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Decentralized Structures for Providing Roads

A Cross-Country Comparison

Frannie Humplick

Azadeh Moini-Araghi

Decentralizing the responsibility for roads costs more at first, mostly through losses in economies of scale. But those losses may be outweighed by increases in efficiency when the locus of roadwork is closer to the people.

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Summary findings

Minimizing costs is often cited as essential for optimizing service delivery. Roads are the oldest, most important infrastructure services provided by governments. They require construction, rehabilitation, maintenance, and administration (planning, selection, and management). Various institutional arrangements — including the structure of decentralization — affect the degree to which costs can be minimized.

Drawing on analyses of experiences with decentralized road provision in eight countries, a longitudinal analysis (over 25 years) of change in the Republic of Korea, and vertical and horizontal analysis across states and local governments in Germany, Humplick and Moini-Araghi found that the impact of decentralization varies depending on which aspect one is considering: the efficiency of producing road services or the impact on road users.

Resource costs — the cost of providing roads (\$/km) — are concave, increasing first and decreasing at later stages of decentralization. Preference costs — the costs to road users as a result of bad roads — are downward sloping, suggesting that road conditions improve as decentralization advances.

In short, decentralization entails initial costs, mostly as losses in economies of scale. But those losses can be

outweighed by increases in efficiency when the locus of roadwork is closer to the people.

The advantages or limitations of decentralization are function-specific:

- Maintenance functions are best provided locally. If both resource and preference costs are considered, local government should have more than 40 but less than 70 percent of fiscal responsibility. If only resource cost efficiencies are considered, there should be complete decentralization.

- To minimize resource costs, construction should be either completely centralized or completely decentralized. The efficiency of construction is more sensitive to the degree of competition in award contracts than to the degree of decentralization.

- Administrative activities are more efficiently provided by local units similar to local maintenance units. At early stages of decentralization, it is more costly to administer a growing number of road agents, making the optimal level more than 50 percent but less than 80 percent local fiscal responsibility.

Exceptions to these results include the United States, where nearly all road functions are decentralized and operate efficiently.

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1. Introduction

Determinants of Optimal Decentralization

Cost minimization is often quoted as a necessary condition for optimization of service delivery. The costs associated with service delivery can be divided into two components based on the distinction between resource costs and social or preference costs. *Resource costs* are activity specific resource requirements for production and provision of services. They include all the direct and indirect inputs required for delivering services. *Preference costs* entail the service quality or conditions affecting the demand for services by beneficiaries. Roads are one of the oldest and most important infrastructure services provided by governments. There are various activities required for provision of road services. These range from construction, rehabilitation and maintenance to administrative activities, the latter encompasses all planning, selection and management activities. The resource requirements for each activity result in respective costs. Preference costs are associated with the road users, whose perception of reliability of road services and their quality is an important determinant of demand for road services and ultimately their optimal supply.

Empirical evidence shows that various institutional arrangements, mainly the structure of decentralization, affects the degree to which the two cost categories are minimized. There are various forms and degrees of decentralization that can be distinguished. Decentralization can be fiscal, functional, or spatial. Fiscal decentralization involves the transfer of expenditure- and/or resource generation authorities to lower levels of government. As for functional decentralization, Rondinelli and Cheema (1983) provide a neat definition, distinguishing between major forms of functional decentralization, mainly devolution, deconcentration and delegation.³ Decentralization can also be spatial and relate to the horizontal division of powers among various levels of government. In that case it serves as a measure of the depth of decentralization. For example, in Germany the horizontal allocation of responsibilities to local governments varies from state to state with some states allocating powers to some 1500 local governments, whereas, others have transferred responsibilities to a much smaller number of local governments.

For the case of roads, we can also distinguish between three forms of decentralized service provision, functional, fiscal and spatial decentralization. Quite broadly, three main responsibilities or *functions*--construction, maintenance and administrative works--can be distinguished where different levels of government are *fiscally* responsible for appropriate

³ Devolution involves the transfer of functions or decision-making authority to legally incorporated local governments, such as states, provinces or municipalities. Delegation involves the transfer of functions to regional or functional development authorities, parastatal organizations, or special project implementation units that often operate free of central government regulations and act as an agent of state in performing prescribed functions with the ultimate responsibility remaining with central government. Deconcentration involves the transfer of functions within the central government hierarchy through the shifting of workload from the central government to field offices, and the shifting of responsibilities to local, administrative units that are part of the central government structure.

expenditure authority. In other words, lower levels of government may be responsible for spending on construction, maintenance and/or administrative works. The distribution of responsibility across functions is functional decentralization, while the distribution across expenditure and resource generation responsibilities is fiscal decentralization. The number of persons served by a given level of government or the number of governments by economic output (GDP) is a measure of the *spatial* extent of decentralization.

The degree of decentralization is associated with the relative share that a unit of government assumes in service provision. The extent to which service delivery is decentralized or centralized in a given country can be related to three factors: a) the relative importance attached to various societal and governmental objectives, mainly equity and efficiency objectives; b) degree of mobility, and c) service characteristics. A country whose overriding objective is equity and harmonization of living conditions will, for example, be more centralized than one where there is emphasis on resource efficiency objectives. The *degree of mobility* also affects the extent to which service delivery is decentralized. The less people move from one jurisdiction to another, the higher the reliance on central government authorities for regulating service quantity and quality standards, for equity reasons. Other cases requiring a central government role is when increased degrees of mobility result in increased inter-jurisdictional spillover effects.

Further, the structure of decentralization varies with the specific characteristics of the service. For the case of roads, it is mainly the *technical characteristics* of roads and the *diversity of demand* that determine the provision outcome. Construction services, for example, require heavy equipment and machinery and lump-sum and large resource allocations, whereas, maintenance operations are more labor-intensive and require in general fewer resources but more periodically. This implies that larger units of government may be in a better position to finance construction services since they possess economies of scale in production of large-scale projects. For maintenance works, recent empirical evidence has shown that there are gains to be made from decentralizing maintenance activities (Humplick and Estache, 1995).

Diversity of demand is another factor affecting the degree of decentralization. Demand varies depending on the role required from the service by service users. For example, a farmer who uses a road for moving his produce from one location to another has a different expectation from the road than a local user who uses the road occasionally to get access to other services. Demand also varies with the provisional structure, regional and socio-economic characteristics of a jurisdiction, and the overall profile of the government and its surrounding environment.

Objectives

This paper aims at investigating through a set of case studies, whether an optimal structure for provision of roads exists. The analysis is based on a two-dimensional provision structure, mainly a combination of fiscal and functional forms and degrees of decentralization. The study is unique in its attempt to develop a conceptual framework for

understanding both the influencing factors (institutional and economic) of the structure of decentralization for the road sector and for evaluating empirically the impact of decentralization on road service delivery. The study is also interesting in that it makes a distinction between the three types of road activities mentioned earlier and the desirability of decentralizing their provision.

Outline of the Paper

The paper is organized as follows. Section two introduces the general and extended theoretical frameworks of the study. Section three provides a framework for the analysis of the optimal structure of road service provision. Section four presents the data set that will be used for the analysis. Section five studies the relationship between decentralization and road service delivery. It discusses the impact of decentralization on road performance for various activities. Further, it looks at the dynamics of decentralization for eight countries that have varying degrees of fiscal and functional decentralization for road works. This provides an understanding of the forces that derive decentralization and the potential tradeoffs that governments can make to reach optimal road service levels. The sixth section is a longitudinal analysis of the road provision experience of Korea. Korea has been selected because of its rich experience with decentralization in the road sector. Section seven presents the findings from a case study conducted for Germany. The analysis in this section is different in that it develops both vertical and horizontal measures of decentralization. Finally, based on the analysis conducted in sections three to seven, section eighth will attempt to develop guidelines for optimal provision of road services for various road activities.

2. Theoretical Framework

General

Governments have complex structures both horizontally in terms of numerous agents and vertically in terms of different levels of government. In many developing countries, the trend in recent years has been towards increasing decentralization in the direction of granting more authority to lower levels of government. Most interestingly, new levels of government have emerged to address the difficulties faced by central governments. The question of which level of government is the appropriate or desirable provider of local public services has received some attention in the literature on decentralization and local finance. This section reviews that branch of the literature that provides some useful insights into the determination of proper levels of government for provision of local goods.

Public Finance Treatment of Decentralization

The fiscal federalism literature has developed very useful guidelines for the assignment of fiscal functions to various levels of government. Musgrave in the Theory

of Public Finance (1959) saw the heart of “Fiscal Federalism” to be in the Allocation Branch. He argued that it is in the tailoring of outputs of local public goods to the particular tastes and circumstances of different jurisdictions that the real gains from decentralization are to be realized. This takes its sharpest form in the Tiebout model (1956) of local finance where individuals move and “shop” among jurisdictions offering alternative levels of output of local public goods. Oates, however, finds that the mobility of consumers is by no means necessary for decentralized provision of local public goods. Even in the complete absence of mobility there will exist welfare gains from varying local outputs matched with local tastes and costs. The tailoring of outputs to local circumstances will produce higher levels of well-being than a centralized decision to provide some uniform level of outputs across all jurisdictions [See Oates (1972, p.35) on the “Decentralization Theorem”]. Furthermore, such gains do not depend on the mobility across jurisdictions or any other external effects.

