0.000171	0.000170	0.000056	0.000155
	(0.602)	(0.609)	(0.405)	(0.758)
Project Planning PCV1	-0.000550	-0.000540	-0.000533	-0.000525
	(-0.877)	(-0.878)	(-0.906)	(-0.829)
Civil Institutions PCV1	-0.000171	-0.000182		
	(-0.655)	(-0.655)		
Training & Capacity Building PCV1			-0.000024	
			(-0.063)	
Information Technology PCV1				-0.000445
				(-1.326)
% Pop. w/out Water	-0.000087		-0.000088	-0.000088
	(-2.363)		(-2.339)	(-2.412)
% Pop. w/Water (Int. Plumbing)		0.000135		
		(0.879)		
% Pop. w/Private Standpipe		0.000067		
		(1.639)		
% Pop. w/Public Standpipe		0.000101		
		(2.012)		
% Pop. w/out Sewerage	0.000085	0.000110	0.000087	0.000077
	(2.217)	(1.485)	(2.249)	(2.097)
% Pop. w/"Other" Sewerage**	0.000113	0.000139	0.000112	0.000103
	(1.793)	(2.481)	(1.850)	(1.725)
_constant	-0.001260	-0.012457	-0.001367	-0.000426
	(-0.393)	(-1.441)	(-0.404)	(-0.136)
R-square	0.0110	0.0114	0.0103	0.0116
Prob>F	0.0832	0.1422	0.0824	0.0635

* OLS regressions reported with robust standard errors t-stats in parentheses; PCV1 = 1st principal component variable.

** "Other" Sewerage refers to non-public-utility, non-septic-tank methods of sewerage disposal.

The water management sector is related to water & sanitation, but is broader in scope. It includes such projects as reservoirs and wastewater treatment lagoons, which are components of municipal (potable) water systems, as well as levees and storm drainage works, which are not. In general the degree of overlap between the two sectors is high, and we use similar indicators of need for both.

Three of our models are jointly significant at the 10 percent level, and a 4th is significant at the 15 percent level. Investment in water & sanitation is lowest where the share of population with no access to water is highest, rises as more people have access to public and private standpipes, and then falls again as internal plumbing becomes widespread. Investment is also highest where few people have access to sewerage, or access to rudimentary sewerage, and decreases as municipal sewerage systems become widespread. These results point to investment that is progressive in terms of need at intermediate and high levels of provision, with a poverty trap amongst the most needy. Hence $p<1$ for most of the population, but importantly not for the neediest districts, where investment falls. Amongst these municipalities it would seem that it is local government that underestimates local preferences. We return to this idea below. Perhaps surprisingly, private sector firms, civil institutions, participative planning methodologies, IT and local training programs have no effect on investment. Only variables of need matter. Annex 2 discusses these results in greater detail in the context of sequential demand curves for water and sanitation services.

Agriculture

Figure 15:
Test 3: $\beta_{2m} - \beta_{1m} = \zeta S_m + \eta_1 Z_{1m} + \ldots + \eta_5 Z_{5m} + \varepsilon_m$

	Model*		
Independent Variable	I	II	III
Private Sector PCV1	-0.000286	-0.000665	-0.000837
	(-0.156)	(-0.466)	(-0.657)
Project Planning PCV1	-0.005871	-0.005644	-0.005932
	(-1.819)	(-1.727)	(-1.853)
Civil Institutions PCV1	-0.000401		
	(-0.226)		
Training & Capacity Building PCV1		-0.001492	
		(-0.420)	
Information Technology PCV1			0.000885
			(0.303)
Malnutrition Rate (Low), Males	0.000720	0.000680	0.000702
	(1.962)	(1.987)	(1.931)
_constant	-0.032749	-0.031594	-0.032157
	(-2.936)	(-2.981)	(-2.918)
R-square	0.0198	0.0209	0.0201
Prob>F	0.0768	0.0818	0.0798

* OLS regressions reported with robust standard errors t-stats in parentheses; PCV1 = 1st principal component variable.

All of our models are significant at the 10 percent level. It is notable that even though agricultural investment decreased after decentralization – fewer municipalities invested here (see Figure 10) and the mean difference in state variables is negative and significant – investment nonetheless increases with the male malnutrition rate, a finding which is insensitive to specification. This implies that those municipalities that did invest in this sector after decentralization did so progressively according to need. Hence $p<1$ in the model above. Once again participative planning techniques decrease agricultural investment under decentralization, and the number of private sector enterprises and civil institutions has no effect. Investment is similarly unaffected by local training and capacity-building programs and installed IT capacity.

Urban Development

Figure 16:
Test 3: $\beta_{2m} - \beta_{1m} = \zeta S_m + \eta_1 Z_{1m} + \ldots + \eta_5 Z_{5m} + \varepsilon_m$

	Model*		
Independent Variable	I	II	III
Private Sector PCV1	0.004749	0.004869	0.005125
	(4.486)	(4.804)	(4.704)
Project Planning PCV1	-0.000801	0.000263	0.000175
	(-0.994)	(0.219)	(0.143)
Civil Institutions PCV1	0.000439		
	(0.750)		
Training & Capacity Building PCV1		-0.000540	
		(-0.716)	
Information Technology PCV1			-0.000609
			(-0.285)
# Markets per capita (1994)	0.136135	0.124015	0.108250
	(6.130)	(3.048)	(2.371)
# Sports Facilities per capita**	4.728497	4.758151	4.814974
(1994)	(2.815)	(2.991)	(3.013)
_constant	0.006800	0.005830	0.005801
	(4.340)	(3.244)	(3.176)
R-square	0.0684	0.0474	0.0474
Prob>F	0.0000	0.0000	0.0000

* OLS regressions reported with robust standard errors t-stats in parentheses
PCV1 = 1st principal component variable.

