# Structural Shifts in the Treatment of Intergovernmental Aid: The Case of Rural Roads

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*Abstract*

The effects of structural shifts in the treatment of intergovernmental aid during the 1980s are tested using a sample of 1,929 rural counties with local road responsibilities. A dynamic model is used to test the hypothesis that local public officials treated intergovernmental aid differently after the Reagan/Bush policy of Fiscal Federalism was implemented. Empirical findings from the dynamic model are that Federal aid was much more stimulative at the end of the decade than in earlier years but the effects of state aid remained the same throughout the 1980s. These differences are attributed to a perception that Federal aid is less certain and more transitory than permanent.

**Key Words: intergovernmental aid, stimulative and substitutive effects, transitory and permanent effects, rural roads**

The relationship between Federal, state, and local governments underwent fundamental changes during the 1980s. Current national fiscal policy has largely removed the responsibility of providing key public services to lower levels of government. In effect, current policies have reduced the intergovernmental connection between county governments, a dominant form of local government in rural America, and the Federal government (Thomas). In addition, current fiscal pressures facing state governments, such as accelerating health care costs and education funding priorities, have threatened the ability of states to replace the shrinking flow of Federal dollars.

Governments located in rural areas were hit especially hard during the 1980s and early 1990s (Atash; Braaten). Major shifts in population and economic base to support rural public services hindered revenue-raising capacity. At the same time, property taxes, the most common own-source revenues, declined in many rural areas. Coupled with statutory limitations on raising revenues from alternative sources and reluctance by voters to support new taxes, rural local officials often faced hard choices about the services that could be provided. Still, a growing number of under-funded and unfunded Federal and state mandates forced rural governments to make major investments in services previously not provided (Snyder). Given the limited options available to rural public officials and the shifts in intergovernmental relations fostered by the Reagan and Bush Administrations and the current Republican Congress changes the manner in which local officials treat intergovernmental aid should be most evident in rural areas.

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The stimulative-substitutive effects of intergovernmental aid have been examined extensively within the public finance literature but little attention has been paid to identifying structural shifts in the behavior of local officials. The bulk of the empirical grants-in-aid literature focused on estimating the effect of a dollar in Federal aid on local government expenditures within a static framework (Gramlich; Huckins and Carnevale). Exceptions include Bahl and Duncombe, Bahl and Sjoquist, Ladd, and Benton.

The model estimated in the analysis reported here is designed to capture structural shifts in how local officials (in this case rural county officials) viewed intergovernmental aid during the 1980s. Our hypothesis is that the manner in which local officials treat intergovernmental aid underwent a fundamental shift. Particularly, we suggest that local officials no longer treat intergovernmental aid, specifically Federal aid, as dependable (or permanent) but rather as transitory. Thus, there is a greater likelihood that aid which previously may have been substituted for local monies is now a stimulant to local spending as local officials spend the funds on infrastructure or one-time projects.

To test this hypothesis, we examine only one local spending category: rural roads and bridges. We do this in part to minimize empirical complications arising from aggregating aid programs. In addition, the local road and bridge system is particularly important to the economic vitality of rural areas. Rural roads are the vital link between farmers, markets, and rural off-farm employment opportunities. Access to health care facilities, shopping districts and educational opportunities also requires a viable rural road network. The manner in which local officials use increasingly scarce Federal dollars to maintain and improve the rural road network is especially important to the rural economy.

The article has five sections. First, a discussion of the revenue structure of rural government with specific attention to how rural transportation is financed is provided followed by a conceptual model of local behavior regarding intergovernmental aid. An empirical model is presented next, followed by a reporting of the empirical results. The article closes with a discussion of the analysis' policy implications.

## The Rural Local Road System

The condition of the low-volume rural road (off-system) network in the U.S. has been studied numerous times. The extensive network may need relatively little new construction, but a major portion has passed its engineered design life and requires serious upgrading (Baumel and Schornhorst). Much of the network (especially bridges) was constructed prior to 1950, thus is more than 45 years of age. Closer examination reveals that 70 percent of the bridges were constructed prior to 1935 and were designed for a 50-year life (Cooper and Kane). Current traffic demands, largely because of trucking deregulation, rail abandonment, subsidization, and shifts in the rural economy, exceed the design of the system. In short, the combined influences of an aging system and changing traffic patterns have accelerated the rate of deterioration.

At issue is the ability of the local governments responsible for the low-volume network to finance the system with local resources, and the role of Federal and state aid in the overall financing mechanism. Several recent studies suggest that the current financial condition of local governments is causing disinvestment in the low volume road network (Chicoine and Walzer; Hackett and Busson; Walzer and Chicoine, 1989; Deller and Halstead). Maintenance costs for the low volume network exceed resources available to rural local governments. A recent national study of low-volume roads (Walzer and Chicoine, 1989), reported that 63.8 percent of the surveyed county highway officials and 61.7 percent of the surveyed township officials perceive current funds as inadequate to meet present and anticipated demands. The same study identified 38.3 percent of rural county mileage, and 32.6 percent of township mileage, as substandard.