Expanding on the “Decentralization Theorem”, Oates (1972) sees the problem of selecting the proper level of decentralization for provision of local public goods as a tradeoff between increased cost-savings from joint provision by central government versus the greater welfare from more responsive levels of provision by local governments. In his model, the following factors are important determinants of centralized versus decentralized provision of a good: i) the technical character of the good (it is argued that the central government possesses economies of scale in large-scale production and provision of certain goods and therefore is a better provider) and ii) the diversity in individual demands for the good (Oates, 1972: 45). If there are wide differences in individual preferences for the public good, one may expect large differences in desired levels of provision among various areas. In such cases the potential losses from centralized provision of the good are large, therefore, decentralized provision is preferred.

While the models of fiscal federalism provide very useful conceptual guidelines for the analysis of the problem of decentralization, they have been subject to lively debate and a wide range of proposals. Tresh (1981), for example, argues that Oates “Decentralization Theorem” is a theory of second-best because the central government is forced to offer equal service levels to all people. Others have argued that these models do not attempt to understand the real choices that drive public sector and institutional decision making processes (Biehl, 1994, Brennan and Buchanan, 1980). No account is taken of costs to collective decision-making, costs incurred while setting up new levels of governments or the costs of management.

For the specific case of roads, both the technical character and mobility are important determinants of supply. The technical character affects the production of roads, whereas, road user characteristics influence the provision outcome. Road users can be divided into two categories: the first include local users such as those who live in the jurisdiction under consideration and who drive on roads and move goods and people from one place to another. They are the beneficiaries who demand that enough roads exist for them to go everywhere they want within the jurisdiction and who would like roads to be

reliable (no congestion or seasonal failures, wide lanes) and in good quality (primarily paved), to minimize vehicle operating costs to make traveling more comfortable. The second group of users include transit users (national or international), whose economic activity depends primarily on roads. Generally, transit users depend on the road network because they are moving inputs to the production plant or for taking products to other locations in the domestic or foreign markets. Similar to local users, transit users are interested in the state of road services.

The two kinds of road users differ in the degree to which they express their demand for reliability and better road quality and in turn the level of government that is most responsive to their demands. Road users' responses can be framed using Hirschman's (1970) exit, voice and loyalty concepts, which has been extended by Humplick (1991) to develop a general framework of analysis of demand for infrastructure reliability. Local users can generally be characterized by their tolerance of the existing road conditions. They are considered as captives or loyal to the road system in their jurisdiction. As unreliability increases, an increasing number of "captive users" respond by changing the nature of their activities. For example, a firm that is dissatisfied with the road system, may reduce its output, hire less labor or for the case of agricultural goods, switch its production to other products. Local users can also substitute to adopt more costly alternatives such as purchasing a vehicle that responds better to prevailing levels of quality. Most often, these users express demand for better quality and reliability using the voice option in their jurisdictions; voting is a powerful instrument which induces local officials to respond to the demands of local users.

Transit users, on the other hand, are characterized by their high degree of mobility.⁴ They can express their preference for road reliability through switching activities, participating in financing of services or more realistically exiting to other jurisdictions and choosing alternative road services. Due to their high mobility, transit users can use relocation as a response to insufficient availability and adequacy of the road system. Transit users differ from local users in that they get their voice heard primarily through the central government, whereas, local users get local government representatives on their side to fulfill their demands.

Public Choice Theory and Decentralization

There is another branch of the literature in economics, embedded in the theory of collective choice that provides some insight into this issue. Buchanan and Tullock (1962) in Calculus of Consent, propose also a purely individualist definition of the public sector and specify a double cost model to provide economic arguments for and against decentralized provision (referred to as decision-making choices). Briefly, Buchanan and

⁴ Zambia is a good example of a transit jurisdiction. The country is landlocked and people from neighboring countries rely on Zambian road services for transportation of goods and services. Reliability of Zambian road services is a critical factor affecting travel distance and timing of transport. Zambian road services have deteriorated enormously over the past decade, as a result, transit users have expressed willingness to participate in financing of road betterment in that country.

Tullock argue that whether decentralization is a preferred option for provision of a good depends on the decision-making rule that is to prevail in collective choice-making. For a given activity, the optimal decision-making rule consists of minimizing the present value of expected resource costs (these are costs involved in a decision-making process) and external costs (costs borne because of negative impact that others decisions have on an individual)⁵ (Buchanan and Tullock, 1962:75).

Since its development, the model has been extended for application to various issues. Biehl (1994), for example, applied an extended version of the double cost model as a reference scheme to determination of optimal federal constitutional structures. In his model, resource costs reflect efficiency criteria and external costs, which he redefines as preference cost, reflect equity criteria. The efficiency and equity objectives are seen as a tradeoff between resource costs compared with preference costs. His analysis suggests that neither complete centralization nor decentralization is an optimal solution for a federal government structure. Of particular interest is his conclusion that differences between various federal governments are determined by the relative importance attributed to the two cost objectives. In unitary governments, resource costs dominate in the decision of optimal degree of decentralization, whereas in highly decentralized governments, preference costs dominate (Biehl, 1994). Although Biehl's approach is very interesting, it is limited to a positive determination of optimal choice of rules for fiscal federalism.

We find the Buchanan and Tullock cost approach most useful for studying empirically the link between decentralization and efficacy with which the delivery of services is performed. The model can be readily adapted to address two issues: a) to determine desired levels of decentralization for delivery of road services and b) to explain the factors that influence decentralization of roads delivery. The next section presents the extended model with a specific application to roads.

The Double-Cost Approach to Decentralization of Road Service Provision

What follows is a presentation of the conceptual framework which has been developed to analyze the links between decentralization and road service delivery. First, in considering the decentralization of roads, it is important to distinguish between various types of decentralization. Depending on the technology and type of resources used in road works, different entities may be suited for the proper assignment of responsibilities. In this respect, three different types of decentralization may be distinguished: a) decentralization of construction, which requires heavy equipment and machinery and lumpsum and large resource allocations; b) decentralization of maintenance operations, which may be labor based or equipment based but require in general fewer resources periodically; and c) administrative decentralization which may serve as a measure of

⁵ The higher the number of those involved in decision-making, the more resources are incurred and the higher the decision-making costs.

functional decentralization, as it concerns the organization and management of road activities.

The types of decentralization defined borrow from concepts introduced in the preceding sections. The impetus for the distinction between construction and maintenance activities derives from Oates' (1972) definition of determinants of centralized versus decentralized provision of a public good; mainly the technical character of the good and the diversity in the individual preferences for the good. We argue that construction activities are more technical in nature, requiring more coordination and complex technology compared to maintenance. Hence, in the absence of possibilities for private provision through competitive contracting out, economies of scale savings may be realized if construction activities are centrally provided through force account⁶. This may be the reason why when service provision responsibilities are decentralized, more contracting out to the private sector takes place, since these lower levels of government are no longer able to realize economies of scale savings (see Lopez-Silanes et al, 1995 for empirical evidence of this effect in the United States).

Individual preferences for varying levels of road condition, however, would suggest potential savings in the form of lower costs to meet diversity of demands locally, if decentralized provision of maintenance is followed.⁷ For the case of administrative activities, according to Buchanan and Tullock (1962), we expect that the resource costs involved in decentralized decision-making processes would differ from those in more centralized ones, and would be captured by the level of decentralization of administrative functions.

In our paper, decentralization is defined in terms of how it relates to efficacy of service delivery or performance. As a measure of performance, we employ the extended double cost approach. We distinguish between two categories of costs: i) *resource costs*, which are simply the costs of provision, administration, and management of roads (input costs); and ii) *preference costs*, which are defined as costs incurred because of insensitivity to local demand for road services. In line with economic theory, a suitable social objective is to minimize total cost, which is the sum of preference costs and resource costs. We recognize that differing *levels of effort* can be applied to achieve the same level of service delivery.⁸

3. Framework of Analysis

⁶ When construction activities are contracted out to the private sector, there is still the question of managing the contracts which requires capacity and skills in procurement and supervision of civil works which may be better provided centrally in some cases.

⁷ Exceptions include for the case of roads, transit users and their demands as well as externalities (air pollution, damage, etc.)

⁸ This term is borrowed from economics of the firm, where it is defined as the degree of attention paid by a manager to reduce costs or improve performance (see, Laffont and Tirole, 1993 p.168).

The relationship between decentralization and road performance can be introduced graphically. Figure 1 shows how theory postulates that preference and resource costs behave at different levels of decentralization.

Resource costs increase initially then decline at higher levels of decentralization after a maximum point is reached. Resource costs decline in a non-linear fashion (convex) but they decline at a decreasing rate or even increase after a certain level of decentralization as economies of scale are lost. We draw the main justification from theory where it is argued that initially, the central government has important economies of scale in the provision of roads and the initial fragmentation of central government may result in loss of economies of scale (both administrative and technological) with a consequent increase in cost of provision, administration, management of roads (Buchanan and Tullock, 1962). However, it seems reasonable to suppose that costs increase at a decreasing rate or even start to decline as decentralization advances. Two economic arguments are put forward in support of this assumption: i) first, there may be important diseconomies of scale resulting from inefficiencies inherent in big administrative units, and ii) second, at higher levels of decentralization expenditure decisions may be tied more closely to real resource costs⁹ (Oates, 1972: 87, Hirsch, 1968: 495) and are hence expected to be lower. In this study, we explicitly test these assumptions for the case of roads.

Preference costs in theory are expected to initially decrease with increasing degrees of decentralization but increase after a certain optimal level of decentralization. The decline in preference costs is non-linear (concave) but they decline at a decreasing rate or increase after a certain level of decentralization as costs of collective decision-making increase. The expected decrease follows simply Musgrave's allocative efficiency argument that decentralized units of government are closer to the people and can better tailor the supply of roads to demand or preferences of local residents. The expected increase follows Oates diversity argument that diversity in demand is best met through decentralization. Preferences of local- and transit users and the social value associated with the production of road quality can be defined in terms of the disutility of the individual user, which we defined earlier as a preference cost.