** Defined as other than football fields, multi-use courts and coliseums.

All of our models for urban development are significant at the 0.1 percent level. In this sector we use the initial (i.e., predecentralization) stock of infrastructure directly as our measure of need. Investment under decentralization increases as the initial number of markets per capita increases, and as the number of general sports facilities per capita increases as well. Investment is thus regressive in terms of need in this sector, as opposed to the others considered above, and this finding is not sensitive to specification. Thus it would seem to be central government that more accurately assesses local need in this sector, and local government that misestimates it. Investment increases with the number of private sector firms, which is as we would expect given that urban development projects often result in lucrative contacts for these firms. Investment is unaffected by participative planning techniques and civil institutions, implying that it is not a high priority at the grass-roots level. Lastly, neither training programs nor IT affect investment in urban projects.

These results suggest that we should modify our model to include p_l and p_c, the probabilities that local preferences will be accurately assessed by local and central governments respectively. Indeed, there are sound political economy reasons related to interest group formation and collective action for believing that local government will be more sensitive to demand in some sectors than in others. The important question would then become, which form of government is better at assessing local preferences, $p_l >_< p_c$? On the other hand, of the six sectors we analyze this is the only one where our indicators of need are unsatisfying (type 2 variables in the characterization of section 4.1), and the only one where we find a broadly regressive pattern of investment in terms of need. It would thus seem wise to reestimate these equations with better indicators before concluding that the model is inadequate. We leave this for future work.

Health

Figure 17:
Test 3: $\beta_{2m} - \beta_{1m} = \zeta S_m + \eta_1 Z_{1m} + \ldots + \eta_5 Z_{5m} + \varepsilon_m$

	Model*		
Independent Variable	I	II	III
Private Sector PCV1	0.000348	0.000234	0.000555
	(0.527)	(0.526)	(0.992)
Project Planning PCV1	-0.001382	-0.001105	-0.001267
	(-1.177)	(-1.012)	(-1.097)
Civil Institutions PCV1	-0.000165		
	(-0.304)		
Training & Capacity Building PCV1		-0.001099	
		(-1.052)	
Information Technology PCV1			-0.001108
			(-1.245)
Health Care, Public %	0.000176	0.000207	0.000179
	(1.292)	(1.428)	(1.320)
Health Care, Other %	0.000387	0.000400	0.000400
	(1.529)	(1.719)	(1.628)
Malnutrition Rate (Moderate)	-0.000371	-0.000274	-0.000330
	(-0.864)	(-0.657)	(-0.756)
Local Health Authority	-0.000754	0.000393	0.000815
	(-0.394)	(0.169)	(0.367)
_constant	-0.004594	-0.007780	-0.006799
	(-0.924)	(-1.462)	(-1.433)
R-square	0.0187	0.0207	0.0202
Prob>F	0.8545	0.6514	0.5682

* OLS regressions reported with robust standard errors
t-stats in parentheses; PCV1 = 1st pricipal component variable

All of our health models are collectively insignificant, and hence we cannot make any claims based on them. This is no great blow, however, as none of the variables in our main model are significant either. In the first alternative model "Other" health care is positive and significant, and in the second alternative it is nearly so. This variable measures the percentage of households that have recourse to health care outside the formal public and private health networks. We might interpret it as an indicator of pent-up demand for health services, and hence its positive coefficient as weak evidence that local governments invested in health care where demand was greatest, and $p<1$. No other variables – the private sector, civil institutions, participative planning, IT or training schemes – appear to have any effect on investment, nor do local sectoral institutions in the form of Local Health Authorities. But

as we observed above, none of these models is collectively significant, the small trend we do find is sensitive to specification, and the difference between state variables examined above is marginally significant for this sector in both tests. We thus conclude that we can make no claims about investment in health.

Results for **Transport, Communication, Energy and Industry & Tourism,** sectors for which differences in state variables are not statistically significant, appear for the sake of completeness in Annex 3.

4.3 Summary

Our results show that decentralization significantly changed national public investment patterns. Investment changed unambiguously in education, water & sanitation, water management, agriculture and urban development after the 1994 reform, and there is some evidence that it may have changed in health, transport, communication and industry & tourism as well. Furthermore, these changes are strongly and positively related to real local needs. In education, water & sanitation, water management, and agriculture, postdecentralization investments are higher where illiteracy rates are higher, water and sewerage connection rates lower, and malnutrition a greater risk respectively. In a decentralized context dominated by the actions of some 250 small, poor municipalities that make up 80 percent of the Bolivian total, public investment is strongest in human capital and social services. And within these sectors investment is progressive in terms of need.

Investment rose by number of municipalities in all of the sectors we examine except agriculture, and the effect of local government on average investment was positive in the social sectors and urban development, and negative in economic infrastructure and agriculture. We can combine our various results to distinguish between the cost advantage and needs-assessment effects that we posit in section 3. We interpret the average rise in investment (*i.e.,* across all municipalities) in education, health, water management and urban development after decentralization as due entirely to the need-orientation of local government, and evidence that the center cannot produce these services at lower cost than the periphery. The fall in average investment in agriculture, by both volume and number of municipalities, combined with the significance of need, is evidence that the center was overinvesting in this sector, and that given the choice municipalities prefer to redirect resources elsewhere. The fall in average investment by value in water & sanitation, combined with an increase in the number of districts investing and the significance of need, implies that the central government concentrated investment in too few projects and districts; local government thus reallocates resources in a larger number of smaller projects where need is greatest. And lastly, the systematic fall in investment by value throughout Bolivia in transport, communication and industry & tourism, combined with modest increases in numbers of municipalities investing and the irrelevance of need, implies weakly

that the center may have had a cost advantage in these sectors, leading volumes to fall after decentralization.