A commonly cited cause of fiscal inadequacy is the decline in purchasing power of intergovernmental aid (Walzer and Chicoine, 1989). In 1987, counties and townships lost Federal General Revenue Sharing (GRS) which had financed road construction and improvements among other things. The resulting loss of funds caused deferred maintenance and upgrades (Walzer and Deller). Other factors such as property tax base declines and property tax rate limits also contribute

to revenue inadequacies. Even with increases in state motor fuel tax rates, local government receipts in many instances have not kept pace with construction cost increases.

Five funding categories are used for rural roads: property taxes, other local revenues, Federal aid, motor fuel taxes, and general state aid.[1] In 1987, state motor fuel taxes represented the largest single source of funds (38.0 percent) followed by property taxes (24.7 percent), own source general revenues (20.7 percent), Federal aid (7.2 percent) and state aid (4.8 percent). These sources are more diverse than 20 years ago when the motor fuel and property taxes represented more than 80 percent of revenues spent on rural roads.

In constant 1982 dollars, total revenues generated for rural roads by Federal, state and local governments were $2,990 per mile in 1967 whereas in 1987, total revenues raised for rural roads were $3,666 per mile, an increase of 22.6 percent. In 1987, counties and townships received $1,395 per mile from the motor fuel tax, $1,831 per mile from own sources (property taxes and general revenues), $265 per mile in Federal aid and $175 per mile from general state aid.[2]

A significant change in revenue sources between 1967 and 1982 involved increased dependence on Federal dollars. In 1967, Federal funds were less than two percent of total revenues collected for rural roads. In 1983, however, Federal funds accounted for 11 percent of total revenues. The Federal aid per mile peaked in 1975 at $336 per mile but in 1987 that support had decreased 22 percent to $265 per mile. Given the elimination of GRS by 1987, a reduction in Federal aid strained the ability of many rural local governments to maintain services.

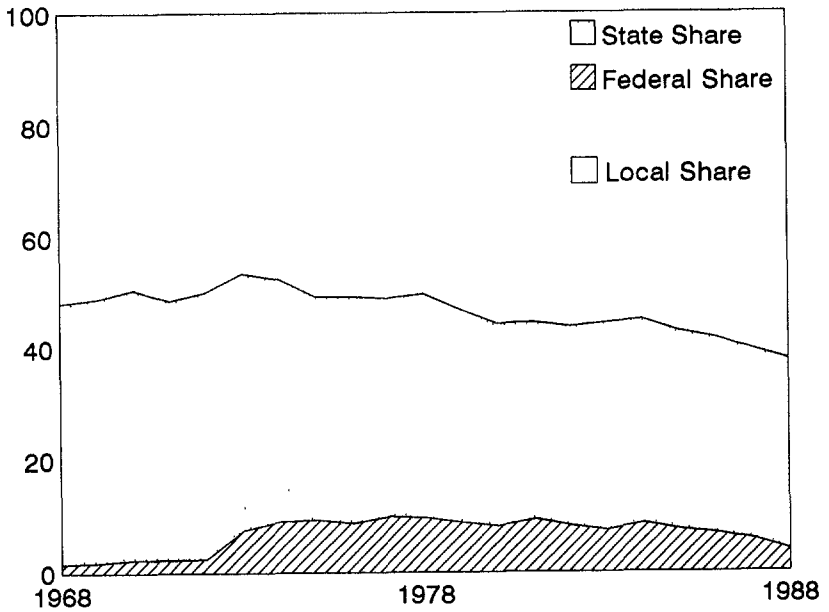
Examining trends in the relative contribution of Federal, state and local sources to total highway revenues lends additional insight into how local decision-making may have changed (Figure 1). Prior to 1972 with the introduction of GRS, the Federal share of total local road revenues was flat, but stable, representing a few percentage points. Through the 1970s and early 1980s, Federal aid, as a share of total road revenues, was again flat and relatively stable at between eight and nine percent. However, fiscal federalism policies of the 1980s brought a steady downward trend in the contribution of Federal aid to total road revenues. The declining pattern observed in this time-frame, we hypothesize, caused a structural break in how the Federal government viewed its role in supporting local efforts, but more importantly, a break in how local officials treated the decreasing flow of Federal aid.

