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The objective of this study is to model an important class of regional institutions, namely metropolitan planning organizations (MPOs). MPOs are responsible for implementing United States Federal transportation policy at the local level in all areas with a population of 50,000 or more. The primary mission of the MPO is to engage in transportation planning to meet requirements for the receipt of federal funds that number in the hundreds of billions of dollars. The Federal-Aid Highway Act of 1962, and subsequent transportation legislation, stipulate that transportation projects can only receive federal funds if they go through a comprehensive, continuing, and cooperative regional process. In continuation of this legal protocol, the recent SAFETE-LU[1] legislation, and its predecessors - the ISTEA[2] and TEA-21[3] programs, require a designated MPO if federal funds are used for federal highway, transit, bridge, and other transportation funds on local projects. Moreover, if a MPO decides to use federal funds (which is always the case) then projects that use state and local funds for transportation projects must also go through a comprehensive planning process.

This research analyzes institutions of governance because institutions can constrain or augment the preferences of decision-makers. This paper focuses on an empirical analysis of MPOs for several reasons. First, MPOs are a common form of local government institutions that have received little scholarly attention (Gerber and Gibson 2006, 7). To understand the nature and extent of intergovernmental cooperation, scholars must consider the institutional context in which cooperation occurs, in addition to the regional conditions, local political and economic interests of the individual board members of MPOs. This paper also seeks to explain why MPOs choose to invest in regional versus local projects. In some places, regional decision-making processes empower local political actors, allowing them to retain significant authority over policymaking and hence shifting that balance of policy outcomes in the direction of local interests. In other cases, regional institutions allocate decision-making authority to more regionally focused actors who are less attached to particular localities. Such institutions allow regional entities to undertake activities that focus more on regional benefits, perhaps at the expense of local interests.

MPOs are not formal governments in the sense of possessing independent taxing and coercive over their members, rather they rely on various forms of voluntary action, compliance, and financing. Nevertheless, compared to most other forms of American regional governance, MPOs tend to be larger, better funded, more highly

[1] The Safe, Accountable, Flexible, and Efficient Transportation Equity Act of 2005
[2] The Intermodal Surface Transportation Efficiency Act of 1991
[3] The Transportation Equity Act for the 21st Century of 1998

institutionalized, engaged in a wider range of activities, and in existence for a longer time. In addition, important for this research, MPOs have a great deal of discretion over exactly they allocate the funds they receive. That is, there is a high degree of freedom to choose between different modes of transportation as well as between different geographic locations within their regional boundaries. Therefore, given the vast of sums of money they control, and coupled with the high degree of discretion they possess the decisions of MPOs result in real and important consequences for individuals and communities.

The decision-making component of MPOs is made up of boards of directors whose composition vary widely across the nation. "MPO members may include local government officials (elected and/or appointed), county government officials (elected and/or appointed), state government officials (especially appointed transportation officials), business and labor representatives, representatives from local universities and other educational institutions, and citizens" (Gerber and Gibson 2006, 7). It is the responsibility of each state's governor, in collaboration with general-purpose governments, to designate an MPO for each region (Lewis 1998, 842). In most cases, an existing regional entity such as a council of governments (COG) is the regionally designated entity. For others a new regional organization is created. The vast majority of MPOs reside in single counties, but it is also common that MPOs form larger umbrella type organizations encompassing many individual counties (such as the Southern California Association of Governments (SCAG)) and states. One reason for the variety of institutional designs is that federal policy makers have been unwilling to set strict requirements that affect board voting and representation (Sanchez and Wolf 2005, 1).

Although MPOs have been in existence since the 1950s, they generally operated as subdivisions of State Departments of Transportation (DOTs) or as a function of regional council of governments. It was not until ISTEA that they became more autonomous by having funds provided directly to them. Before the introduction of ISTEA, metropolitan planning organizations informally selected transportation projects from a wish list of projects that were not subject to any rigid financial constraints. After ISTEA, metropolitan planning organizations must now select transportation projects that only have a reasonable expectation of being funded from realistically anticipated revenues (Lewis 1998, 842-3). Taken together, the result is that MPOs now have more final discretion to select transportation projects with far few opportunities for local governments, transit districts, or state departments of transportation to influence MPO choices (Advisory Commission on Intergovernmental Relations 1995; Gage and McDowell 1995; U.S. General Accounting Office 1996).

An Electoral Analysis of MPOs

The first step in understanding how MPOs operate is to analyze them in terms of their electoral structures. This is because the resolution of conflicts, and thus what social policies we observe, hinges on the nature of the political institutions in place (Persson and Tabellini July 2000, 3). In relation to transportation planning, institutional theory tells us that MPO policies should be a function of the preferences of their board members, and the rules that aggregate these preferences into outcomes (North 1990). For example,

Gerber and Gibson (2006) find evidence that when the structures of MPOs privilege the interests of local actors, more locally situated projects emerge.