Various levels of effort must be expended to minimize the gap between the two costs. In figure 1, at low levels of decentralization, high levels of effort are required to reduce resource and preference costs. But as the level of decentralization increases lower levels of effort are expended as it becomes easier to align the objectives of the beneficiaries to the implementation of required works. We assume that the level of effort (e) is unobserved and affected by non-quantifiables such as governmental, fiscal, and institutional structures as well as societal objectives, all of which are specific to the

⁹ This is one of the arguments that Oates (1972) put forward in favor of decentralization of provision of public goods. Assuming that higher degrees of decentralization imply greater autonomy in expenditure decision-making, he argues, local governments will operate more efficiently because local people weigh the benefits of a service versus its costs.

decision-making unit of analysis. The above presented framework allows us to study graphically the optimal structure of provision for road services. The concepts developed so far are applied in the next section.

4. Data Definition and Sources

The performance of roads is measured by the double cost concept introduced in the previous sections. Resource costs are defined in terms of unit cost of road works for the activities of construction, maintenance, and administration measured in \$ per km of road. These are essentially the input costs. A measure for preference costs is derived using a framework developed by Ben-Akiva et al (1993) where condition of roads are substituted as a proxy for users costs while utilizing roads of a given condition. Decentralization is measured in terms of percentage local government contribution towards road works.

The analysis relies on data from three main sources:

(a) cross-country and time series data on the unit costs of construction, maintenance and administration, the percent roads in bad condition (as measured by a proxy developed in the World Development Report of 1994 on Infrastructure and Development), and the contribution of local governments to financing road expenditures are obtained from the International Road Federation (IRF) statistics¹⁰ for eight countries: Argentina (1982-86), Brazil (1982-93), Colombia (1982-90), South Africa (1982-1989), Germany (1982-92), USA (1982-92), Philippines (1982-86)¹¹, and Indonesia (1982-86)¹²;

¹⁰ The quality of data from the International Road Federation may suffer from problems of precision. Many countries are unable to report with any precision the expenditures of local government units of roads since their accounting systems do not record these data directly. Therefore, most of the local government data is based on estimates. This is the main reason why we used a case study from Germany where we conducted an original data collection and verified the results with supportive field work before using the definitions of data we used in the final analysis. The cases of Germany and Korea provide qualifying evidence of the findings in the cross-country cases.

¹¹ There may be an overestimate of the length of roads pertaining to a class called "baranguay" which may overstate the importance of the class of roads at the subnational level in the case of the Philippines. To avoid the effect of classification on the results of the analysis, we use the overall network length at the national level. We expect that the incentives to over- or under-state the length of a particular category of roads to vary by country and have used a country-specific dummy in a cross-country analysis presented in a companion paper (see Humplick and Moini-Araghi, 1995).

¹² The period 1982-86 for which data for Indonesia is available is a period when there was a priority given to betterment and reconstruction of the existing main road network (arterial and collector). That is, substantial improvement in quality with little extension, and substantial external funding. In the same period, the local (district) network was extended about 100% by inclusion of low standard roads which would appear to reduce the average "quality". The analysis conducted in this study is based on the total network of arterials, collectors, and low standard roads. This could mean that the "preference costs" for Indonesia are underestimated due to the "dilution" of the quality impacts.

(b) the same data as in (a) above but focusing on the switches from centralized to decentralized provision for the case of Korea from 1968-92 from the IRF source; and

(c) data on roads disaggregated by activity at state and local government levels obtained from seven German states (Baden-Wuerttemberg, Hessen, Bayern, Niedersachsen, SchleswigHolstein, Nordrheinwestfalen, Saarland and Rheinlandpfalz). The data covers the period from 1980-1993. The state government data was provided by the Deutsche Strassen Liga, a non-governmental institute.¹³ The local government data was collected from the yearly Finanz Bericht and from interviews with road experts and officials in seven states.

In addition, technical experts at the World Bank and in Germany were contacted and interviewed to obtain additional information.

From the first data set we can investigate the relative impact of fiscal decentralization across the three main road functions, giving an indication of the optimal fiscal-functional allocation of responsibilities. With the second data set, we can measure the specific contribution of changes in degrees of decentralization across time, as we are looking at one country which has changed the relative shares of local government contributions to road expenditures. The third data set allows us to conduct a two level (horizontal and vertical) analysis of the impact of decentralization on road performance in addition to the functional and fiscal analysis possible with the first and second data sets, as well as a spatial analysis. The measures of decentralization differ depending on the level of analysis. At the horizontal level, the analysis takes the number of local governments per capita GDP to measure spatial decentralization. At the vertical level, decentralization is measured through the conventional variable percentage local government spending versus central government expenditure. This analysis is limited to measuring performance in terms of resource cost efficiency. An analysis of performance with respect to preference costs measured as is not possible since almost all roads are paved and an inventory of road quality is only conducted in only two out of the seven states.

5. Country Case Studies

Empirical analysis of the optimal structure for decentralized provision of roads suggests that the impact of fiscal decentralization on road performance is partially driven by country specific factors (see a companion paper by Humplick and Moini-Araghi, 1995). But these country effects are generally fixed and unobservable. In this paper, we

¹³ The Deutsche Strassenliga brings together professionals working in different areas on roads. Members come mainly from the private sector but the agency is in close cooperation with the state and federal governments. It promotes the development of roads in Germany.

employ the above introduced double-cost approach, adapted to capture the some of the country-specificity's as weights attached to resource and preference costs to provide a discussion of the decentralization experience in the eight countries mentioned above. These countries were selected because of their diverse decentralization experience in the road sector. Road financing and delivery remains centralized in some of these countries, whereas, in others, the functional and fiscal responsibility is decentralized.

Employing the estimated results from a cross-country panel data (taken from Humplick and Moini-Araghi, 1995) we can get the average relationship between decentralization and performance by road activity. Further, overlaying simply the country specific data obtained from the cross country sample to the general graph allows us to conduct a comparative study of proper levels of decentralization and performance for the above mentioned countries. We obtain two points for each country, one reflecting resource costs and the other preference costs; each of the points represents country specific levels of performance and decentralization. For each country, our inquiry looks into the following issues: i) what is the level of decentralization and performance? ii) what is the variation in performance, measured in terms of deviation of preference and resource costs from the estimated value and what are the factors driving cross country variations in observed levels of effort? iii) for those countries where the level of variation is high, what would be required to minimize resource and preference costs?

The expended level of effort varies from country to country depending on the weight attached to preference and resource costs in that country. The weighting procedure is driven by the objective to operate efficiently and to satisfy beneficiaries' demand. Moreover, the ability and willingness of governments to fulfill the desired standards and objectives that are demanded from the road network is a function of the available resources, financial and institutional arrangements (whether expenditures are financed from own-source revenues or from transfers, whether these are ear-marked or not), implementation capacity, as well as fiscal and political attitudes in a given country. Actual levels of effort expended to maximize performance can thus be viewed as the result of the above factors, which by no means are independent of each other.

Quite broadly, the interdependence of these factors can be shown through the following examples. In a country where road operations are fiscally decentralized and there is no ear-marking of transfers, beneficiaries are not very clear about the opportunity cost of production of road quality since spending is not tied to road works. There is essentially only a loose link between quality of road services and its price. The extent to which preference and/or resource costs are minimized is dependent on local factors such as the incentive structure provided to local governments, degree of accountability and involvement of beneficiaries, system of preferences and values, etc. In fact, this is why we see that decentralization is good for maintenance activities; when people jointly determine their preference and resource costs. A country that is decentralized functionally but not fiscally focuses primarily on minimization of preference costs. The beneficiaries are unaware and do not care about efficiency objectives. In contrast, a country that is both functionally and fiscally decentralized and uses ear-marking of road

charges, voters are highly aware of both resource and preference costs. Fiscal decentralization with ear-marking essentially means that taxes are benefit levies. Increasing the quantity of production of road quality will result in a higher ear-marked tax bill, making the opportunity cost of road services much clearer to the voter. The country studies in the next section allow us to gain a better understanding of these issues.

Decentralization of Construction Expenditures

Figure 2(a) shows the relationship between decentralization of construction expenditures and performance as obtained from the data set described in section 4. On the ordinate we have the countries in increasing degrees of decentralization of construction in terms of percentage local government expenditure for road construction. On the abscissa, we measure performance in terms of preference costs¹⁴, defined as the cost of roads in bad condition (roads not paved (million \$/km)) and resource costs, defined as unit cost of construction (expenditure on construction per km (million \$/km)). In figure 2(b) we present the same costs normalized by GNP per capita to adjust for differences in technology. The determination of the proper level of decentralization for construction of roads involves minimizing total cost of provision, expressed as the sum of preference and resource costs for a given level of effort.

A first look at the graph shows that there are multiple-equilibria of decentralization, as countries attain different levels of unit costs with increasing degrees of decentralization. The countries selected in the case study in figures 2(a) and (b) fall into four categories. Brazil, the Philippines and Indonesia¹⁵ are all centralized with regard to financing of their road construction operations falling under the category [0-10] percent decentralization; Argentina, Colombia and Germany are more decentralized with the central government and local governments sharing the fiscal responsibility for construction activities. Moving further to the right, in South Africa, financing of construction works is with local governments at [70-90] percent decentralization. Finally, the USA is the most decentralized of all countries. Counties and townships and state governments are almost 100 percent responsible for financing of construction activities in their jurisdictions.