The loss of GRS funds was particularly hard felt in rural counties. Although GRS was a relatively small percent of total revenues, these funds represented a lump sum payment spent at the discretion of local officials. In rural counties, these monies were often used to leverage local dollars to finance one time road and bridge (re)construction projects or capital equipment purchases (Chicoine and Walzer). Other programs, such as Community Development Block Grants, Federal-Aid Secondary funds and the Highway Bridge Rehabilitation and Replacement Program, also supported infrastructure improvements, but often these funds did not find their way into rural counties. GRS provided the flexibility, but also a level of uncertainty from a budgetary planning perspective, needed for major road and bridge investments.

A second, equally important trend documented in Figure 1, is the declining share of state aid to county and township road programs. In the period examined, state aid, both motor fuel tax and general appropriations, represented 48.3 percent of total local road revenue at its peak in 1970. Starting in the mid-1970s, the share of state aid continually declined. By far, the largest decline was in the motor fuel tax which also peaked in 1970 at 46.5 percent of county and township road funds. In 1988, the last year examined here, the motor fuel tax was only 30.4 percent. The primary reason for this decline in motor fuel tax revenues is the introduction of more fuel efficient automobiles. The decline, or at least slow growth, in consumption of motor fuels simply did not allow motor fuel tax revenues to keep pace with demands for expenditures.

In the late 1970s and early 1980s, the influence of inflation also was felt directly by local governments. In a study of Midwestern township road officials (Chicoine and Walzer), inflation was reported as the worst problem facing rural road service delivery. Even during a period of relative

**Figure 1.** Sources of Local Revenue




Source: *Highway Statistics*, US Department of Transportation, Washington, DC (various years)

price stability, local road officials in New England expressed concern about the effects of inflation on local road budgets (Deller and Halstead). In constant 1982 dollars, the typical U. S. county/township spent $1,488 per mile on maintenance and $926 per mile on construction in 1964. In 1984, however, per mile maintenance expenditures increased 29 percent to $1,928 while construction expenditures per mile decreased slightly more than 5 percent, to $877 per mile. The financing of local road services was affected in at least two ways; first, aid from higher levels of governments, both Federal and state, contracted, second, lower purchasing power compounded the downward trend, thus leaving local officials in a difficult position. Based on surveys of local road officials, these trends forced many local officials into a mode of trying to maintain the current stock at the price of reinvesting in new or existing stock (see Walzer and Deller for more detailed discussions).

Given the documented deterioration of the low-volume rural road network, these expenditure changes may be inadequate to compensate for increased demands on the network. A comparison of real maintenance expenditures through time shows that most of the increase in spending followed the introduction of Federal aid. Despite the apparent small role Federal aid plays in the total revenue picture, the availability of Federal support had become an integral part of the local decision-making process. At issue is whether intergovernmental aid, particularly Federal aid, serves as a stimulant to raising additional local monies, or is aid simply substituted for local monies. More importantly, have the dramatic policy changes during the 1980s regarding Federal aid altered the manner in which officials treat aid.

## A Conceptual Model of Local Government Spending

The stimulative/substitutive effects of intergovernmental aid have been extensively examined both theoretically and empirically. A conceptual discussion of structural shifts in the treatment of aid, however, is lacking. The few exceptions tend to focus on static empirical evidence and anecdotal rationales. A theoretical framework is needed to more fully conceptualize how such a structural shift occurs.

A simple way to achieve this objective involves examining the level of revenue generated by a local government. This can be expressed as:

$$g = t \cdot Y + G \quad (1)$$

where $g$ is local government expenditures, $Y$ is total tax base within the community, $t$ is the tax rate applied to that base and $G$ is intergovernmental aid. Note that within the framework developed here no behavioral assumptions are imposed on either the voter (consumer) or the local official. Rather, the explicit derivation is used to illustrate the conceptual framework developed below.

Available evidence, both empirical and theoretical, suggests that the local tax rate, $t$, is related to several factors ranging from local prices to the level of intergovernmental support. Specifically, $t$ is an implicit function of $G$ and $z$, where $z$ is a vector of other factors. Rewriting eq.(1) yields:

$$g = t(G,z) \cdot Y + G. \quad (2)$$

The stimulative, or non-stimulative effect of intergovernmental aid (i.e., the sign of $\partial g/\partial G$) can be inferred from eq.(2). Holding other factors (z) constant and taking a partial derivative yields:

$$\partial g/\partial G = \partial t/\partial G \cdot Y + 1. \quad (3)$$

The effect of a dollar increase in aid can take one of three forms. A one dollar increase in intergovernmental aid will have no effect on total local spending (i.e., $\partial g/\partial G=0$) if $\partial t/\partial G=-1$, or local officials completely substitute aid monies for local monies in the form of a lower local tax rate. The one dollar increase will have something less than a stimulative effect ($0<\partial g/\partial G<1$) if local officials partially substitute aid monies for local monies (i.e., $-1\leq\partial t/\partial G<0$). The grant is said to have a stimulative effect ($\partial g/\partial G>1$) if local officials treat the aid as seed money to leverage local dollars, or $\partial t/\partial G>0$. The key is to formulate a rationale for the sign and magnitude of $\partial t/\partial G$.