The Sample

As of 2008, there are 384 MPOs in the United States, which exist in all 50 states. This allows a multi-state analysis that captures significant variation in both institutional structures and social, economic and legal contexts in which MPOs operate. At the same time, MPOs are sufficiently similar to one another in terms of their institutional structures, resources, mandates, and activities to limit the number of variables necessary to explain and understand variation in their policy outputs. This study takes a random sample of 50 MPOs in order to obtain a representative sample of the total population. Table 1 gives some descriptive statistics for the 50 MPOs in the sample and compares the numbers with the entire population of MPOs. As we can see, the random sample and the universe are very similar in terms of mean population and mean designation year, while the mean sample area is slightly larger. Nevertheless, the sample is for the most part representative, and any trends that may develop we can extrapolate back to the entire MPO set.

Table 1: Some Descriptive Statistics of the MPOs

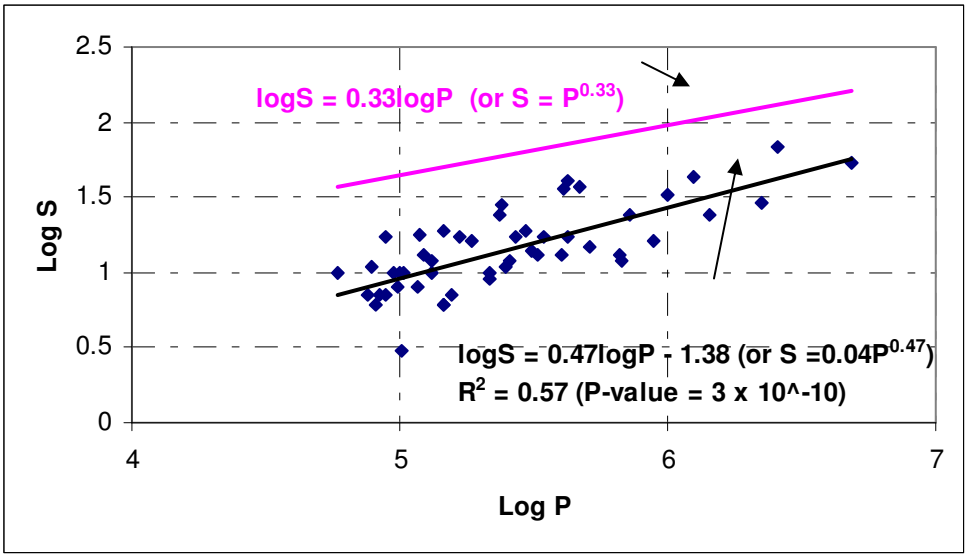
MPO Parameters	**Sample (n = 50)**	**All MPOs (n = 384)**
Mean Population	500,481	573,378
Mean Area (sq mi)	1,793	1,139
Mean Designation Year	1980	1979

The Assembly Size

The first step in analyzing MPO governing boards is to analyze their size in order to gain insight into their institutional composition. Without considering the constituent territories (or cities and counties in the case of MPOs), a logical first direction is to analyze their size in terms of population. Empirical studies have found that the total number of seats of most national assemblies tends to move toward the cube root of the total population (Taagepera, 2008). That is to say, we should expect the number of representatives of the board of directors to approximate $S = P^{1/3}$ if we consider only the individual MPO populations. Figure 1 regresses Log S against Log P, and we can see that the governing boards of MPOs are smaller than otherwise would be expected by only taking into account population. The actual best-fit line is represented by the equation $S = 0.04P^{0.47}$. The data produces a clear relationship between the assembly size (S) and

population (P) (with $R^2 = 0.57$), however, it is systematically below the theoretical line of $S = P^{0.33}$.