After needs, the next most important indicator is participative planning techniques. We expect such planning techniques to contribute to needs-based investment insofar as they help local governments to sense θ_m accurately. But where they enter significantly their sign is negative. This may be because such activities are expensive and divert resources and attention from implementing investment projects, implying that they may not be worthwhile. Alternatively, it could be due to the avoidance of projects that are not desired by the grass-roots, implying that these activities are valuable. The latter is only really a possibility if there is a general level of overinvestment in the Bolivian public sector, as otherwise we would expect good participative planning to increase investment in at least some sectors. We consider this possibility highly unlikely, and conclude that participative planning does not seem to improve local government's ability to sense local preferences.

In econometric terms, the most interesting single feature of our results is that the only terms that are consistently significant across the five principal sectors we analyze are indicators of need. These relationships are robust and insensitive to specification. By contrast social, institutional and procedural variables are infrequently significant across sectors, and seem to account for little total variation. Indeed, the only effect we find for private sector firms is to transfer resources from education to urban development. Civil institutions are significant only for education, where they increase investment, and insignificant everywhere else. Training, capacity-building and IT are insignificant for all sectors. This implies that the differences in investment patterns chronicled above are not related to the number of private enterprises or civil institutions, or driven exogenously by training programs or information technology, but are instead determined by local needs. We conclude that decentralization led to an increase in investment in those municipalities least well endowed with infrastructure, and with the worst demographic indicators in the respective sectors which we examine. This is exactly the opposite of what many academics and policymakers predict, and what other researchers have found in the past. Given this finding, it is important that we investigate the social and institutional mechanisms that cause these changes. We turn to these questions in Faguet (2000a) and (2000b).

5. Conclusions

Our results confirm that decentralization did change local and national investment patterns in Bolivia, and that local preferences and needs are key to understanding these changes. Taken together, the pattern of centralized public investment and the structure of the decentralization program imply that these results are largely driven by the smallest, poorest municipalities investing newly devolved public funds in their highest-priority projects. We find that investment in education, water & sanitation, water management and

agriculture are progressive in terms of need, implying, in the language of our model, that central government's $p<1$. Even in agriculture, where total investment fell between the pre- and post-decentralization periods, our evidence indicates that the remaining investment was reallocated amongst districts according to need.

The results also point to the existence of a poverty trap in the water management sector, where decentralized investment falls in the neediest districts as need increases. Within this range of the stock of public services, local government fails to respond to need and central government provision is superior. Our model can explain this indirectly, if in these neediest districts the costs and complexity of making initial investments in water are so great (from developing water sources, laying water mains and building treatment plants, for example) that local governments cannot undertake them alone, but once these initial investments are made the marginal costs of extending the system are manageable. In the language of the model, central government has a cost advantage over local government for initial investments, $\alpha<1$, an advantage that disappears at intermediate and higher levels of provision.

By demonstration, this paper seeks to make a case for conducting empirical research on decentralization and fiscal federalism in the manner in which we have done. Much of the empirical work on decentralization to date focuses on the share of national expenditures conducted by different levels of government, and ignores the many insights waiting to be uncovered by moving down to the level of the local political economy and conducting a careful comparison of spending and investment patterns with economic, institutional, social and demographic indicators. The data presented here is from one of the poorest countries in the Western hemisphere, and took years to collect, clean and organize. But as this paper demonstrates, its quality is sufficient to permit significant and (for many) counter-intuitive results. Applying a similar methodology to more sophisticated countries in the region, not to mention Europe and North America, might prove very fruitful.

Lastly, the above analysis leaves open the question of how political power is distributed in a central government, the institutional mechanisms by which governments sense and take up local demand for public services, and the precise nature of the organizational or technical advantages or scale economies which might benefit one level of government over another. That is, p, θ_m and α are all exogenous here. Research is needed to understand these processes and endogenize them in our models of public goods provision. Several authors have made progress in this direction but more work is needed.

Annex 1. Methodology, Including Principal Component Analysis and Interpretation

N.B. This annex is general to all of the papers originating from the study "Participatory Planning and Decentralization in Bolivia." It describes the strategy used to arrive at the principal component variables used in this paper as well as Faguet (2000a). Hence some of the variables and categories referred to below do not appear in this paper but are exploited elsewhere.

Methodology

Our empirical strategy is iterative, and begins by finding the best idiosyncratic model of public investment for each of the ten sectors of interest. Hence we fit the equation

$$G_m = \zeta S_m + \eta Z + \varepsilon_m \,, \qquad \text{(A1)}$$

separately for central public investment (1991-3) and local public investment (1994-7) where G_m is aggregate investment per capita in the public good subscripted by municipality, S_m is a scalar or vector of the existing stock of public goods of that type (variously defined) at an initial period, and Z is a vector of socio-economic, demographic, regional, political, institutional, administrative and procedural variables which might affect investment decisions. Our use of the Z term follows the literature on the demand for public goods exemplified by Bergstrom & Goodman (1973) and Rubinfeld, Shapiro and Roberts (1987) within the context of the available data. In particular, no income data is available at the municipal level in Bolivia, and so we substitute several alternative indicators of income and wealth, including for example type of cooking fuel, and housing size, quality and related characteristics. But we expand the scope of the Z indicators considerably from that of previous authors by including measures of the strength of local political forces as well as municipal institutional capacity. This innovation allows us to investigate the micropolitical basis of local government decision-making, which we explore in detail in Faguet (2000a).