The more common rationales advanced to gain insight into the stimulative nature of intergovernmental aid focus on income and price (i.e. tax rate) effects (Wilde; Gramlich; Courant, Gramlich and Rubinfeld). In general, if the demand for the local public good is price-elastic and can be characterized as a normal good, the net effect on spending will be greater than the change in level of aid (i.e., $\partial g/\partial G>1$). If, however, the demand for the good in question is either price-inelastic or characterized as an inferior good, then the change in local spending will be less than the change in level of aid (i.e., $\partial g/\partial G<1$).

Grossman notes that these general rules reflect myopic behavior by local officials. If the local decision-making process more closely follows the "greedy politicians model," local spending will increase greater than the change in intergovernmental aid, regardless of the demand for the local good. Such behavior can be explained by fiscal illusion (Hewitt; Grossman, 1989 and 1990; O'Brien and Shieh). Because consumers (voters) lack a clear perspective of the effects of a change in the local tax rate, local officials can sometimes increase the tax rate, expand local programs, and maximize their own utility rather than the consumer (voter) utility.

Other factors, explicitly modeled in eq.(2) by the vector $z$, can influence the manner in which local officials treat intergovernmental aid. For example, local institutions might prohibit expansion of local taxes. Numerous local governments are hindered by state-imposed tax rate limits or statutory limitations on methods of generating local revenues. Other considerations might include prices of inputs used in the production of local public goods or a declining tax base which characterized so many rural areas during the 1980s.

Perhaps the single most important factor is the political environment in which local officials make decisions. Recent empirical evidence suggests that the "New Federalism" and tax policies prompted a structural break in local fiscal behavior in the 1980s (Bahl and Duncombe; Bahl and Sjoquist; Ladd; Benton). The reallocation of Federal programs to state and local governments, coupled with growing unfunded mandates during the 1980s, fundamentally changed the political environment in which local officials function. Stewart called this an era of "fend-for-yourself-federalism."

The limited empirical evidence to date supports our hypothesis of a structural shift. For example, in estimating the magnitude of the partial derivative $\partial g/\partial G$ for three time periods, Bahl and Sjoquist found relative stability in the size of the corresponding regression coefficient from 1967 to 1977, but in 1987, the coefficient nearly doubled in size. Unfortunately, the available empirical work has been restricted due to both the descriptive nature of the analysis and the rudimentary development of the empirical models. In addition, the empirical analysis has studied local expenditures in the aggregate rather than by function. Institutional variation at the local level coupled with the complexity of the grants-in-aid programs causes aggregation of functions to mask fundamental differences. While Bahl and Sjoquist and others offer intuitive reasons for the shifts observed, they present neither a model nor a theory to predict the structural change in local behavior.

We suggest the issue can be viewed within the framework of a modified "permanent income" model. Here local officials may view intergovernmental aid as either a permanent or transitory source of income for the community. If aid is treated as permanent within the planning horizon of local officials, they may incorporate the aid into the regular budgets for current operations. Given the generally acceptable premise that local residents demand a high level of services, but want someone else to pay for the service, one might reasonably expect intergovernmental aid to substitute at least partially for local monies, or $\partial t/\partial G<0$ hence $\partial g/\partial G<1$. Alternatively, if aid is considered transitory or more directly declining, local officials may shift the monies to one-time ventures such as expensive construction projects or equipment purchases. In this instance, aid complements local funds, or $\partial t/\partial G>0$ . Hence $\partial g/\partial G>1$.

We can express this logic within our simple mathematical representation by rewriting eq.(3) as:

$$g = t(E(G),z)\cdot Y + E(G). \qquad (4)$$

Here $E(G)$ is the expected value of intergovernmental aid ($G$) during the relevant planning horizon. Assuming a simple adaptive process, $E(G_t)=\lambda(G_{t-1})$ where the function ($\lambda$) captures the process, the manner in which local officials treat aid in terms of permanence or dependability can be examined. For example, if $\Delta G_{t-1} \geq 0$ then officials may be more inclined to treat aid as permanent, thus building the aid into operating budgets which, for a given level of service demand, serves as a substitute for locally generated revenues. We hypothesize that under this scenario local officials may be inclined to substitute $G$ for local monies. If, on the other hand, $\Delta G_{t-1} < 0$, or aid declines through time, officials are less likely to view aid as permanent, but rather as transitory.[3] Here we hypothesize that aid will tend to be used to leverage local monies to undertake projects that the community could otherwise not afford.