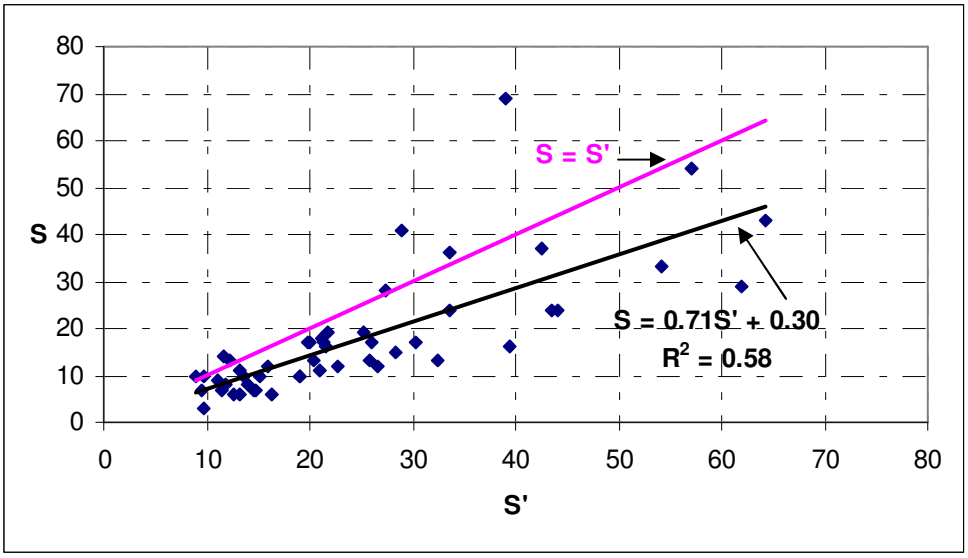
Figure 1: The Assembly Size and Population



However, considering only population does not take into account any territorial subunits, or in the case of metropolitan planning organization - the city and counties that comprise them. In this situation, what is a fair allocation of seats? Is it fair to consider one territory one vote, or to consider one-person one vote? The above equation $S = P^{0.33}$ considers only one-person one vote. Taagepera and Recchia (2002) have devised an equation that balances between these two extremes. The reasoning is that the lowest value of any assembly size will be the number of territorial subunits (T). At the other extreme, the largest size will be the cube root of the population. If we take the geometric mean between these two logical limits, then an ideal assembly size is predicted by the equation: $S' = P^{1/6}T^{1/2}$. This equation picks the mean value to be the fairest and most equitable balance between population and territorial subunits.

Figure 2 measures the actual assembly size (S) versus $S' = P^{1/6}T^{1/2}$ (the ideal assembly size). The line $S = S'$ (or $y = x$) represents the ideal assembly size, while $S = 0.71S' + 0.30$ depicts the best-fit line ($R^2 = 0.58$). Because the best-fit line trails below the ideal line, this tells us that the MPO governing boards are still undersized with an over representation of territorial subunits (i.e. one territory one vote) at the expense of population (i.e. one person one vote), and especially when the assembly sizes get larger. If we take the average value of S and divide it by the average value of S' then MPOs are roughly 72 percent of what they should be if we consider the geometric average to be a fair balance. However, Figure 2 also tells us that S approximates S' when the assembly size is small showing that there is a balance between population and territorial subunits with the smaller MPO governing boards.

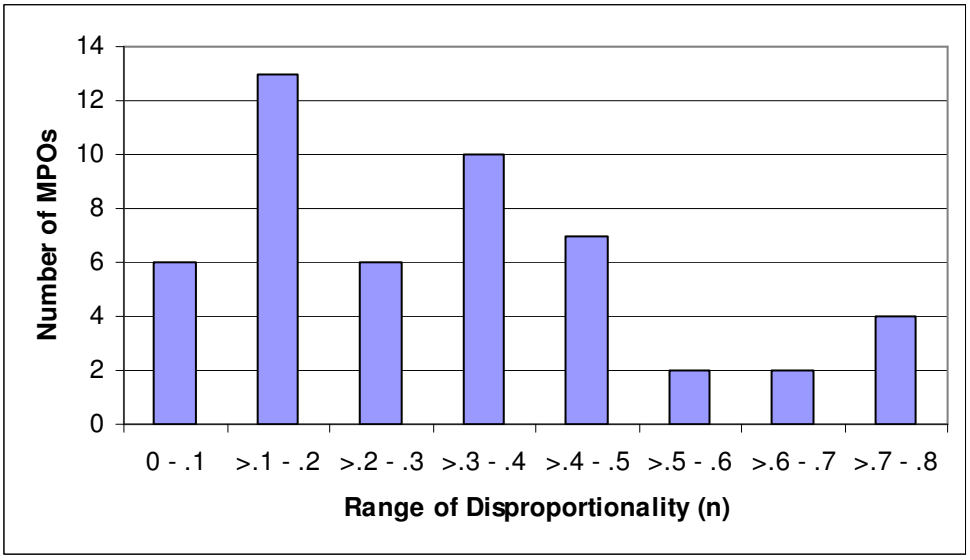
Figure 2: The Actual Assembly Size and the Ideal Assembly Size



There is a measure that illustrates the balance between territorial subunits and total population. Taagepera and Hosli (2006) present a modification of the law of minority attrition where they express the disproportionality exponent (n) in terms of not only total population (P) and the total number of seats (S), but also the number of territorial subunits (T). The equation is given by the formula: n = (1/log S – 1/log T)/ (1/log P- 1/ log T). In this model when the exponent equals 0.5, there is a balance between territorial subunits and population. Any number less than 0.5 shows that there is an over representation of territories, while a number larger than 0.5 shows the minorities (or territories) are under representative in terms of total population. The average value of this disproportionality exponent for the sample of fifty MPOs is 0.32 (with a range from 0 to 0.78). Therefore, on average about 18 percent of city (or territorial seats) are misallocated at the expense of regional seats. Figure 3 shows the relative distribution of the disproportionality exponent "n" for the sample of 50 MPOs.