¹⁴ Quality of roads is used as a proxy for preference costs and quality is further interpreted as paved roads. The expenditure data is separated into three activities: construction, maintenance and administration. It was assumed that, the three activities would contribute differently to preference costs and that the actual effect is latent and hence unobservable. Furthermore, preference costs are assumed to be related to user savings due to better quality roads. Quality of roads has been transformed into costs using a latent variable model specification where the indicator of quality is related to the three expenditure categories to get the separate effect of the three activities on preference costs. For more detail on the ability to relate indicators of quality to user costs using a latent variable model specification see Ben-Akiva and Gopinath (1995)

¹⁵ The analysis was performed on a panel data set. The years for which data is available may not be totally representative of the current situation in these countries.

Table 1 shows a comparative view of performance by various cost categories, in both normalized and non-normalized terms. Indonesia stands out in its performance, before normalization, in terms of very low unit costs of construction and low costs to users as a result of improved road conditions (see also figure 2(a)). However after normalizing by GNP per capita to control for differences in technology (as in figure 2(b)), we see that the best performer is the USA followed by Germany, Argentina, Brazil, and South Africa, respectively.

At [0-10] percent decentralization, Brazil is quite a good performer with respect to resource costs which are far below the rest of the countries in the case study. This is not the case with respect to preference costs which are higher than Indonesia and the Philippines at the same level of decentralization. Such an outcome is a reflection of Brazil's experience with restructuring of the construction sector throughout the 1980s. For a very long time, financing of road construction was centralized with municipalities being excluded from participating in the name of centralism; national coordination objectives and economy-of-scale gains. The government introduced administrative and fiscal decentralization measures in the mid 1980s to transfer responsibilities for construction to municipalities and to increase resources and expenditures at the state and municipality levels. But evidence shows that the provinces and municipalities have been quite reluctant and slow at adjusting to their new roles due to their highly centralized organization and lack of resources (World Bank, 1993). The high preference costs in Brazil indicate that road users are paying for this lack of capacity and interest at the local level in terms of roads in bad condition.

While Indonesia is not as good a performer as Brazil in terms of resource costs, it is better with respect to preference costs. The superior performance of Indonesia with respect to preference costs relative to Brazil and the Philippines may be attributed to centralization of fiscal authority which has traditionally been fostered with the argument that it preserves national unity and promotes efficiency. Works on road construction are funded entirely by the central government through grants and shared revenues. In addition, the central government is heavily involved in planning, and implementation of road construction programs. Central government's interference in road construction activities has been questioned by many in practice, however, our analysis suggests that these criticisms may not have foundation, when looking at countries with similar levels of decentralization. The criticism holds, however, when compared to countries at different levels of decentralization where it appears that the benefits that the central government can attain in economies of scale in production of roads are not as high as those due to increased efficiency with decentralized provision as in the case of Argentina.

The Philippines produce road services at a lower level of efficiency than expected at [0-10] percent decentralization. Resource costs are as low as in Argentina (after normalizing by per capita GNP), implying low unit costs of construction, but preference costs are higher than Indonesia also at [0-10] degrees of decentralization and Argentina at a much higher level of decentralization. In the Philippines, the central government finances road construction operations from general grants, maintaining tight control over

expenditures while taking advantage of economies of scale in conducting construction works. These results give credence to the argument that they are differing levels of effort, at the same level of decentralization, to reduce resource and preference costs.

Argentina is more efficient than Colombia even after normalizing by per capita GNP. Colombia's seemingly worse performance is surprising, especially considering its unique "contract" approach towards decentralization, which accommodates flexibly local conditions and diversity of implementing and financing of construction works. Road construction in Colombia is the functional responsibility of departments although most of the financing comes from the national budget. But just how construction works are financed and carried out varies from department to department, perhaps resulting in a loss in economies of scale as evidenced by the poorer performance compared to Argentina. Each area can make specific arrangements with accordance to their financial and institutional capacity and interests. In the coffee-growing region, for example, the quasi-public Federation of Coffee Growers plays an important role in shaping and financing rural development policy in terms of building roads and making infrastructure investments (Bird, 1995). In some of the oil-producing regions, the state oil company, Ecopetrol, plays a similar role in helping municipalities put their royalty income towards construction activities. In some of the better-run departments, such as Antioquia and Valle, the departmental government itself takes on the major responsibility for construction activities. In others, some of the coastal provinces, the regional offices of national agencies play a more important role. There seems to be much lower level of effort in Colombia than in Argentina and Indonesia, as there is a wider gap between resource and preference costs than in the comparator countries. It may be that since most of the financing still comes from the national budget that functional and fiscal responsibilities are not well aligned.

At [50-69] percent decentralization, Germany's performance deviates the most from the other seven countries in terms of non-normalized costs in the performance ranking (see table 1). However, at the comparable level of decentralization after normalizing for technological differences, it performs better than Argentina and Colombia. Its road condition is very good but interestingly enough satisfaction of preferences is achieved at high unit costs. This outcome reflects a unique feature of German governmental objectives, the traditional tradeoff between the guarantee of autonomy and efficiency versus the objective of safeguarding the unity of living conditions throughout the German territory. In the road sector, the federal government provides a degree of uniformity of living conditions by requiring uniform road condition standards in the country. This is mainly achieved through federal government transfer of funds (GFVG funds), ear-marked specifically towards construction activities. However, since these funds are fixed and their allocation is independent of level of performance, local governments do not have any incentive to operate cost efficiently. To reduce unit costs of construction, the government could consider untying the GFVG funds, rendering

them more flexible as to allow local governments to establish service levels that reflect actual demand.¹⁶

South Africa and the US both are efficient producers at very high levels of decentralization. In the United States, resource costs are very high (before normalizing for technology) but preference costs are lower than the mean level. The responsibility for construction works rests with counties, local governments and townships. With the loss of Federal funds (GRS funds), local governments are faced with major adjustments. They have to fund construction works essentially from already limited internal revenues, generally from shared motor fuel tax receipts and license fees from state governments, property tax revenues and appropriations from the general fund of local governments. Faced with these budgetary constraints, local governments seem to have improved their delivery of road services, as the USA is well below the cross-country average in terms of total costs of road service provision. To reduce the high level of resource costs, local governments should opt for cost reduction strategies, limiting construction service programs. To improve performance, local governments could merge into larger jurisdictions to capture back economies of scale and reduce unit costs. With the average township in the Midwest having only 40 miles of road, Walzer et al (1987) emphasized that this alternative certainly deserves attention. But a survey conducted in the Midwest showed that nearly 63 percent of the farmers thought local governments were efficient providers of road services (Walzer and McWilliams, 1989). They showed relatively strong support for managing the system via the current decentralized structures. More cooperation between townships and counties is an alternative to consolidation. Cooperation purchases of materials, sharing of specialized equipment's, and cooperation in large projects are examples of the kinds of efforts that can be considered to improve performance even further (to levels close to Germany for example).

Resource costs using the eight country experience are seen to be highly variable in the [0-50] percent decentralization range, and they decline systematically (with the exception of South Africa) as we move to the right from [50-100] degrees of decentralization, as seen in figure 2(b). This result is in line with Oates' hypothesis that initially the central government has economies of scale in managing the financing of construction works (perhaps as observed in more efficient centralized procurement and supervision systems) and that greater decentralization results at the beginning in loss of economies of scale resulting in cost increases. The observed declining of costs corroborates Oates' contention that there may be a switch in the resource cost curve. As for the preference costs curve, there is evidence for a downward slope, which implies an improvement in the condition of roads with increasing degrees of decentralization. But as we move to the right on the graph road condition worsens (as in the case of Colombia) and then improves again. Following Biehl's (1994) diversity argument, at higher levels of decentralization, local preferences may be expressed in terms of accepting poorer road

¹⁶ A more in-depth analysis of Germany's experience with decentralization and its performance in the road sector is in section seven.

conditions, which may explain the upward slope in the preference costs between Argentina and Colombia.

Of particular interest is that there is evidence for several points of inflection in the graphs in figures 2(a) and (b): Note what the various points on the curve represent. The first point, where there is complete centralization, shows quite clearly the tradeoff between resource and preference costs, with preference costs being generally high. Although unit costs of construction can be low, as in the case of Brazil, there is a high price to be paid in terms of roads in poor condition. However, there is a possibility of differing levels of effort, as Brazil and Indonesia have milder differences between each other than between them and the Philippines. The second inflexion point represents even higher levels of central government involvement in financing of construction works. At this point, somewhere between [50-60] percent decentralization, a country like Argentina is more efficient than a country like Colombia. It is interesting to see that the costs to road users as well as the cost of providing roads decrease as we move further to the right. But clearly maximum satisfaction of local preferences can solely be achieved at a very high cost, as in the case of Germany, which is a country trying to balance preference and resource costs at a high level of decentralization and has resource costs much higher than the USA which does not have this objective. Moving further to the right, in terms of increased degrees of decentralization represents various tradeoffs between low and high unit costs of construction and poor or improved road conditions.¹⁷ South Africa [77% decentralization] is a country which is not performing this balancing act very well, while the USA with 97% decentralization of construction is.

Consistent with theory, our graphical analysis, suggests that when central governments are fiscally responsible for construction activities, they may have economies of scale due to centralized management of the procurement and supervision of construction activities; however, some decentralization may be desirable to improve efficiency. Total decentralization is not always guaranteed to result in a reduction in resource costs, however, as it depends on the expended level of effort. Preference costs are the hardest to satisfy at differing levels of decentralization, with country-specific factors playing an important role in determining the achievable performance under any given structure of decentralization. There are however, more serious deviations in performance at the centralized level of provision.