The rationale for the leveraging concept follows directly from the limited empirical evidence, and to a large extent actual practices adopted by local road officials. For example, Bahl and Duncombe and Bahl and Sjoquist in their static analyses of a structural break during the 1980s, find that Federal aid became much more of a stimulant to local government. Bahl and his colleagues suggest that the shift in intergovernmental aid policies created pressure on local officials to place greater emphasis on local revenues to maintain the same level of services. In other words, local officials no longer have the luxury of substituting intergovernmental aid for local revenues. More direct evidence is available from survey data designed to elicit local road officials' response to the demise of GRS (Walzer and Chicoine, 1989). Based on survey responses Walzer and Deller identify capital investments such as new or rebuilt roads and equipment purchases, as projects that were the first to be delayed. In practice, without the leveraging capability of Federal aid or special state funds, new projects or equipment purchases are difficult to finance or justify based on cost.

The notion of permanency, that is perceived changes in the permanency of Federal aid, affect how local officials spend dollars. During periods of increasing (or at the least stable) aid, local officials can plan on the revenues being available. Given the well-documented pressure on rural property taxes, there is a strong incentive for local officials to substitute Federal dollars for local dollars. In the case of major investments, local

residents perceive that the level of services they received is increasing with someone else (i.e., the Federal government), paying a "significant" portion of the bill.

Unfortunately, data do not permit a direct test of this hypothesis. Still, this hypothesis provides a conceptual framework for viewing structural shifts identified during the 1980s. Rather, the above framework allows for a conceptualization of the problem and our hypothesis of local official behavior. To test our hypothesis, we now present an empirical model designed to directly capture the presence of structural shifts in the treatment of intergovernmental aid by rural county officials.

## An Empirical Model of Local Government Spending

Our hypothesis of a structural shift is tested with a dynamic model using cross sectional data for two time periods and using Ordinary Least Squares. Data for 1,929 rural counties with rural road responsibilities provide the cross-section component to the model and data for 1982 and 1987 provide the dynamic component. While the empirical model does not allow for a direct test of the rationale outlined above, it represents an alternative to the static analyses performed to date.

To address these issues, assume that the expenditure determinant model for time $t$-1 (i.e. 1982) can be expressed as:

$$E_{t-1} = \beta_{t-1}X_{t-1} + \alpha Z_{t-1} + \gamma Y + e_{t-1} \tag{5}$$

and the structural expenditure determinant model for time period $t$ (i.e. 1987) is expressed as:

$$E_t = \beta_t X_t + \alpha Z_t + \gamma Y + e_t. \tag{6}$$

Here $E$ is the level of expenditure for each respective time period, $X$ and $Z$ are vectors of variables which change through time, and $Y$ is a vector of variables fixed through time.[4] The model assumes that expenditure levels adequately reflect both flow of services from rural roads and level of effort exerted by local rural officials.

A key component of this specification is allowance for changes in the structural relationship through time. The structural relationship between the vector $X$ and expenditure levels ($E$) is assumed to change through time ($\beta_{t-1}$ vs. $\beta_t$). The model further assumes that certain structural relationships are fixed during the time period examined. In this case, the structural model is constant through time for variables $Z$ and $Y$.

Direct estimation of the two respective structural eqs.(5) and (6) offers insight into the role of intergovernmental aid at a specific time. To extract the change in the structural relationship between aid and rural road expenditure levels, the structural relationship presented in eqs.(5) and (6) must be combined. The structural change can be identified by taking the difference between the two equations, or

$$(E_t - E_{t-1}) = (\beta_t X_t - \beta_{t-1}X_{t-1}) + (\alpha Z_t - \alpha Z_{t-1}) + (\gamma Y - \gamma Y) + (e_t - e_{t-1}) \tag{7}$$

$$= (\beta_t X_t - \beta_{t-1}X_{t-1}) + \alpha(Z_t - Z_{t-1}) + (e_t - e_{t-1}). \tag{8}$$

By adding, then subtracting, $\beta_t X_{t-1}$ the change in the structural relationship can be identified:

$$(E_t - E_{t-1}) = (\beta_t X_t - \beta_{t-1}X_{t-1}) + \alpha(Z_t - Z_{t-1}) + (\beta_t X_{t-1} - \beta_t X_{t-1}) + (e_t - e_{t-1}) \tag{9}$$

rearranging terms,

$$= (\beta_t X_{t-1} - \beta_{t-1}X_{t-1}) + (\beta_t X_t - \beta_t X_{t-1}) + \alpha(Z_t - Z_{t-1}) + (e_t - e_{t-1}) \tag{10}$$

$$= (\beta_t - \beta_{t-1})X_{t-1} + \beta_t(X_t - X_{t-1}) + \alpha(Z_t - Z_{t-1}) + (e_t - e_{t-1}) \tag{11}$$

$$\Delta E = \Delta\beta X_{t-1} + \beta_t \Delta X + \alpha\Delta Z + \varepsilon, \tag{12}$$

where $\Delta E = E_t - E_{t-1}$, $\Delta\beta = \beta_t - \beta_{t-1}$, $\Delta X = X_t - X_{t-1}$, $\Delta Z = Z_t - Z_{t-1}$ and $\varepsilon = e_t - e_{t-1}$. Direct estimation of eq.(12) with OLS provides estimates of the structural relationship in time periods $t$ and $t$-1 and, more importantly, the *change* in the structural relationship through time ($\Delta\beta$).[5]