One possible explanation for the widening of the gap between the ideal assembly size and the actual assembly size in Figure 2 is there are a certain constant number of token regional seats in any given MPO governing board. That is to say, the numbers of token seats are somewhat independent of the number of territorial units. An MPO, in theory, does not need regional seats to have a balance between one-person one vote and one territory one vote. However, when they are present they help the balance in favor of one person or one vote. In general, regional seats tend to be various state and federal representatives, such as members of the respective state department of transportation or the Federal Highway Administration. An implication of this theory is that the number of regional seats will not change very much as the numbers of territories increase. If we regress the number of regional seats (R) against the number of territorial subunits (T), then the best-fit linear relationship is R = 0.10T + 4.2, R^2 = 0.05 (P-value = 0.111). In this instance, the implication holds true where the average number of regional seats is 5.2 and increases very slowly from the baseline value of 4.2 as the number of territories increase. This by itself does not confirm that there is token representation at play; however, it does provide some validity to this assumption.

Figure 3: The MPOs and the Levels of Disproportionality



Other Measures of Proportionality

In electoral system's theory, proportional systems allow representation from a greater variety of interests, while majoritarian systems are more grounded in local interests (Ferretti, Perotti, and Rostagno 2001, 1). In a proportional system, each district elects more than one representative. Hence, more than one social group will be represented in an electoral body. Therefore, in comparison to the majoritarian system, each representative derives a different type of utility from different type of transfer (Ferretti, Perotti, and Rostagno 2001, 2). This generates a dichotomy between allegiance to social constituents and allegiance to geographic constituents, with a greater variety of interests being represented in proportional systems and the greater importance of local interests in majoritarian systems (Ferretti, Perotti, and Rostagno 2001, 3).

Equity issues arise from the structural arrangements of membership and voting within MPOs. In most MPOs, each political jurisdiction normally receives one vote. Citing the principal or one-person, one-vote, larger jurisdictions may consider themselves to be unfairly represented. At the same time, the smaller jurisdictions may prefer the one-jurisdiction, one-vote procedure as a way to prevent larger jurisdictions, often in the urban center, from dominating planning recommendations and decisions (Sanchez and Wolf 2005, 7).

Federal transportation laws do not require an organizational or vote structure that prevents bias in allocating transportation investments. As a result, MPO voting is usually non-proportional or unweighted based on population. Given the challenges of MPOs addressing regional needs, this creates tension among competing jurisdictions (Francois 1995). In very few cases is the MPO voting structure apportioned directly on the basis of population (Lewis and Sprague 1997, Lewis 1998). There are two ways to evaluate MPOs in terms of the importance they place on social or equity, and that is to examine

the products of their planning activities and also the representativeness of their policy makers (Sanchez and Wolf 2005, 2).

It is possible to quantitatively measure the degree to which representation of the population is skewed in any MPO by calculating an index of disproportionality. For example, Lewis (1998) uses the Loosemore-Hanby index, given by the following formula

$$D = (1/2) \sum \left| s_i - p_i \right|,$$

where s is the percentage of votes on the MPO governing board by each population unit, and p is the percentage of total population held by that unit. The resulting index D, which measures the overall deviation of the MPO from proportional representation of its population, will range from 0 percent to 100 percent. The higher the value of D, the worse representation is within the MPO.

As an illustration, for most MPOs, the relevant units of analysis for measuring proportionality are individual cities. However, an account must also be made for an MPO board's representation of residents in unincorporated areas. The assumption is made that the country supervisors sitting on the MPO board represent the residents of a city within their county in proportion to the population share of that city. For example, a city that constitutes 50 percent of the population of its county, and if the city has one vote on the MPO board, and a supervisor from this city's county also has one vote on the board, them the city effectively gets 1.5 votes on the board. An unincorporated portion of a county that makes up 30 percent of its county's population may have no direct votes on the MPO board but would be assumed to be represented by 0.3 votes of any county supervisor on the board (Lewis 1998, 847). If a voting member on an MPO board is from a state department of transportation, then the assumption is made that member represents the whole county (or region). Many times, these sorts of representatives from interest groups or state bureaucracies have a nonvoting status. In this case, I do not consider there preferences have any real value on the selection of transportation projects.