We allow no constraints across sectors on the particular variables admissible in Z. We use the Huber/White estimator of variance to produce consistent standard errors in the presence of non-identically distributed residuals. This produces ten different models of public sector investment, one for each sector. Individually these models are quite satisfactory, with high R^2 and few variables insignificant. But because of large variation in the specification of the Z vector, comparison across sectors is problematic. Additionally, on a theoretical level these models would seem to assert that public investment in different sectors happens according to different processes, in which different variables intervene. This is evidently unacceptable.

In our second iteration we return to equation (A1) and estimate it, holding the Z vector constant across all sectors. But we take advantage of the previous stage by using only those variables found significant there; in this sense the previous stage constitutes a method for reducing the 1200+ indicators to a subset of 197. But even so we still suffer from a dimensionality problem. We then employ a method of forward and backward substitution and elimination in order to reduce this subset to 22 variables encompassing the 13 categories of Z, in specifications of 23-30 variables overall (see Faguet 2000c, Annex 3). These models benefit from being readily comparable across sectors. The ratio of significant to insignificant variables drops sharply compared to the first stage, however, and R^2 values are somewhat lower.

The insignificance of the variables chosen is not entirely separable from the issue of comparability, however. It is evident from these results that none of the variables is significant in most of the sectors, and many are significant in only 2 or 3. How do we interpret a given variable across sectors, knowing as we do that an alternative one from the same group would produce a different pattern of significance and insignificance? The training & capacity-building variables in Faguet 2000c (Annex 3), for example, are insignificant in most of the models. What importance do we attach to this when we know from stage 1 that there is at least one alternative training variable which would be significant for each sector where the current ones are not? We evidently cannot assert for any sector that politics does not matter; we must conclude that the comparability constraint forces us to omit from our models information that is important in explaining investment behavior.

Indeed, given that there are 197 variables, many of them quite specific, which have explanatory power over our dependent variable, *any* subset of 20, 30, or even 100 will omit valuable information. We require a solution which allows us to retain the full breadth of information, and yet produce a specification which is both parsimonious and comparable. We turn to principal component analysis, a data reduction technique in which the objective is to find the unit-length combinations of explanatory variables with the highest variance. We follow Maddala (1977) in calculating variables z_1 to z_k where z is a linear combination of the x variables,

$$z_1 = a_1x_1 + a_2x_2 + \ldots + a_Lx_L$$
$$z_2 = b_1x_1 + b_2x_2 + \ldots + b_Lx_L \quad \text{etc.}$$[15]

ranked in order of variance, with highest first. Principal component analysis regresses y on $z_1, z_2, \ldots, z_k$, where $k < L$ and z's are constructed so as to be orthogonal. So long as the z's chosen represent combinations of variables that have economic meaning and can be interpreted, this affords us a method for estimating parsimonious models with limited loss of information.

[15] For further treatment of this topic, see also Greene (1997), and Jackson (1991).

We calculate a set of principal component variables (PCVs) based on the raw variables retained in stage 1. We discard all those with low eigenvalues, as per normal procedure, and then find the subset of the remaining ones which optimally estimate equation (A1), where Z is a vector of PCVs. Figure A1.1 contains the eigenvectors associated with each of the PCVs used in this paper. The factor loadings on the raw variables can be read vertically down each column. The numbered column headings denote which PCV is referred to. Our interpretation of each PCV is explained below.

Interpretation of PCVs

Civil Institutions: This is an indicator of the number organizations and institutions of local civil society. It rises in all the variables, especially in the more general measures. We interpret it as a proxy for the strength of local civil institutions.

Private Sector: This PCV rises in the number of private businesses registered locally. We construe it as an indicator of the dynamism of the local private sector.

Training: This variable rises in categories of training (i.e., institutional strengthening) received by the municipality and falls in those requested but not yet received. Hence we interpret it as a measure of the intensity of capacity-building efforts undertaken by/for local government.

Information Technology: This PCV rises in the IT systems - hardware and software (especially software) - at the disposal of each municipality.

Project Planning: This PCV loads positively where municipalities use information on education and health when planning projects, where sectoral regulations are followed in water & sanitation, where a Municipal Development Plan exists, and where councilmen and oversight committees identify investment projects using the MDP and urban cadaster. It loads negatively where the mayor is the one who identifies investment projects, and where problems arise with the Annual Operating Plan. This is thus a straightforward indicator of informed project planning which follows consensual and open procedures.

Figure A1.1

CIVIL INSTITUTIONS

Eigenvectors

Variable	1
cv	0.09745
indig2	0.01988
jvec2	0.29229
otbregi	0.4194
otbregi2	0.43286
otbs_e	0.42137
otbs_pj	0.42934
otbsoli	0.42372

PROJECT PLANNING

Eigenvectors

Variable	1
catastur	0.04701
dpoacoor	-0.00839
dpoaotro	-0.07581
epoaham	0.00306
evalres	0.07426
idenalc	-0.00973
idencons	0.0145
idencv	0.09214
idenpdm	0.14818
info_ed	0.53349
info_sa	0.51649
pdm94	0.14019
plan_sye	0.56911
reconu_a	0.24654

TRAINING

Eigenvectors

Variable	1
capadpe	0.28556
capci1	0.30671
capci2	0.2612
capdis	0.2793
caplemu	0.34451
caporad	0.38803
capprin	0.37869
capprop	0.34559
temacz	-0.14204
temadis	-0.20036
temaorad	-0.22559
temaprop	-0.18667