Decentralization of Maintenance Expenditures

In figures 3(a) and (b) we present the results of a comparison in achievement for the eight case study countries. The ordinate measures the share of local government in

¹⁷ The possibility of multiple optima of the resource cost function in figures 2(a) and (b) may be due to the unobserved level of effort expended by the various levels of government in construction activities such as through competitive contracting of works to lower costs. The same holds for figures 3(a) and (b) and 4(a) and (b).

financing of maintenance operations. The abscissa measures performance in terms of the unit cost of maintenance in \$ per km and the cost of bad condition of roads to the users also converted to \$ per km. We overlay the concepts developed in section 2 in these figures to further demonstrate this result. A look at the two cost curves shows that there are almost no costs to decentralization of road maintenance from the road users perspectives for both the normalized (figure 3(b)) and non-normalized (figure 3(a)) costs. Preference costs decrease systematically the more decentralization advances. Resource costs are low at complete centralization for Brazil and the Philippines, but not for Indonesia. Resource costs rise at high levels of decentralization (between 30 and 50%), declining again to a value equivalent to that before decentralization. This observation supports Musgrave's allocative efficiency argument that local governments are more prone to tailor their budgets toward local preferences.

Taking preference and resource costs together, the total cost curve shows that the optimal level of decentralization for maintenance lies at two regions, between 0 and 30% and more than 80% fiscal decentralization. At these points resource costs are at their minimum and preference costs are declining. In the region to the right of 90% the savings from decentralization seem to be achieved at an increasing rate, and not at the expense of increasing preference costs (see South Africa and the USA in Table 1).

In summarizing the performance of countries in figures 3(a) and (b), we see the following: Argentina, Brazil and Philippines all are highly centralized in financing of their maintenance operations. The Philippines has the worst performance for this group of countries with resource costs well the comparator countries even after normalizing by per capita GNP. In Brazil, performance in terms of resource costs is good after normalizing by per capita GNP, but preference costs are higher than in Argentina, indicating that the road users are not getting as good road quality as in Argentina for about the same level of resource cost. To understand this outcome we need to look at Brazil's experience with decentralization. Throughout most of the 1980s, road service delivery and financial resources were concentrated in the hands of the central government but in 1988, the government initiated decentralizing financing and authority. Transferring responsibilities to municipalities and state road agencies has been a slow and resource intensive process since appropriate capacities first had to be built at these levels to establish adequate planning and maintenance operation systems (World Bank, 1994). In accord with our theoretical expectations, this has led to some cost efficiencies in Brazil, but the benefits to the users are yet to come.

The benefits of decentralized functional responsibility even in the presence of fiscal decentralization can specifically be seen in the case of Argentina. In Argentina, road maintenance operations are financed centrally, whereas, the responsibility for road maintenance works has traditionally rested with the provinces. Compared to Brazil, Argentina's long experience with functional decentralization has allowed more autonomy and resources for maintaining road networks. This explains potentially why preference costs are lower in Argentina than in Brazil, for the same level of resource costs.

Measuring performance in terms of resource cost efficiency, we find Brazil and Argentina to be better than the Philippines in producing maintenance activities at the same level of fiscal decentralization. This may be due to the differential use of contracting out within these countries. A World Bank review of nine different countries found that roads under contract were well-maintained in at least seven of them (Harral and Faiz, 1988:19). The authors concluded that “By and large contract maintenance leads to be more cost -effective than maintenance by other methods.” Evidence from Ponta Grossa in Brazil indicated that force account maintenance costs 60 percent more than that by contractors (Harral et al, 1986: 11-12). Humplick (1995) conducted an analysis of performance for maintenance in Argentina, showing that variations in performance may be determined by the level of competition, essentially the relative use of force account versus the private sector. Her study shows that “Provinces that use the private sector more substantially for maintenance works in Argentina are more efficient, allowing a large part of the network to be maintained with a fixed budget.” (Humplick, 1995). Other experience with contracting in Latin American countries confirm Humplick’s results. For example, Gyamfi and Ruan’s review of the experience of Argentina and Brazil with private contracting, shows that private contracting in Brazil has brought about adequate levels of performance, and when private contracting was completely stopped in Argentina, performance suffered substantially. Gyamfi and Ruan (1992) note, however, that a clear government agency policy and support, the existence of a capable local construction industry with sufficient road maintenance capacity and the ability of road agencies to administer and manage have been important factors for the successful adoption of private contractor systems in Brazil.¹⁸

Moving further to the right, we see that Colombia at a decentralization category of [11-49] allows its local governments more expenditure decision-making power in maintenance of roads. The provision of maintenance is at a very high cost compared to the seven other countries with the exception of Indonesia which has similar unit costs of maintenance. Preference costs are lower than in the Philippines which is fiscally centralized with respect to maintenance, but are higher than all other remaining countries in the case study. This is quite surprising because with both fiscal and functional decentralization and ear-marking of funds, expenditure decisions should theoretically be tied closely to maintenance operations, producing better road quality.¹⁹ Starting in 1983, the government in Colombia introduced decentralization measures to increase local resource mobilization. But major expenditure authority still remains with the central government (FNCV is mainly financed through central government contributions, consisting of earmarked and quasi-earmarked funds). Since 1987, Colombia has

¹⁸ The theoretical literature and practical experience with contracting is rich. For an overview of arguments for and against contracting, see Schroeder L. (1990), Managing and Financing Rural Road Maintenance in Developing Countries, Decentralization and Management Project, Associates in Rural Development.

¹⁹ This is essentially the public economics argument for earmarking, for a thorough discussion, see Mcleary, W., “Notes on the Principles and Practice of Earmarking”, prepared for a seminar titled Earmarking: Road Funds and Toll Roads, The World Bank, INUTD-PERTM, November 21-22, 1988.

introduced also functional decentralization, granting local governments increasing responsibility for planning and budgeting of roads. This negative outcome may reflect a problem that many developing countries face with ear-marking of road user charges. Especially for maintenance, Herral and Faiz (1988) find ear-marking rarely finds its way where it is supposed to and it is used inefficiently and for purposes other than maintenance. But more importantly, Colombia's poor performance may be attributed to the fact that despite the introduction of functional decentralization, municipalities remain weak institutionally and financially to carry out the assigned road maintenance operations. An alternative explanation may be that when people have the autonomy to choose both the quality and resource expenditure levels, as in Colombia, they choose lower levels of quality, preferring to expend resources for other needs. A recent World Bank local government capacity study confirms that local governments in Colombia are, in fact, facing difficulties in carrying out their new functions due to inadequate administrative or technical capacities (World Bank, 1990).

Although resource costs are high, Colombia's performance in time is improving. This is understandable when we look at Colombia's experience with production of maintenance. Throughout the 1980s Colombia provided increasing opportunities to private contractors for conducting maintenance works. In 1984, it started the micro-empresas initiative with UNDP's assistance and a review of Colombia's experience indicates that the use of micro-empresas have led to reductions in unit of maintenance by half (Gyamfi and Ruan, 1992:22). This trend is positive but better resource cost efficiency gains can be made if more contractors would be involved.

At [50-69] percent decentralization, in Germany the responsibility for road maintenance operations rests entirely with local governments. Financing comes, however, partially from the state governments government. There is no ear-marking of revenues for maintenance and expenditures are allocated from general local and state government appropriations. This means that local governments are autonomous and quite flexible in their expenditure decision-making. Considering local demands, they may see spending on road maintenance as more prestigious than new construction or spending on other services. This may explain why preference costs are far below all the other countries in the case study, reflecting, in effect, the preference expressed for higher levels of road service quality to meet the demand for other services. Such high quality levels of maintenance are achieved at a reasonable resource costs. It seems that are more incentives to operate efficiently with respect to maintenance than with respect to construction in Germany, possibly because there is no earmarking of maintenance funds and local governments finance their expenditures from state grants at their discretion.

In Indonesia, road maintenance operations are functionally and fiscally decentralized at [70-90] percent decentralization. Although the central government's share in financing of operations is high, local governments have real control over maintenance delivery, allocating expenditures independently from the central government and also financing maintenance from own-source revenues. The performance of Indonesia, while worse than that of Argentina and Brazil after

normalizing by per capita GNP, is improving over time. Accountability seems to be the key to Indonesia's improving performance. Studies show that roads are maintained cost efficiently when information (on the performance of local governments) is enhanced and when there is a sharing mechanism that makes it possible to deal with observed problems (Bird, 1994:17). One study showed that local governments involve beneficiaries in road maintenance works; for example private firms maintain roads they need to get their products to the main highway. In other instances, well-defined groups of farmers who clearly benefited from road improvements were similarly carrying out routine maintenance tasks (Bird, 1994:15). In yet another, an appropriate solution appeared to lie in the imposition of explicit user charges since most road users were willing to pay. These examples show that maintenance service levels reflecting beneficiaries' demand may be established if local authorities can exercise real control over maintenance service delivery and allocate expenditures freely.

South Africa represents a better performer than Indonesia at even a higher level of decentralization, with costs well below those of other countries in the case study except for Argentina, Germany and the USA. At very high levels of decentralization, local governments in South Africa are not as efficient in conducting road maintenance works and accounting for local demand for good road conditions.