To determine both the structural relationship between intergovernmental aid and rural road expenditures and the change in the structural relationship a specification of eq.(12) was estimated. Using data from the 1982 and 1987 *Census of Governments* (i.e. $t$=1987, $t$-$1$=1982), the dependent variable ($\Delta E$) is change in per mile expenditure on rural county roads.[6] The vector $X$ is two dimensional, composed of Federal aid and state aid per mile of county road.[7] The vector Z captures demand related variables which are allowed to change during the time period examined. These variables include county population and county per capita income.[8] Positive changes in both demand variables are expected to increase rural road expenditure levels. Given the specification of eq.(12), both demand variables are measured in changes. These data were obtained from the 1988 *City and County Data Book*. To minimize potential biases due to inflation, all variables expressed in money terms are adjusted to 1982 dollars.

Variables originally in eqs.(5) and (6) are removed from the final model eq.(12) (i.e. the vector $Y$) include governmental organization, proximity to metropolitan areas and regional location. This omission represents perhaps the most serious limitation of the current approach since information related to time-invariant variables ($Y$) is lost in the final form of the model.[9] For example, institutional arrangement, for all practical purposes a time-invariant factor, plays a significant role in local expenditures patterns (Deller, Chicoine and Walzer). The most obvious is economies of scale in the production process. Because previous empirical studies of structural change have found these time-invariant variables important, two specifications of eq.(12) are presented to test for specification sensitivity. The first (Model A) follows directly from eq.(12) while the second (Model B) includes certain key time-invariant variables. If including these time-invariant variables alters our policy conclusion, there is sufficient evidence to suggest that a more complex decision making process is present.

The additional variables include three regional dummy variables identifying the regional location of the county. These are included to capture institutional variations, age and nature of the road system, and to a limited extent geographical differences. Specifically, counties located in specific regions of the nation are identified by an appropriate dummy variable. We grouped counties into the four major regions of the US as defined by the Bureau of the Census (Western, Southern, North Central, and Northeastern). A dummy variable capturing proximity to metropolitan counties is also included. Nearness to urban areas is expected to reflect higher levels of demand on the rural system. For counties located next to a metropolitan area, the value of the dummy is one, it is zero otherwise. We hypothesize that higher demand for road services in these areas will increase expenditure levels. Finally, a dummy variable directly capturing institutional arrangements is introduced. Counties embedded within a tiered system where local road responsibilities are shared with townships are expected to have higher per mile costs due to the higher service level roads (e.g., paved vs. gravel) maintained by these counties. In other words, the roads with better surface types (paved) in these counties are expected to have higher road maintenance costs. Here the dummy variable has a value of one if located within a tiered system, zero otherwise.

**Empirical Results**

The overall performance of Model A appears reasonable, explaining slightly more than 50 percent of the variation in road service delivery effort (Table 1). The general performance of the demand variables is mixed. Changes in county population seems to imply a slower growth rate and perhaps a decline in road expenditures. This may be explained in part by economies of scale. Change in income has the expected positive coefficient, but the coefficient is statistically insignificant.

We introduced selected time-invariant variables (Model B) to determine if certain fixed characteristics, assumed constant in Model A, shift the expenditure equation. The estimated coefficients of the time-variant variables are remarkably stable, lending confidence to the policy implications of the analysis. Proximity of the county to urban areas does not appear to significantly affect the change in road expenditure levels. This finding may reflect the stability of the urban-rural distinction between census years. This weak result might also be explained in part by the relatively small number of