INFORMATION TECHNOLOGY

Eigenvectors

Variable	1
sitotal	0.51744
siotro	0.36119
sisin_ad	0.42748
sisin_ai	-0.27289
sisinidp	0.28173
sicom	0.38812
impresor	0.3385

PRIVATE SECTOR

Eigenvectors

Variable	1
eereg_cm	0.61675
eereg_ea	0.56212
eereg_fi	0.55103

Figure A1.2:
Summary of Principal Component Variables, PCV Constituents, and Needs Variables

Variable	Obs	Mean	Std. Dev.	Min	Max
Principal Component Variables					
pcps1	302	-3.2400E-09	1.5298	-0.3015	18.0787
eereg_cm	306	202.7255	1229.8060	0	14117
eereg_ea	306	0.5556	2.0973	0	30
eereg_fi	310	2.6097	26.7243	0	454
pcpp1	310	2.3600E-09	1.5915	-2.7175	2.2313
catastur	310	0.1581	0.3654	0	1
dpoacoor	310	0.8548	0.9991	0	4
dpoaotro	310	0.6968	1.1790	0	4
epoaham	310	0.8355	0.3713	0	1
evalres	310	0.8226	0.3826	0	1
idenalc	310	0.7968	0.4030	0	1
idencons	310	0.4129	0.4932	0	1
idencv	310	0.7323	0.4435	0	1
idenpdm	310	0.3742	0.4847	0	1
info_ed	310	0.5581	0.4974	0	1
info_sa	310	0.5839	0.4937	0	1
pdm94	310	0.3032	0.4604	0	1
plan_sye	310	0.5839	0.4937	0	1
reconu_a	310	0.6839	0.4657	0	1
pcci1	303	2.4000E-09	2.2150	-2.1130	14.5313
cv	310	0.6419	0.4802	0	1
indig2	310	0.6290	3.5208	0	51
jvec2	310	8.9548	26.2524	0	247
otbregi	308	34.25	41.3093	0	299
otbregi2	310	46.9226	49.6351	0	339
otbs_e	307	50.2280	59.0375	0	520
otbs_pj	305	43.8557	52.5067	0	416
otbsoli	308	40	43.9176	0	323
pctr1	310	-5.4000E-09	1.6762	-2.8227	4.2889
capadpe	310	0.2516	0.4346	0	1
capci1	310	0.2	0.4006	0	1
capci2	310	0.5710	0.4957	0	1
capdis	310	0.4871	0.5006	0	1
caplemu	310	0.3452	0.4762	0	1
caporad	310	0.3	0.4590	0	1
capprin	310	0.3613	0.4812	0	1
capprop	310	0.3903	0.4886	0	1
temacz	310	0.5194	0.5004	0	1
temadis	310	0.3161	0.4657	0	1
temaorad	310	0.5065	0.5008	0	1
temaprop	310	0.4290	0.4957	0	1
pbit1	310	1.6400E-08	1.5235	-1.5591	5.0864
sitotal	310	0.4355	0.4966	0	1
siotro	310	0.2226	0.4167	0	1
sisin_ad	310	0.1548	0.3623	0	1
sisin_ai	310	0.6968	0.4604	0	1
sisinidp	310	0.3258	0.4694	0	1
sicom	310	0.2806	0.4500	0	1
impresor	310	0.2903	0.8737	0	10
Need Variables					
sa_minsa	310	32.0264	20.0876	0	85.5147
sa_otro	310	4.3985	7.4206	0	65.2706
desmod	294	8.2202	4.4993	0	26.2548
dilos	310	0.9161	0.2776	0	1
analf	310	30.4638	15.8231	5.5	78.7
ed_alfa	310	69.0462	15.9098	21.2128	94.5433
edana6	310	26.5292	13.1925	6.3780	69.7183
dile	310	0.5032	0.5008	0	1
sin_alca	310	76.1424	21.8893	14.6586	100
sin_agua	310	74.3487	21.1723	17.9204	100
merca4pc	304	0.0014	0.0108	0	0.1517
infot4pc	286	6.0100E-05	0.0006	0	0.0095
deslevh	294	23.0698	7.2684	0	57.1429
sin_luz	310	76.0124	25.4209	5.9936	100
agua_nr	310	67.6176	23.3971	10.4521	100
alca_sin	310	76.2768	21.8418	14.6586	100
alca_otr	310	16.1283	16.3147	0	64.1026
agua_dv	310	8.9680	10.3644	0	56.4501
agua_fv	310	16.7037	13.7505	0	65.9341
agua_ft	310	6.7107	7.1615	0	48.2235
teatr4pc	304	2.8300E-05	8.3400E-05	0	0.0007