Moving towards absolute decentralization, in the United States, performance is better than all the case study countries except Germany, after normalizing by per capita GNP. In the United States, the responsibilities for road maintenance are both functionally and fiscally decentralized with local governments having the jurisdiction to serve their areas. Our graphical analysis, directly comparing the USA to Germany, corroborates empirical evidence that roads in the United States are not in good condition after decentralization (Walzer and Chicoine, 1989:79). Furthermore, unlike the theoretical expectations that preference costs increase at extreme levels of decentralization, we see that the USA has been able to keep these costs lower than the other case study countries. This can be understood by looking at recent trends in road financing structures in the United States. Traditionally, intergovernmental aid (federal aid) has constituted a major source of revenue for state and local governments. Beginning in 1987, the federal government stopped the federal General Revenue Sharing (GRS), which was a transfer used to finance road construction and improvements. Since then, funds for road works are raised locally from general appropriations. These funds are not earmarked. This has put state and local governments in a tight budgetary position, perhaps increasing their productivity. It was predicted that the cost of bringing roads to good condition are well beyond the current fiscal capacity of most local governments. A survey conducted in 1987 indicated that bringing all roads in the system to an acceptable²⁰ performance level would cost over six times the average spending per mile by governments (Walzer et al, 1987). The actual effect has been to increase efficiency, as preference costs have not declined since 1987. A caveat is necessary at this point: some evidence suggests that

²⁰ An acceptable level in the eye of local governments is below the desired engineering performance standards but it is consistent with local demand for the service.

local governments in the United states have adopted a cost containment or cost reducing alternative, not maintaining roads and rather bringing revenues in line with service demand (Walzer et al, 1987:36). This response may show up in the future as higher preference costs as the road conditions deteriorate.

What can most clearly be depicted from the graphical discussion is that as countries become more decentralized, the level of effort to be expended on minimizing preference and resource costs declines. Brazil and the Philippines who are highly centralized have wider differences in performance than South Africa and the USA who are almost totally decentralized. Local governments in Colombia, Brazil and the Philippines need to invest more resources in meeting demand and operating cost efficiently, compared to Germany, South Africa and the USA. With fiscal (partial or total) and functional decentralization, the performance of the latter countries reflects actual demand for maintenance service levels. Further, the discussion indicates that in the presence of fiscal centralization, both functional decentralization and increased competition can improve performance. However, there is a cost to decentralization which is reflected in the presence of inferior service levels (see South Africa and Indonesia) than can be achieved at more centralized levels (such as in Argentina). The United States presents an example where performance is maximized at very high levels of decentralized maintenance, indicating that the dangers of decentralization are country specific.

Decentralization of Administration Expenditures

Similar to the above cases, we discuss the effect of decentralization of administration, defined as the fiscal share of local government in administrative works, on resource costs, measured in terms of unit cost of administration and preference costs which are the costs to users at different levels of decentralized administration. In figures 4(a) and (b), we see that the countries that are fiscally centralized such as Brazil, Indonesia, and the Philippines, have a wide range of performance with respect to the efficiency of administration. The central government seems to operate along high unit costs of administration in Indonesia and the Philippines compared to Brazil. This result is consistent with the challenging argument put forward by public choice economists that matching grants, preservation of positions and inertia can encourage governments to operate at high marginal cost (Hirsch (1968), Brennan and Buchanan (1980)). Musgrave (1959), among others, has vigorously contested this view. But what is of interest here is support of Brennan and Buchanan's claim that decentralization is an effective mechanism to control large central governments from spending too much. In fact, we see that as we move to the right, decentralization allows for decline in administrative resource costs, with the lowest unit cost, after normalizing for per capita GNP, being in Argentina, Germany and the USA, all three highly decentralized from an administrative point of

view. South Africa²¹ and Colombia stand out with very high costs of administration at high levels of decentralization.

It appears that costs increase rapidly initially, then decline at between 60 and 80% decentralization. Administrative costs increase again between 80 and 90% decentralization of administration, after which they decline rapidly indicating that it takes low levels of effort to satisfy the same level of preferences at higher levels of decentralization. Moving further towards increased degrees of decentralization, condition of roads improve systematically, however, at the expense of increased resource costs. The choice between centralization and decentralization, therefore depends on societal objectives, contingent on country specific governmental and fiscal structures. The presence of the point in which South Africa lies, suggests that there is a need for a central government role in administration and that it is rare to achieve the kind of savings that can be seen in the USA at high levels of decentralization. An argument supporting this observation has been made by Parker (1995) in recognizing the separate role of political, fiscal and functional decentralization in determining the impact on performance of a sector.

Decentralization of Administration and Cost Recovery

In this section we examine the impact of decentralizing administrative functions on cost recovery and collection of road user revenues (see figure 5). Cost recovery is defined as the share of road user charges in total revenue. While user charges increase with increasing degrees of functional decentralization, maximum cost recovery is reached when there is only a limited degree of functional decentralization. This outcome is in accord with economic theory, where it is argued that that the central government is more cost efficient and in a better position to impose and collect user charges.²² The central government has an advantage because it can impose user charges, for example, tax on gasoline and tires, at various levels, either to the wholesale distributor or at the point of manufacturing or even at the point of import. Local governments would have to impose such levies at the retail level, thereby, adding greatly to administrative costs. Similarly taxes on the sale of vehicles are probably most readily administered by the central government since it is the central government that oversees custom duties as well as records vehicle ownership.

Looking at the experience of four countries, we see that in the United States cost recovery is high at [90-100] percent decentralization. Local and state governments are responsible for the administration and collection of these road use related revenues. The basic idea is that since these levels of government are entirely responsible for serving roads in their areas, they should also have the responsibility for collection of appropriate

²¹ The political conditions that existed in South Africa at the time this data was collected have an impact on the performance outcomes observed.

²² For more on this topic, see Hyman, 1990.

financing instruments used for that purpose. States levy taxes on motor fuels and registration taxes, sale taxes, vehicle safety fees, transport tax and a number of other taxes. Similar to the USA, Argentina represents an interesting position at [50-69] degrees of decentralized administration. Cost recovery is quite high in Argentina with the federal government levying all taxes on fuel revenues. In detail, the fuel revenues are made up of a tax on registration, domestic tax on gasoline and fuel oil, and a domestic tax on all other liquid fuels.

In Germany cost recovery is very low. The most important of road user charges is the value-added tax (VAT) on vehicle acquisition, whose rate is set by the federal government. In general state and local government taxes represent “own” revenues in so far as they are collected within the respective territory. This also means that the tax collection rate is higher. VAT, however, is an instrument used by the federal government for horizontal fiscal equalization. VAT revenues are allocated 35 percent to states and 65 percent to the federal government but local governments do not receive any funds from the VAT revenues. This can explain lower cost recovery levels in Germany compared to the USA and Argentina. To address this issue, currently there is debate in Germany to do away with the local government business tax and replace it with VAT for local governments.

6. Case of Korea

Next we conduct a longitudinal analysis, examining the Korean experience in fiscal and functional decentralization of its road sector from 1968-1992. The main idea is to test the double cost model adapted for the fixed country effect to see whether the Korean experience validates our results from section 5. Similar to before, we employ the graphical analysis to estimate the impact of various types of decentralization on Korea’s performance in the road sector. Korea was selected because of its rich and diverse decentralization experience in the road sector. Table 2 shows that road financing in Korea has been subject to various changes from 1968-1992. Briefly, throughout the 60s and 70s, the financing of road operations was centralized. The major breakpoint towards decentralization of road financing took place in 1976 when local governments became more autonomous in their expenditure decision-making.

Employing the double-cost approach, we investigate the optimal choice of location of road provision for various types of decentralization from the Korean experience. Following the familiar convention, the ordinate measures various degrees and types of fiscal decentralization and the abscissa measures performance in terms of resource and preference costs. We start with the case of maintenance, in figure 6, where the ordinate measures the share of local government in financing of maintenance operations and the abscissa measures the unit cost of maintenance and the condition of roads. Of particular interest is that the plots of the two cost curves for Korea have the same trend as that for the eight country panel. In figure 6 we see that resource costs are concave, increasing first and decreasing at later stages of decentralization. The preference

cost curve is convex. It decreases initially and then increases at higher levels of decentralization before it starts leveling off. The optimal level of decentralization of maintenance for Korea can be determined by looking at the total cost curve. Total costs increase initially and then decrease to reach a minimum at [50-69] percent decentralization; this observation is very much in line with the results of our general analysis.

As for construction, figure 7 shows that resource costs are at their minimum when financing is centralized. They increase at an increasing rate as decentralization progresses, reaching a resource cost maximum at [50-69] degrees of decentralization and declining after that. As for the preference cost curve, consistent with the theoretical expectations, it is downward sloping, implying that road conditions improve as decentralization advances. Overall, in support of the fiscal federalist argument, the optimal level of service provision would lie at [0-10] percent decentralization if the objective is resource cost minimization. But at this point preference costs are at their maximum, indicating essentially that road quality is poor and not enough money is being spent on road works. Increased levels of decentralization, however, lead to betterment of road conditions but this is achieved with increased resource costs. The total cost curve displays the point where total costs are minimized, namely at [70-90] degrees of decentralization.

A look at figure 8 suggests that administrative operations are conducted most cost efficiently when there is [50-69] degrees of decentralization. At point A, resource costs are low but as decentralization advances, resource costs increase at an increasing rate (see point B). This shows that breaking up the already existing administrative units is costly but decentralization pays off once the units are created. See that when we move from point B to C, we observe declining trends in resource costs; in fact, point C represents the minimum for administrative resource costs. Although the preference cost minimum is reached at point B, the total cost curve shows that point C is the most preferred level of decentralization for financing administrative operations for Korea.