**Table 1. A Dynamic Model of Rural Road Expenditures**

| Independent Variables | Parameter | Model A | Model B |
|---|---|---|---|
| Δ Population | $\alpha_1$ | -0.05286<br>(2.19) | -0.02711<br>(1.08) |
| Δ Per Capita Income | $\alpha_2$ | 0.03853<br>(1.01) | 0.01015<br>(0.25) |
| Federal Aid per Mile 1982 | $\Delta\beta_1$ | 0.42245<br>(14.15) | 0.44422<br>(14.97) |
| Δ Federal Aid per Mile | $\beta_{1,t}$ | 1.15578<br>(26.57) | 1.17760<br>(27.28) |
| State Aid per Mile 1982 | $\Delta\beta_2$ | -0.00227<br>(0.32) | -0.00781<br>(1.11) |
| Δ State Aid per Mile | $\beta_{2,t}$ | 0.51539<br>(26.97) | 0.52074<br>(27.44) |
| Adjacency | $\gamma_1$ | - | 16.69085<br>(0.12) |
| Government Structure | $\gamma_2$ | - | 274.93730<br>(1.91) |
| Southern | $\gamma_3$ | - | -1,555.02866<br>(5.32) |
| Western | $\gamma_4$ | - | -2,119.39950<br>(6.74) |
| North Central | $\gamma_5$ | - | -1,586.34511<br>(5.69) |
| Constant | $\gamma_o$ | -354.63650<br>(1.14) | 1,316.66874<br>(2.85) |
| F | | 398.12 | 227.08 |
| adj $R^2$ | | 0.5544 | 0.5650 |
| n | | 1,929 | 1,929 |

Dependent variable is change in road expenditure per mile expressed in 1982 dollars.
Numbers in parenthesis are absolute value of t-statistics.

adjacent counties given the complete sample size. Governmental structure, however, is significant in the positive direction, meaning that states with tiered governments tend to experience faster growth rates in per mile expenditures. This result reflects the higher service level roads maintained by counties in these tiered systems. Specifically, growth in the cost of maintaining higher service level roads is out pacing the cost of maintaining lower service roads, as expected. Counties located in the Southern, North Central and Western states had below average expenditure growth rates, even when adjusted for governmental structure. The original time-variant independent variables, however, remained similar in significance and sign. The stability of the parameter estimates across the two specifications of the model lend support to the richness of the estimates. For consistency with the structure of the empirical model, further discussion is limited to Model A.[10]

The results concerning intergovernmental aid indicate a shift in the structural relationship between Federal aid and road expenditures. In the

**Table 2. Empirical Results on Structural Change Hypothesis**

| | Model A | | Model B | |
|---|---|---|---|---|
| Hypothesis | State | Federal | State | Federal |
| $H_o$: $\beta_{t-1} = 1$ | 69.66 | 42.95 | 70.66 | 43.39 |
| $H_o$: $\beta_{t-1} = 0$ | 23.76 | 5.49 | 24.43 | 18.36 |
| $H_o$: $\beta_t = 1$ | 25.36 | 3.58 | 25.25 | 4.11 |
| $H_o$: $\beta_t = 0$ | 26.97 | 26.57 | 27.44 | 27.28 |
| $H_o$: $\Delta\beta = 0$ | 0.32 | 14.15 | 1.11 | 14.97 |

Test statistic is a standard t-statistic with a 95 percent critical value of 1.96.

most current time period (1987), the estimated coefficient of 1.15578 is greater than one, indicating Federal aid has a *stimulative* influence on road expenditures. The estimated change in the structural parameter for Model A is positive (0.42245) and significant. This implies that between 1982 and 1987 the influence of Federal aid on road expenditures underwent a structural change. Recalling that $\Delta\beta=\beta_t-\beta_{t-1}$, or $\beta_t-\Delta\beta=\beta_{t-1}$, the influence of a dollar of Federal aid on per mile road expenditure prior to fiscal federalism was only 73 cents (0.73332), or Federal aid was *not* stimulative. These results suggest that due to changes in the behavioral pattern of county road officials, Federal funds have gone from having a substitutive effect ($\beta_{1,t-1}$=0.73332<1) to having a stimulative effect ($\beta_{1,t}$=1.15578>1). Further credence is endowed to the results when we test to see if either coefficient ($\beta_{1,t}$ or $\beta_{1,t-1}$) is statistically equivalent to one. As reported in Table 2, neither coefficient is equivalent to one. The results for state aid indicate no structural change ($\Delta\beta_2$ is not significant) and that state aid does not have the same stimulative effect as Federal aid ($\beta_{2,t}=\beta_{2,t-1}$=0.51539). Although state aid declined as a share of total aid (Figure 1), it did not appear to undergo any significant structural shift during the period examined.

Five conclusions have can be drawn from this analysis, all of which become most evident in Table 2. First, in 1982, prior to the enacted Reagan-Bush policy of fiscal federalism, Federal aid had a substitutive effect ($\beta_{1,t-1}$=0.73332<1). Here Federal aid was used as a substitute for local monies. Second, during the 1980s, while the policy of fiscal federalism was instituted, there was a significant change in how local county road officials treated Federal aid ($\Delta\beta_1$=0.42245 with a *t*-statistic equal to 14.15). Third, the magnitude of change in the treatment of Federal aid resulted in aid now having a stimulative affect ($\beta_{1,t}$=1.15578>1). Forth, state road aid appears to have a substitutive effect ($\beta_{2,t}=\beta_{2,t-1}$=0.51539<1). Here state aid is used as a substitute for local monies. Finally, there appears to have been no structural change in how local road officials treat state aid ($\Delta\beta_2$ is not statistically different from zero).