Annex 2. The Demand for Water Management Services

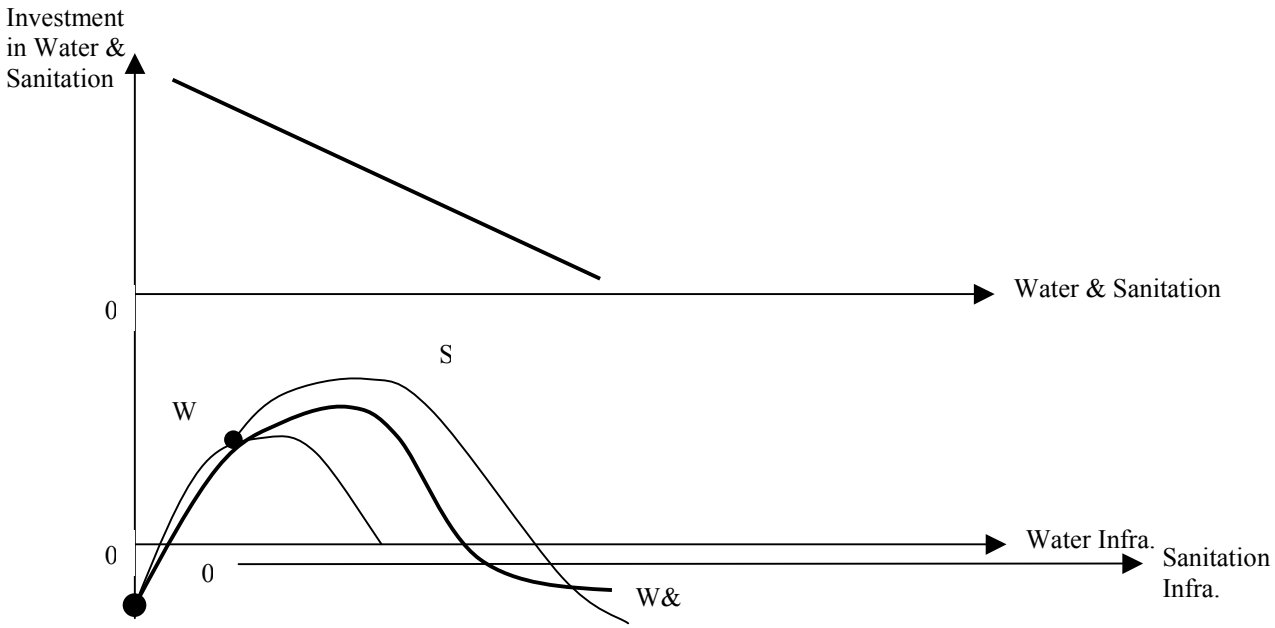
We can understand the results for water management better by noting that, in terms of demand, water & sanitation and water management are different from other sectors in that they are the aggregation of two public services – water and sewerage – which are technically and economically distinct. Indeed, water and sewerage are additive, sequenced services where water is generally the higher priority and one must have the first before having access to the second. Improvements to local water systems will tend to follow a progressive pattern as communities become wealthier and more is invested in this sector, resulting in a service escalation roughly as follows:

1. No water, no sanitation
2. Public standpipes, no sanitation
3. Public standpipes, open sewers
4. Private standpipes, open sewers
5. […]
6. Internal plumbing, municipal sewerage

This pattern holds both across time, and cross-sectionally across a range of communities differing in wealth. In reality such an escalation occurs not in discrete steps but more-or-less continuously in terms of access rates of the population to each level of service. The point is that sequencing occurs, and not the precise path that the sequence takes.

Our analysis of needs variables must take this into account, and accordingly we posit a demand curve for this sector which looks like figure A2 below.

Figure A2: Marginal Demand for Water & Sanitation



If demand for water & sanitation were linear in nature and progressive in terms of needs (i.e., existing infrastructure), it would look like the downward-sloping line in the upper half of the graph. Common sense and our data suggest that demand will not vary uniformly over different levels of service provision, however, nor equally over each type of service. It stands to reason that populations with low levels of water and sanitation will demand more new water infrastructure than communities where service levels are high. The lower curves in figure A2 are implied demand curves for water and sanitation respectively, assuming that investment in this sector goes first to water (public standpipes) and only then to sewerage (initially rudimentary), as water service is simultaneously improved. Hence the origin of the sanitation axis is shifted to the right of that of the water axis. The curve in boldface is the vertical sum of the two independent curves.

The negative range at the left of the graph, where many people have no potable water at all, can be interpreted as a poverty trap. Here a lack of water & sanitation infrastructure leads to ignorance about its benefits, and hence to low demand. As service levels rise, however, people witness its value to themselves or their neighbors, and demand – and hence investment – increases. At high levels of service provision, where water infrastructure is abundant, investment falls again. Our results support this interpretation. Indeed the graph above is constructed from the results in figure 14, as well as additional regressions using variables for many levels of infrastructure stock.

Annex 3. Sectors Where State Variables Are Not Significantly Different

(i.e., $\beta 1m = \beta 2m$).

Industry & Tourism

Figure A3.1

Test 3: $\beta_{2m} - \beta_{1m} = \zeta S_m + \eta_1 Z_{1m} + \ldots + \eta_5 Z_{5m} + \varepsilon_m$

	Model*		
Independent Variable	I	II	III
Private Sector PCV1	0.00021	0.00029	9.4E-05
	0.66	1.046	0.42
Project Planning PCV1	0.00071	0.00091	0.00068
	0.723	0.815	0.708
Civil Institutions PCV1	0.00015		
	0.418		
Training & Capacity Building PCV1		-0.00113	
		-1.348	
Information Technology PCV1			0.00066
			1.312
# Theaters per capita	16.6466	17.5936	16.4068
	1.855	1.959	1.996
_constant	-0.0023	-0.00226	-0.00224
	-1.562	-1.583	-1.58
R-square	0.0073	0.0144	0.0088
Prob>F	0.3984	0.2549	0.2921

* OLS regressions reported with robust standard errors
t-stats in parentheses; PCV1 = 1st pricipal component variable

Our models in this sector are all insignificant. We saw above that state variables are significantly different on average (i.e., test 1), but individually different only for 7 municipalities. Hence we cannot draw conclusions for this sector. Unfortunately we have no good, comprehensive indicator of need for industry & tourism. The variable we can use is the number of theaters per capita – municipalities trying to develop their tourist potential often invest in theaters, sports stadiums and similar projects in the hopes of attracting internal tourism (see Faguet 2000b). This variable is significant and positive, indicating that investment rose under decentralization where such infrastructure was in greatest abundance. No other variable is significant in our models, including surprisingly the number of private sector firms, which we would expect to benefit most from such investment. The evidence thus weakly suggests that post-decentralization investment in this sector was regressive in terms of need.