The results from the longitudinal analysis in Korea give a better understanding of the optimal ranges of decentralization for the road sector. We find that the position attained by Germany and the USA in the analysis in section 5, is corroborated in the case of Korea which has had switches in its degree of fiscal decentralization in the road sector.

7. Case of Germany

Germany is the second detailed case study for the measure of the impact of decentralization on road performance. Germany has been selected for two reasons: First, it has a highly decentralized government structure with state and local governments bearing full autonomy over road expenditures. Second, the combination of a horizontal and vertical financing structure raise some interesting issues with regard to the performance of state and local governments in the infrastructure sector. Table 3 gives a

summary of the degree of decentralization and performance of the road sector in various states in Germany.

In general, the German Federal system before the unification comprised a federal government, 11 states, among them 3 city states, and 328 districts and roughly 8500 local governments. Local governments as organizations of self government are part of state governments. But the constitution guarantees local self government within the framework of laws. Local governments have a general authority to deal with all matters of local concern in the framework of the constitution, and the federal and state laws; the federal government has some explicitly stated exclusive competencies and can enter the field of local governments when uniform solutions are required for the entire German territory. The German government system has been described as cooperative federalism or “unitary federal state” where the principles of optimal differentiation of responsibilities are realized with a tendency towards cooperation and coordination.

The distribution of expenditure authorities between the federal, state and local governments is in line with this principle of optimal differentiation of responsibilities and a pronounced preference for cooperation. State governments decide on their own on the level of expenditures for different road work activities. Similarly, local governments determine how much to spend on their respective roads. State governments are responsible for construction, maintenance and administration of state roads, whereas, local governments are in charge of all district and municipal roads. It shall be mentioned that local governments assume also responsibility for portions of state roads on behalf of state governments.²³

The fiscal structure in Germany provides the framework for cooperative arrangements. Although state and local governments finance major parts of their expenditures on road works from own-source revenues, the intergovernmental grant system serves as an instrument of equalization and harmonization of living conditions. In general, state governments dispose of yields from the tax on beer, wealth tax and motor vehicle tax and generally finance expenditures on local services from these sources. Local governments derive their revenue from the property tax and the local business tax and from taxes on consumption and excise taxes and use charges and credits. These constitute approximately two-thirds of local government revenues. The remaining is financed from state and federal government grants and transfers. As mentioned, grants are used both between the federal and state governments and between the state and local governments as instruments of vertical fiscal equalization. They are often times of a general untied nature and based on weights derived from the number of inhabitants, but some are for specific purposes. One such grant is the GVFG provided by the federal government through the state government to local governments for constructing road

²³ There are 237 districts in Germany in charge of 67,285 km of district roads and 296,737 km of municipal roads under the responsibility of municipalities. Districts also take charge of municipal roads on a voluntary basis. These add up to 364,022 km of local government roads, almost three times the length of state roads (65713 km) and federal roads (39633 km) taken together.

works.²⁴ Local governments also receive grants (FAG funds) from state governments to conduct maintenance works.²⁵ These transfers represent instruments that have been criticized because of their “good merit” or “golden bridle” character where the granting government can attach strings to such funds such that the receiving government is no longer free to use them according to its own preferences. We will look at the implications for the road sector in the next section.

Vertical Analysis

The graphical analysis at the vertical level aims at discussing the road performance of state- versus local governments. For construction, figure 9 shows that resource costs decline systematically with increased decentralization at the state government level. At the local government level, resource costs increase initially and then decrease at higher levels of decentralization. Looking at the two curves simultaneously, recognizing that an increase in decentralization at the state level means more responsibility for the local governments, we may be witnessing a “passing-on-of-the-costs” of road provision to lower levels of governments in the early stages of decentralization. The increased autonomy at the local level may then lead to increased efficiency at higher levels of decentralization; hence explaining the difference in the shape of the gains between local and state governments. State governments seem to have economies of scale in production of roads--better technology and equipment to conduct the works--which local governments do not inherit when decentralization takes place. Considering the financing side, we had observed in section 5 that Germany has very high unit costs of construction, even after normalizing by per capita GNP. The local government financing structure for construction activities can help explain this effect. Local governments receive ear-marked transfers from the federal government (GVFG transfers) to construct road works. These transfers are only allocated for very large construction projects and cover on average between 50-80 percent of the costs.²⁶ Tied grants of this sort provide less incentives for governments to operate efficiently.

As for maintenance activities, at lower levels of decentralization, local governments are better performers than state governments (see figure 10). But unit cost of maintenance at the local government level increase in a linear fashion as decentralization advances, whereas, at the state government level, resource costs decrease

²⁴ Two related arguments are put forward for provision of federal government grants: a) the overall importance of roads in economic development of the German territory; and b) the positive externalities resulting from such transfers. The GVFG transfer covers on average 50-80 % of the construction costs and can only be requested for construction projects larger than 200,000 DM.

²⁵ The allocation formula varies from state to state: in Baden-Wuerttemberg, for example the FAG transfer is 13,800 DM for 1. km/'000 population; 17,300 DM for 2 km/'000 pop. and 20,700 DM for 3 km/'000 pop. . In Bavaria, it is lower at 3000 DM/'000 pop for 1. km and 6,700 for 2. km/'000 pop. and 9,200 DM for 3. km/'000 pop. In Schleswig-Holstein, it a fixed amount of 5500 DM per km. In all other states, FAG transfers are allocated as share of total amount of transfers to local governments.

²⁶ Information from Jung, Dieter, Direktor beim Landkreisverband Bayern, Muenchen.

with increased decentralization. This result is consistent with the “passing-on-of-the-cost” observation made in the case of construction; only it is more apparent. The proper level of decentralization for local governments seems to lie at [40-65] percent decentralization. At the state government level, resource cost minimum is reached at [76-100] percent decentralization. This indicates that state governments operate more cost efficiently when local governments have more responsibility, whereas, local governments are less cost efficient with increased transferred responsibilities.

We can conduct a comparative study of performance for the seven states by simply overlaying the state and local government specific data obtained from the sample. We obtain two plots for each state, one reflecting the performance of the state and the other performance of various local governments in that state. For maintenance, figure 10 shows that six out of seven states behave similarly in their performance. Schleswigholstein, Rheinlandwestfalen, Saarland, Baden-wuerttemberg, Bayern and Hessen are all excellent performers with resource costs at local- and state government levels being well below the average resource costs. Further, the gap between local and state government performance in these states is very small. This result reflects the typical attribute of a cooperative federalism where there is emphasis on coordination among the state governments. Coordination is fostered through so-called “Gremiums” or “vertical fraternities” whose mandate is to develop guidelines and periodically review the criteria for provision of grants to local governments and to discuss issues regarding harmonization of conditions relating to roads at the local government levels. These Gremia are very useful since they reduce the involvement of the federal government but still act as national coordinators in the representation of road users.

Further cooperation is fostered through contracting out. States contract out maintenance works to local governments, who are closer to the road users and more efficient deliverers of maintenance works both on state and local roads. But coordination seems more feasible at lower levels of decentralization. This can be seen in the example of Nordrheinwestfalen, where there is a large gap in performance of state and local governments. High levels of decentralization seem to lead to cost inefficiencies.

As for construction, figure 9 shows that six out of seven states are highly decentralized in their construction activities. Saarland can be categorized as one of the good performers. At [66-75] degrees of decentralization, unit cost of road construction in Saarland is well below the average level of performance. Moving further towards increased decentralization, we see that local governments in Schleswigholstein perform even better. Resource costs are lowest for local governments in this state. In all other states, both state and local government performance is poorer than average (see Bayern, Badenwuerttemberg, Hessen and Nordrheinwestfalen). This result is quite interesting, especially since the latter are the richer states in Germany. To understand these results, we would need to conduct a more in-depth study of the construction sector in these states.

Horizontal Analysis

The horizontal analysis is a discussion of resource cost efficiency at the local government level for different types of roads. Again, the measure of decentralization at this level is different in that the number of local governments per capita GDP serves as an indicator of spatial decentralization and measures the depth of decentralization. Local governments are responsible for three types of roads. Districts maintain, construct and administer district roads. Municipalities are in charge of all road activities on municipal roads. Further, districts and municipalities assume some responsibility for state and federal roads. Since there is no data available on local government expenditure for municipal roads, this section focuses on district and state road activities.

For construction, figure 11 indicates decreasing unit costs for both types of roads with increasing depth of decentralization. Resource costs for district roads decrease in a linear fashion, whereas, for state roads, the decline is non-linear. Rheinland-pfalz is the best performer at the highest level of decentralization. In that state, unit cost of construction for both types of roads are equal. This reflects the fact that as there are more local governments, there is potential for more competitive bidding leading to more efficient road production activities. We see also that at lower levels of decentralization, Baden-Wuerttemberg performs better than Bayern. This is certainly due to the increased use of contracting out in Baden-Wuerttemberg. The Bavarian local governments possess standing fleets of vehicles and equipment that conduct regularly works on district and state roads. There is a high cost associated with this strategy. In contrast, in Baden-Wuerttemberg, states and local governments use contractors to conduct road works.

For maintenance, as can be seen in figure 12, resource costs decline initially with increasing decentralization for district roads but they increase after [11-20] degrees of decentralization. This is not true for state roads, where resource cost efficiency gains are made as decentralization advances. Local governments operate as delegated agents on behalf of state governments and since local governments have to report to state governments about their performance, there are more incentives to operate cost efficiently. We see that Rheinlandland-Pfalz is a poor performer at the highest degree of spatial decentralization. In contrast, Hessen and Schleswigholstein perform better with less spatial decentralization.