Figure 4 presents the relative distribution of disproportionality for the sample of 50 MPOs. The minimum value of disproportionality (D) is 0.07 for Bi-State Regional Commission in Iowa, and a maximum value of 0.64 for the Fresno Council of Governments located in California. The average level of disproportionality is 0.29 with a standard deviation of 0.14.

The question then becomes what is driving these levels of disproportionality? From the electoral analysis already done, the most logical variables to investigate are the number of territories and the percentage of regional seats. Figure 5 regresses the percent of disproportionality (D) against the number of territorial units (T). Here there is a strong linear relationship between the two with $R^2 = 0.51$ (P-value = 5×10^{-9}).

Next, what happens when we regress percent of disproportionality against the percentage of regional seats? In Figure 6 we can see that as the number of regional seats increase the levels of disproportionality decrease. In this case the best-fit line is $D = -0.39R + 42.83$, with an $R^2 = 0.29$ (P-value = 8×10^{-5}). However, the percentage of regional seats creates an upper threshold on the maximum levels of disproportionalitiy can take. This is because regional seats are perfectly proportional, so the percentages of regional seats decrease the maximum value of disproportionality by a corresponding amount. If we know nothing else and the sample is random, then the values of disproportionality will take on any random value anywhere within the upper threshold at any given percentage of regional seats. The best guess of a logical relationship will be

Figure 4: The MPOs and the Levels of Disproportionality

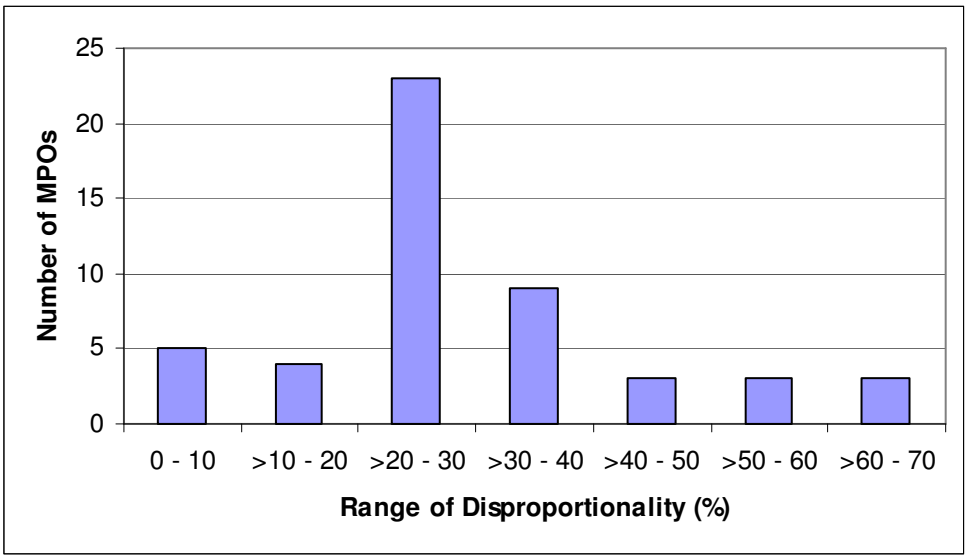
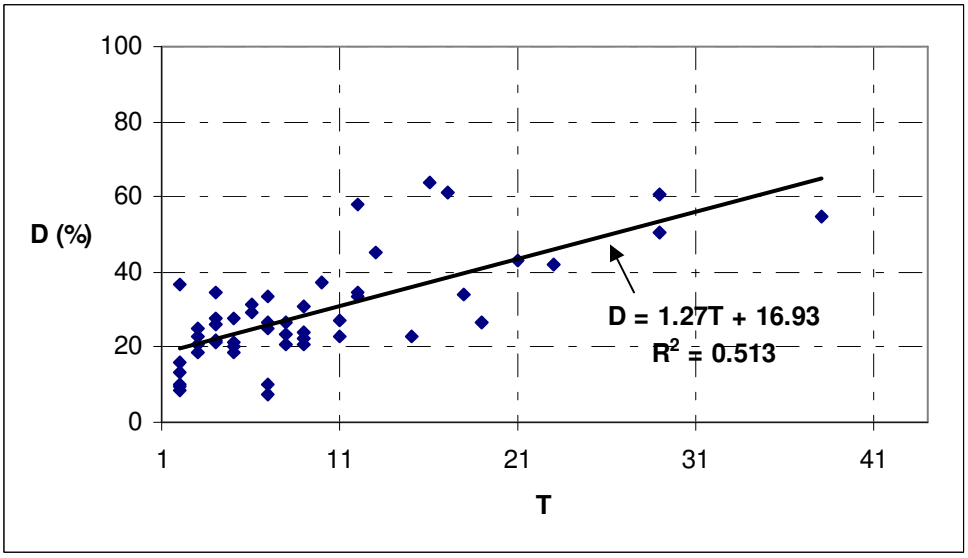