## Conclusions and Policy Implications

The empirical results of the dynamic model of county road expenditures suggest that the policy of fiscal federalism changed the stimulative effect of federal aid, in particular General Revenue Sharing for rural counties, on highway expenditures. Local officials had treated federal aid as a permanent source of revenue on which they had become dependent. Because of the aid's perceived level of permanence, local officials used Federal aid as a form of local tax relief substituting part of these funds for own source funds. In the 1980s, local officials were forced to change the manner in which they viewed Federal aid policy. Specifically, local officials changed their view of aid, treating it with less certainty, transitory rather than permanent (i.e. a structural shift). The estimated coefficients of the

dynamic model imply that Federal aid now has a stimulative effect on county road expenditure patterns.

County road officials are more inclined to use federal aid as a way to leverage local dollars to undertake expensive projects that would otherwise not be feasible. These projects include constructing new roadways to support the development of rural areas, major upgrades or reconstruction of existing roads, or the purchase of expensive road maintenance equipment. This finding concurs with the previous empirical literature examining structural shifts. Given no substantive change in state aid policies, there would be no reason to expect local officials to treat state monies differently now and the empirical results of the model support this contention.

The impact that future changes in federal aid policy will have on local decision-making processes is unclear. On one hand, the looming federal deficit couple with uncertainity about the direction of the Republican controlled Congress, may lead local officials to continue treating Federal aid as transitory. In this case, federal aid will continue to have the stimulative effect identified in these findings. If, on the other hand, federal aid policy returns to the pre-Reagan and Bush era, there is no reason for local officials to treat aid as transitory. Indeed, a prolonged return to more generous and predictable federal aid policies may find local officials treating aid as more permanent. It is possible that local officials may return to using Federal aid as a form of local tax relief.

Because it is difficult to use these results to confidently predict future behavior on the part of local road officials, the reader should treat these findings and the subsequent analysis as suggestive rather than definitive. In particular, the complications that arise from the growth in matching grants and aids from the Federal government which flow through state governments, to name a few, have been glossed over in the analysis. In addition, the analysis assumes that there is little if any lag structure in the expenditure decisions. However, by viewing intergovernmental aid within the framework of permanent/transitory income, additional insights into the behavior of local officials are available.

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**Endnotes**

1. Much of the data in the following discussion are drawn from the Census of Governments, 1987 and Highway Statistics, various years. At the time of this analysis, the 1992 Census of Governments had yet to be released.

2. For the sample of counties used in the statistical analysis reported later in this article, federal aid per mile declined by 27.3 percent between 1982 and 1987.

3. Note the key here is a permanent decline through time. It is not expected that year to year volatility will cause a permanent shift in how local officials treat intergovernmental aid. In addition, the announced intent of the Reagan/Bush Administrations, coupled with a rising Federal deficit, clearly signaled the permanent reduction in Federal aid.

4. This model has been used primarily in the labor economics literature. See the work of Sue Augustyniak for more specific details on the specification of the structural model.

5. Note that aid is not treated as an endogenous variable. This is due to the nature of the road aid formulas dominant among counties. Specifically, road aid is a formula driven where local expenditures are not part of the formula (Chicoine, Walzer and Deller, 1989a). Most common, road aid depends on number of road miles maintained by the local jurisdiction.

6. Expenditures are for county governments only; responsibilities for rural road maintenance assumed by other units of local government (e.g. towns/townships) are not considered. For example, because counties have no road responsibilities in New England, these states are not included in the analysis. In addition, because no counties in New Jersey are defined as rural, this state was also removed. For a more complete discussion of local road responsibilities see Chicoine, Walzer and Deller (1989a).

7. These aids are limited to road designated aids. Federal aids also includes GRS monies. This may introduce a certain level of error because GRS monies need not necessarily go to roads but may support other functions.

8. Based on a limited empirical literature estimating demand for local low-volume road services, these variables appear to be time variate dominating (e.g., Chicoine, Walzer and Deller, 1989b).

9. A second possible limitation of this model involves the lack of an explicit trend variable. For example, a comparison from the depths of a recession through a period of prosperity could introduce a bias in the data. A "regression to the mean" problem is most likely if all or most of the observations have experienced major economic growth (Griliches and Hausman). This clearly is not the case in this study because many rural areas continued to suffer relatively high unemployment even when many urban areas experienced relative prosperity.

10. Please note that the policy conclusions are identical across both Model A and B.