8. Summary and Policy Conclusions

The analysis of the experience in decentralization of road provision activities in a panel of eight countries, a longitudinal analysis over 25 years of change in Korea, and a vertical and horizontal analysis across states and local governments in Germany resulted in remarkably similar conclusions which are summarized in this section. We found that the impact of decentralization varies depending on which aspect one is considering: efficiency of producing road services or the impact on road users. Resource costs--the costs of providing roads in \$ per km--are concave, increasing first and decreasing at later

stages of decentralization. Preference costs--the costs to road users as a result of bad roads--consistent with theoretical expectations are downward sloping, implying that road conditions improve as decentralization advances. The implication of this finding is that there are initial costs to decentralization, most of which seem to be in the form of losses in economies of scale. However, there is empirical evidence that these losses can be outweighed by increases in efficiency that come about when the locus of provision is closer to the people.

The advantages or limitations of decentralization are function specific, resulting in different optima for the level of decentralization of road functions. Cross-country and longitudinal analysis suggest the following general ranges of optimal decentralization: (a) maintenance functions are best provided at the local government level, with the optimal range being more than 40 but less than 70 percent fiscal responsibility at the local level, when the optimization involves minimizing both resource and preference costs. When one is considering only resource cost efficiencies, then the optimal level is complete decentralization. The upper bound of about 70 percent in the former case may be due to the increased diversity of choices at higher levels of decentralization and the added difficulty of managing multiple preferences, but it may also be due to a loss in equity across jurisdictions (as in the case of South Africa); (b) if the objective is resource cost minimization, as in the fiscal federalist arguments, then the optimal level for construction functions is either completely centralized or completely decentralized. The efficiency of construction activities is more sensitive to the degree of competition in the awarding of contracts than to the level of decentralization; and (c) administrative activities are more efficiently provided at decentralized levels similar to those for maintenance. There is supporting evidence that at early stages of decentralization it is more costly to administer a growing number of road agents, making the optimal level more than 50 percent but less than 80 percent fiscal responsibility at the local level.

There are a number of exceptions to these general results. The USA is a case in point; highly decentralized in all road functions and operating efficiently. In fact there is evidence that when decentralization was deepened, the level of cost efficiency improved even further (Walzer et al, 1989). This result supports the classical fiscal federalism argument that local governments are closer to the point of demand and are, therefore, more efficient providers of road services. Similarly, consistent with public choice theory, decentralization of administrative functions is considered desirable because it leads to larger efficiency gains in terms of resource cost savings. For all three road functions, but especially for construction, the analysis results suggest two solution points: fiscal centralization or complete decentralization. Economies of scale and technological effects make the central government a good provider of road construction services (in terms of financing and not necessarily producing the works through force account), while ability to match supply to demand makes decentralized units more efficient. These results indicate that there are definite benefits to decentralization for activities that are more localized in nature such as road maintenance, and lesser benefits from decentralized construction and administration of roads which do have the potential for large externalities.

The country studies also show, however, that the choice of which activities to decentralize depends on country specific situations. The local environment differs in many ways; historically, economically, politically, culturally, affecting the achievable level of efficiency with decentralization. Nonetheless, there are certain lessons to be learned depending on the type and degree of decentralization as was summarized above. In particular, we find that performance at various levels of decentralization depends on the structure of allocation of fiscal and functional responsibilities, essentially what we may refer to as the “incentive structure” needed for the government unit to conduct the assigned work efficiently. Where the central government controls all the details of construction and maintenance works, tight or “over-control” is perhaps the desired option, if it can be implemented. The central government has economies of scale in production of roads and should do the planning and budgeting, and in poorer countries managing the hiring of labor and machinery. Fragmentation of the central government or what may be referred to as “under-control” of major activities may initially result in cost inefficiencies and poor conditions (see for example the experience of Indonesia). But once decentralization is under way, recognition of local realities, circumstances and local diversity is quite important. This is particularly crucial for construction, which is technology and resource intensive and also has the potential for serious externalities. Performance depends to a large extent on the degree to which the diversity and heterogeneity of the local government universe are recognized, essentially how far local governments are allowed to come up with their own set of responses to financing and conducting construction works.

The Colombian experience with decentralization may be mentioned again. The decentralization reform in Colombia has allowed local governments and municipalities to have greater decision-making powers with regard to planning, selection and budgeting of road projects and greater expenditure authority. Depending on the region, different government entities are responsible for conducting construction works and also financing of road projects varies. In oil-rich regions, royalties have constituted an important source of revenue for construction of roads. In fact, a World bank study shows that close to 300 municipios had their investment projects financed through royalties. In 1987 and 1988, 15 municipios receiving royalties spent 39 percent of the income on water and sewerage projects, 24 percent on roads and the rest on other services (World Bank, 1989:5). This fact supports the contention that when local authorities have expenditure as well as functional responsibility, they may set priorities in sectors other than roads and choose the appropriate level of road quality for their constituencies. In the coffee-growing region, for example, the quasi-public Federation of Coffee Growers plays an important role in shaping and financing rural development policy in terms of building roads and making infrastructure investments.

The importance of aligning fiscal responsibilities to functional ones is underscored for the case of road maintenance, a finding that supports the “souffle

theory”²⁷ postulated by Parker (1995). The analysis shows that maintenance is clearly best provided under decentralized structures. Resource cost efficiency and demand for maintenance service levels are best reflected when both functions and the expenditure decision-making are decentralized. However, preference costs can be minimized if those charged with provision of maintenance works are held accountable both to those who pay for them and to those who benefit from them. Enforcing accountability at the local level is not always easy. It requires not only clear incentives but also the provision of adequate information to local constituents as well as the exercise of real influence or control over the service delivery system (essentially true functional decentralization). Under centralized production of maintenance, cost efficiency depends in effect on the method of production. Traditionally, central governments have attempted to carry out the bulk of maintenance tasks directly, commonly through force account. But evidence suggests that under force account there are few built-in incentives for efficiency production. Contracting for maintenance is an alternative that has proven particularly successful in minimizing resource costs. In fact, it has been shown that when services are locally provided, the use of contracting out is more frequent (Lopez-de-Silanes et al, 1995).

A number of examples in developing countries show that the existence of competition can make a real difference. Real efficiency gains can be made when contractors are allowed to implement the actual maintenance works, leaving the central government agency to focus exclusively on planning and monitoring maintenance. Likewise, private contractors may have greater flexibility in responding to seasonal fluctuations in the demand for maintenance than the central government. Harral and Faiz (1988) note, as well, that where maintenance has been a largely ignored activity, contractors can form an effective lobby for increased or continued funding of routine maintenance activities. But it is important to bear in mind that efficiency gains from contracting will occur only if there is adequate supply of contractors and real competition among those vying for the right to conduct the maintenance activity. In some cases, such as the experience of France in contracting out, it is evident that at the central government level collusion is not as problematic as at the local level.

There is some evidence that services are decentralized to pass on the costs of provision to local governments. The case study in Germany showed that while state governments benefitted from increased levels of decentralization in terms of lower unit costs of providing roads, local governments initially picked up (at low levels of decentralization) the difference in cost since they showed, at the same time, higher unit costs. This transfer of costly functions does have a long term benefit; at high levels of decentralization both state and local governments show low unit costs indicating that there may be efficiency gains at higher levels of decentralization that override the initial increase in costs.

²⁷ Parker suggests a “soufflé” theory of decentralization that incorporates the essential elements of political, fiscal, and institutional decentralization as they relate to rural development. He argues that a successful program of decentralization must include just the right combination of political, fiscal, and institutional elements to improve rural development outcomes.

Finally, in the countries studied, ear-marking of intergovernmental transfers characterized much of fiscal decentralization: this feature was found in Argentina, Brazil, Colombia, Germany, and the Philippines. Whether ear-marking improves performance or not is not quite clear. Consistent with evidence, we find revenues ear-marked in developing countries more often disappear probably because they are connected in ways that are not actually desirable locally. In Germany, ear-marking has proven useful for keeping uniform road quality standards across the country but it has also brought about large cost inefficiencies. Whether ear-marking accompanied with fiscal decentralization is desirable or not depends again on the specific country objectives. In Germany we see that the equity objective overrides the efficiency objective.

This paper has provided empirical evidence and guidance in the selection of optimal structures for providing road services. A companion paper examines the same issues econometrically with a larger data set (cross-country panel, time series, and state and local data) and qualifies some of the findings in this paper (see Humplick and Moini-Araghi, 1996).

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Table 2: Korea Decentralization in the Road Sector

YEAR	Condition Roads not paved (%)	Degree of Decentralization (%)	Per capita GNP Constant \$ 1987
1968	93.7	0	2388
1969	92	0	2404
1970	91	2	2446
1971	85.8	0	2642
1972	82.9	22	2376
1973	82.1	0	2726
1974	80.4	0	2636
1975	77.7	0	2532
1976	76	46.4	2582
1977	73.5	53.1	2628
1978	70.5	71.3	2870
1979	69.2	57.6	3178
1980	66.8	67.3	3691
1981	65.9	57.5	2921
1982	64.3	53.5	2355
1983	61	67.3	2401
1984	53.7	77.6	2492
1985	50.2	63.3	2474
1986	45.8	47.2	2746
1987	39.7	54.2	3230
1988	33.6	57.84	3853
1989	33.6	44.8	4319
1990	28.5	55.7	4682
1991	23.6	50.4	4919
1992	19.2	48.7	5012

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