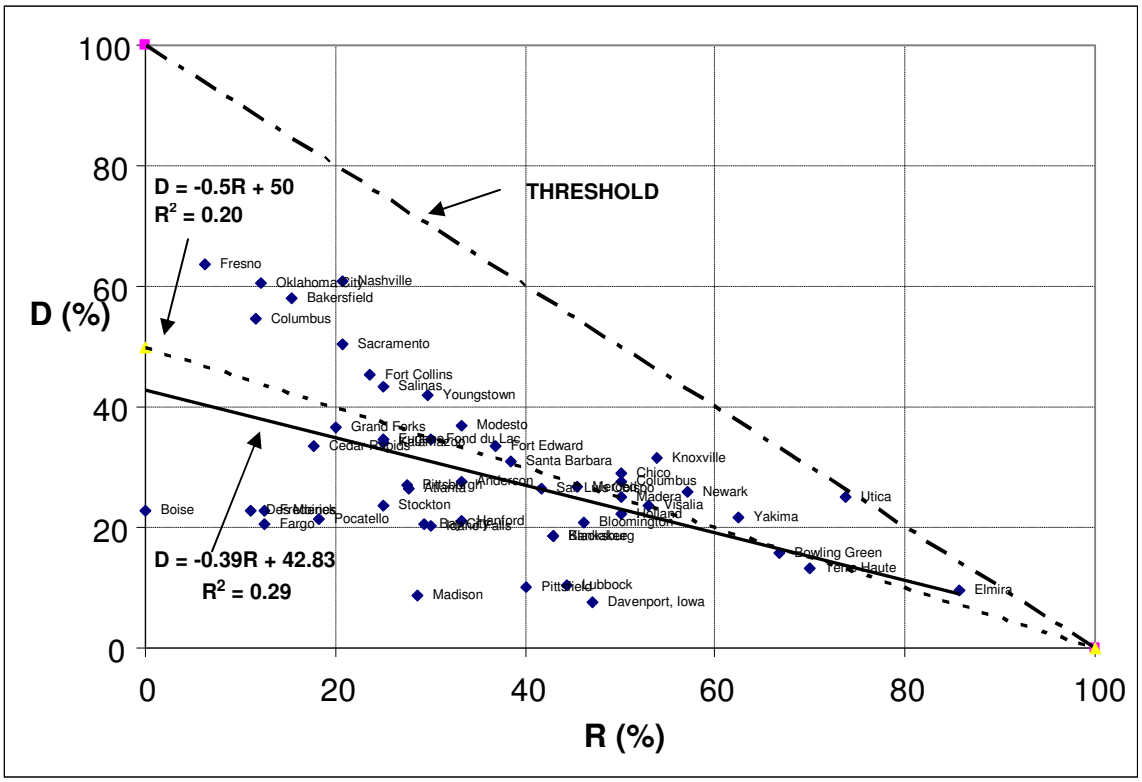
Figure 5: The Percent Disproportionality and the Number of Territorial Units



the average value between the two relative extremes. For example, when the percentage of regional seats is zero, the average value of disproportionality is 50 percent; and when the percentage of regional seats is 100 percent with pure proportional representation, then the only value disproportionality can take is zero. If we draw a line connecting these two extremes, this comes very close to being the best-fit line ($R^2 = 0.20$).

Having a certain amount of regional seats is not necessary to have a low level of disproportionality as we can see in Figure 6. That is, there are quite a few MPOs with low levels of disproportionality even when they have low amount of regional seats. However, having regional seats, truncates the permissible values of disproportionality. This means that in the case of Fresno with a disproportionality level of 63.77, the real level of disproportionality for the city seats are even worse. This is because we do not divide by 100 because when we have 6.25 percent of regional votes. For example, the real level of disproportionality of the combined city seats is 63.77/93.75, which equals 68.02 percent.

Figure 6: Disproportionality versus Regional Seats



Interregional Cooperation

This section of the paper seeks to explain why MPOs choose to fund regional versus local projects in order to test the propensity of MPOs to cooperate on a regional basis. Local projects are those whose geographic scope is contained within a single jurisdiction, such as a single bride repair, intersection improvement, or a localized road construction repair.

These sorts of projects can be thought of as direct allocations to individual local governments that require little or no cooperation between MPO members to plan, develop, manage, or implement. By contrast, regional projects are those whose geographic scope traverses multiple local government boundaries.