Transport & Communication

Transport

Figure A3.2

Test 3: $\beta_{2m} - \beta_{1m} = \zeta S_m + \eta_1 Z_{1m} + \ldots + \eta_5 Z_{5m} + \varepsilon_m$

	Model*		
Independent Variable	I	II	III
Private Sector PCV1	-0.00083	0.00573	-0.00143
	-0.102	0.626	-0.255
Project Planning PCV1	-0.01236	-0.01365	-0.01196
	-0.405	-0.427	-0.405
Civil Institutions PCV1	0.0091		
	0.437		
Training & Capacity Building PCV1		0.01463	
		0.566	
Information Technology PCV1			0.02305
			0.666
_constant	-0.10798	-0.10787	-0.10698
	-2.203	-2.204	-2.234
R-square	0.0009	0.0013	0.0020
Prob>F	0.9281	0.9404	0.8689

* OLS regressions reported with robust standard errors
t-stats in parentheses; PCV1 = 1st pricipal component variable

Communication

Figure A3.3

Test 3: $\beta_{2m} - \beta_{1m} = \zeta S_m + \eta_1 Z_{1m} + \ldots + \eta_5 Z_{5m} + \varepsilon_m$

	Model*		
Independent Variable	I	II	III
Private Sector PCV1	-0.00044	-0.00054	-0.00049
	-0.746	-1.132	-0.984
Project Planning PCV1	-0.00052	-9.9E-05	-0.00025
	-0.694	-0.131	-0.301
Civil Institutions PCV1	-0.0002		
	-0.474		
Training & Capacity Building PCV1		-0.00084	
		-1.038	
Information Technology PCV1			0.00013
			0.109
% Population w/out Electricity	-2.8E-05	-9E-06	-3.7E-07
	-0.458	-0.137	-0.005
_constant	-0.00014	-0.00183	-0.00251
	-0.034	-0.417	-0.492
R-square	0.0021	0.0031	0.0009
Prob>F	0.5504	0.3348	0.6882

* OLS regressions reported with robust standard errors
t-stats in parentheses; PCV1 = 1st pricipal component variable

All of our models in these sectors are insignificant. Additionally, though both sectors pass test 1, they fail test 2 (above) for a significant difference between state variables. Hence we cannot draw conclusions from our results. As it happens there are no conclusions to draw anyway, as none of the variables we use are significant. Our models suffer from the absence of a needs-related indicator for transport, and an unsatisfying one for communication.

Energy

Figure A3.4

Test 3: $\beta_{2m} - \beta_{1m} = \zeta S_m + \eta_1 Z_{1m} + \ldots + \eta_5 Z_{5m} + \varepsilon_m$

	Model*		
Independent Variable	I	II	III
Private Sector PCV1	-0.00464	-0.00341	-0.00468
	-1.283	-1.794	-2.311
Project Planning PCV1	-0.01206	-0.01148	-0.01188
	-1.696	-1.681	-1.729
Civil Institutions PCV1	0.00191		
	0.422		
Training & Capacity Building PCV1		-0.00133	
		-0.21	
Information Technology PCV1			0.00863
			1.466
% Population w/out Electricity	-0.00026	-0.00025	-5.8E-05
	-0.802	-0.859	-0.273
_constant	0.01539	0.01511	0.00018
	0.895	1.01	0.016
R-square	0.0131	0.0128	0.0170
Prob>F	0.0357	0.0452	0.0798

* OLS regressions reported with robust standard errors
t-stats in parentheses; PCV1 = 1st pricipal component variable

Investment in energy did not change significantly before and after decentralization, as we saw above, and hence this model is included here for the sake of completeness. Our variable of need, the share of population without electricity, is not significant in any of our models. Participative planning methodologies are significant, and negative, suggesting that the use of such processes led to a decrease in post-decentralization investment in energy. The private sector is significant and negative in two models and insignificant in the third, implying that this result is sensitive to specification. Civil institutions, IT and local training activities are insignificant in all the models. But in sum we make no claims about energy investment.

Bibliography

Andersson, A., Harsman, B., Quigley, J., eds. *Government for the Future: Unification, Fragmentation and Regionalism.* Contributions to Economic Analysis, vol. 238. Amsterdam; New York and Oxford: Elsevier Science, North-Holland, 1997.

Atkinson, A.B. & J.E. Stiglitz, *Lectures on Public Economics,* London: McGraw-Hill, 1980

Bardhan, P. and D. Mookherjee, "Expenditure Decentralization and the Delivery of Public Services in Developing Countries," Working Paper No. C98-104, Center for International and Development Economics Research, Berkeley, 1998.

Bennet, R.J., *Decentralization: Local Governments and Markets*, Clarendon Press, 1990.

Bennet, R.J., *Developments in Decentralization to Local Governments and Markets: Recent Experiences in OECD, Former Communist and Developing Countries*, UN UP 1993.

Bergstrom, T. and R. Goodman, "Private Demand for Public Goods," *American Economic Review,* 1973.

Besley, T. and A. Case, "Does Electoral Accountability Affect Economic Policy Choices? Evidence from Gubernatorial Term Limits," *Quarterly Journal of Economics*, 110, 1995.

Besley, T. and A. Case, "Incumbent Behavior: Vote-Seeking, Tax-Setting, and Yardstick Competition," *American Economic Review*, 85, 1995.