Methodology

To study the role that institutions play in the transportation planning process, the primary outcome variable is the share of all federal funds from all modes of transportation that an MPO allocates to regional projects (excluding aviation). The most recent three year Federal Transportation Improvement Program (FTIP) is the primary data source for this project. SAFETE-LU federal legislation requires MPOs to adopt, by a vote of their board, a three-year FTIP that lists each project that will receive funding from the several funds that make up federal bridges, highways, and air quality programs. It is the norm that individual transportation projects use a variety of federal, state, and local funding sources for the same project. The MPO must designate the federal, state, and local funding sources for each project so that the FTIP is effectively fiscally constrained. The number of projects included in a FTIP range from several thousand in the largest MPOs to several dozen in the smallest.

This study takes data from the 50 MPOs' most recent FTIP according to whether the federal funds are allocated for regional projects. A project is considered "regional" if the sponsoring agency is a regionally focused organization, such as a multi-jurisdictional transit authority or the MPO itself. A project is coded "local" if its geographic scope is limited to one or two local government jurisdictions or sponsored by an individual local or county government. The outcome variable is the percent of all federal funds in the three-year FTIP allocation to regional projects. The plan is to use current federal dollars (not prior dollars) that are allocated to the current FTIP. This is because projects delays can span over a few FTIP cycles, often due to environmental or right-of-way constraints (usually on a non-random basis). Therefore, prior dollars are not really a conserved quantity since some prior dollars have already been "closed-out" on other projects that met their schedules.

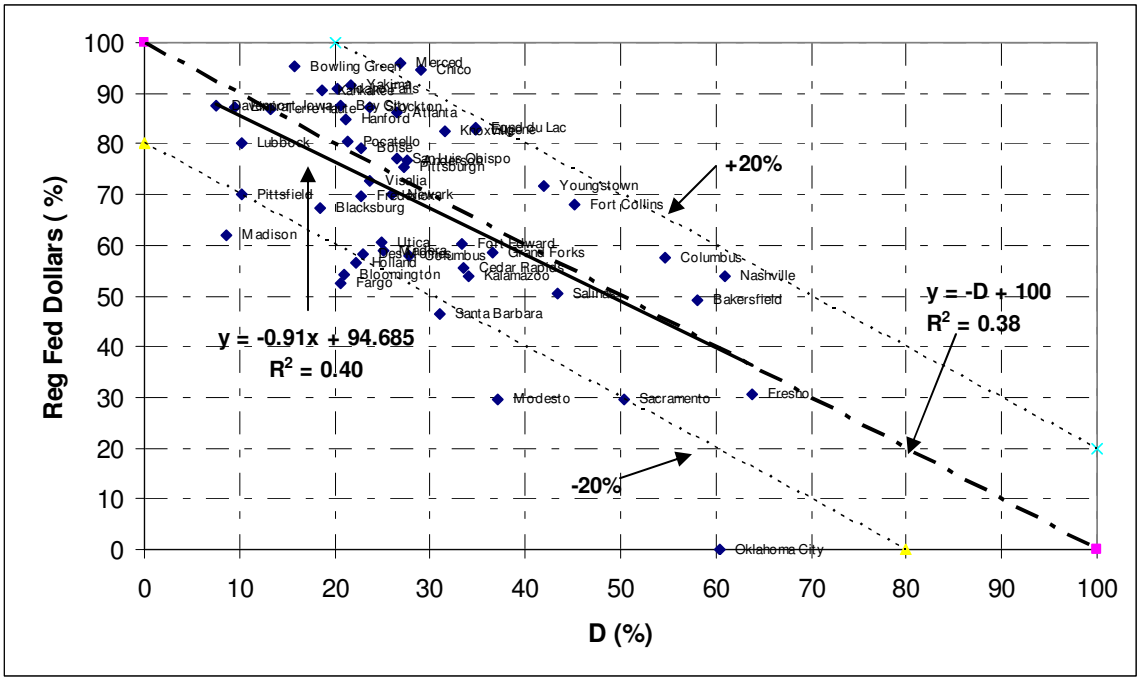
By definition, a project is a temporary endeavor undertaken to create a unique product or service (Project Management Institute, 2000, 4). An individual project may involve any of a wide range of activities, such as repairing a bridge, resurfacing a portion of an existing road, repairing environmental damage caused by an existing roadway, widening a stretch of highway, reconfiguring an intersection, conducting a transit engineering/feasibility study, adding enhanced metering systems to a regional road network, building a new transit facility, constructing a pedestrian/bicycle path, purchasing buses or light rail cars, etc. (Gerber and Gibson 2006, 12). It is commonplace that several projects may be underway in a given location at any given time.