Besley, T. and S. Coate, "Centralized versus Decentralized Provision of Local Public Goods: A Political Economy Analysis," NBER Working Paper No.W7084, 1999.

Besley, T., and S. Coate, "Public Provision of Private Goods and the Redistribution of Income," *American Economic Review*, 77, 1991.

Besley, T., and S. Coate, "An Economic Model of Representative Democracy," 1995, manuscript.

Besley, T. and S. Coate, "Efficient Policy Choice in a Representative Democracy: A Dynamic Analysis," Working Paper: 95/10, Center for Analytic Research in Economics and Social Science (CARESS), University of Pennsylvania, 1995.

Besley, T., and S. Coate, "Legislative Elections With Citizen Candidates," manuscript.

Cheema, G.S. and D. Rondinelli, *Decentralization and Development: Policy Implementation in Developing Countries,* Beverly Hills; London: Sage Publications, 1983.

Coase, R., 1960, "The Problem of Social Cost," *Journal of Law and Economics*, 3, Oct, 1-44.

Crook, R.C. and A.S.Sverrisson, *To What Extent Can Decentralized Forms of Government Enhance the Development of Pro-Poor Policies and Improve Poverty-Alleviation Outcomes?,* typescript, 1999.

Downs, A., *An Economic Theory of Democracy,* New York: Harper and Row, 1957.

Dunkerley, J. *Rebellion in the Veins: Political Struggle in Bolivia, 1952-82.* London : Verso, 1984.

Dunkerley, J. *Political Transition and Economic Stabilization : Bolivia, 1982-1989* London: Institute of Latin American Studies, 1990.

Faguet, J.P., "Institutions, Political Competition and Local Government Decision-Making: Decentralization and the Provision of Public Services in Bolivia" (Paper 2), manuscript, 2000a

Faguet, J.P., "The Micro-Political Foundations of Local Government in Nine Bolivian .Municipalities: Organizations, Social Heterogeneity and the Control of Public Resources" (Paper 3), manuscript, 2000b.

Faguet, J.P., *Decentralizing the Provision of Public Services in Bolivia: Institutions, Political Competition and the Effectiveness of Local Government*, manuscript, 2000c.

Greene, W. *Econometric Analysis*. Upper Saddle River : Prentice Hall, 1997.

Heckman, J. and J. Snyder, "Linear Probability Models of the Demand for Attributes With An Empirical Application to Estimating the Preferences of Legislators," *RAND Journal of Economics,* Vol.28, No.0 (1997), pp.S142-S189.

Jackson, J.E., *A User's Guide to Principal Components*, New York: John Wiley & Sons, 1991.

Klein, H. *Historia de Bolivia.*. La Paz: Libreria-Editorial Juventud, 1993.

Lea Plaza, M., interview, La Paz, 29 September, 1997. Mr Lea Plaza was then Director of Participative Planning in the National Secretariat of Popular Participation, Ministry of Human Development.

Ley de Participación Popular, Reglamento de las Organizaciones Territoriales de Base, Secretaría Nacional de Participación Popular, Ministerio de Desarrollo Sostenible y Medio Ambiente, La Paz, 1994.

Maddala, G. S., *Econometrics.* New York, London : McGraw-Hill, 1977.

Manor, J., *The Political Economy of Democratic Decentralization,* Washington, D.C.: The World Bank, 1999.

Mueller, D., *Public Choice II,* Cambridge: Cambridge University Press, 1989.

Oates, W., *Fiscal Federalism,* Harcourt Brace: New York, 1972.

Persson, T. and G. Tabellini, "Federal Fiscal Constitutions: Risk Sharing and Redistribution," *Journal of Political Economy,* 1996, vol. 104, no.5: 979-1009.

Persson, T., G. Roland and G.Tabellini, "Separation of Powers and Political Accountability," Working Paper No.136, Center for Economic Studies, University of Munich, 1997.

Rondinelli, D., "Government Decentralization in Comparative Perspective: Theory and Practice in Developing Countries," *International Review of Administrative Science*, 47(2), 1981.

Rondinelli, D., G.S. Cheema, and J. Nellis, *Decentralization in Developing Countries: A Review of Recent Experience*, World Bank Staff Working Papers No.581, 1984.

Rubinfeld, D., "The Economics of the Local Public Sector," chapter in *Handbook of Public Economics*, Auerbach, A., and M. Feldstein, eds, Oxford: North-Holland, 1987.

Rubinfeld, D., P. Shapiro and J. Roberts, "Tiebout Bias and the Demand for Local Public Schooling," *Review of Economics and Statistics*, 69(3), August 1987, pages 426-37.

Seabright, P., "Accountability and Decentralization in Government: An Incomplete Contracts Model," 1995, mimeo.

Smith, B.C., *Decentralization: The Territorial Dimension of the State,* London: George Allen & Unwin, 1985.

Tiebout, C.M., "A Pure Theory of Local Expenditures," *Journal of Political Economy,* 64, 416-424.

van Zyl, Johan, Analyzing Capacity of Local Government: A Case Study of Municipalities in North East Brazil, The World Bank, 1995.

Varian, H., *Microeconomic Analysis* (Third Edition) New York: W.W.Norton & Co., Inc., 1992.

Veira, 1967, in Rondinelli, D., G.S. Cheema, and J. Nellis, *Decentralization in Developing Countries: A Review of Recent Experience*, World Bank Staff Working Papers No.581, 1984.

Williamson, O., *Institutions and Economic Organization: The Governance Perspective*, Annual Bank Conference on Development Economics Paper, The World Bank, 1994.