Testing Interregional Cooperation

The first place to start is by testing the relationship between the percentage of federal regional funds against the level of disproportionality produced by the Loosemore-Hanby index (see Figure 7). In this case, there is a strong correspondence between the level of disproportionality and the percentage of federal funds allocated to regional projects (R^2 = 0.40). Moreover, the relationship follows very closely to the line that connects the maximum values on each axis, which corresponds to y = x (R^2 = 0.38). For example, when the level of disproportionality is zero, one hundred percent of federal funds are allocated to regional projects. We can also see that most the data points fall within plus or minus 20 percent from this line.

Sometimes statistics seem trivial and mundane; however, the current dollar value of the total federal funds allocated to the sample of 50 metropolitan planning agencies is 17.3 billion dollars! Therefore, if approximately 40 percent of federal funds, which are allocated to regional projects are predicted by the levels of disproportionality, then approximately 7 billion dollars of federal transportation funds are spent on non-regional projects that could otherwise be spent on regional projects. This is not to say that MPOs will not invest in local projects, rather they will use state and local funds instead of federal funds, which are more of a pure collective good because the cost of these funds are spread across all tax payers in the United States.

Figure 7: Regional Federal Dollars and Disproportionality

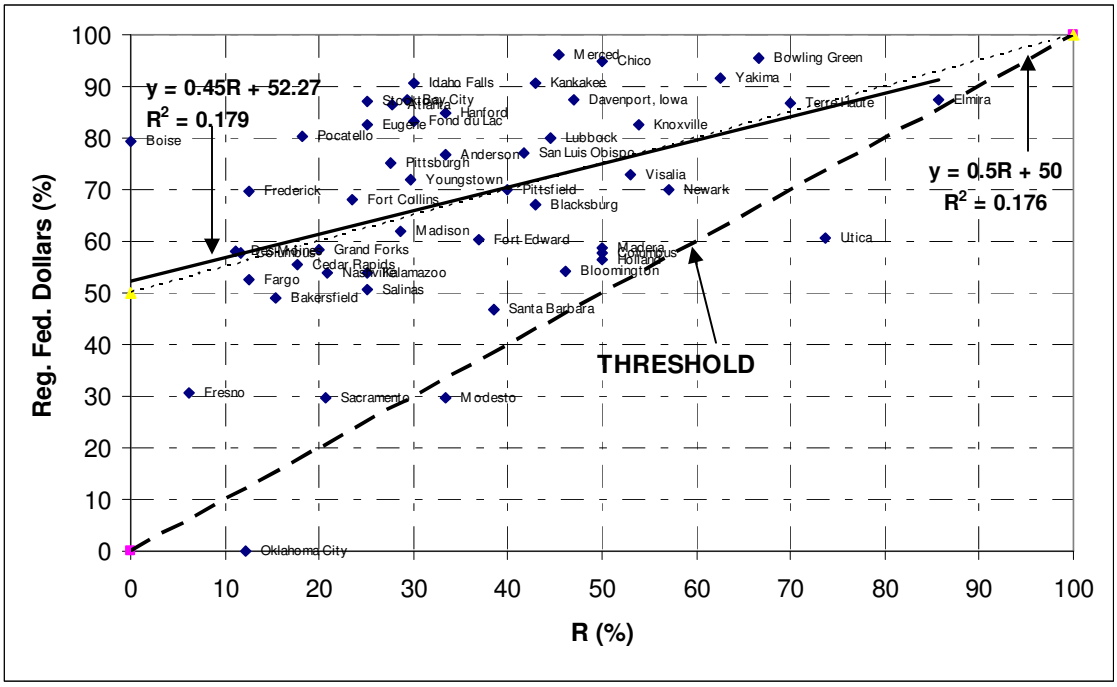


Now, what happens if we plot the percentage of regional federal dollars against the percentage of regional seats? From Figure 8, it turns out that it looks very similar to Figure 6 (which plots disproportionality against the percentage of regional seats). We can see from Figure 8 that there is a forbidden zone here as well. Generally, the amount of federal regional dollars allocated to regional projects stays within the prescribed

threshold, because the percentage of regional seats more or less truncates the range of federal dollars that can be allocated to regional projects. The best-fit line is given by the equation $y = 0.45R + 52.27$ ($R^2 = 0.179$). The most logical expression is a line that connects the means of the two logical extremes the percentage of regional federal dollars can take when the percentage of regional seats is 0 percent and 100 percent. In this case, the equation that this line produces is $y = 0.5R + 50$ ($R^2 = 0.179$).

Given the closeness between this line and best fit line, this confirms that the amount of federal regional dollars are spread somewhat randomly between the extreme values it can take when bounded by a prescribed percentage of regional seats. Again, it is not necessary to have regional seats to be proportional. However, when regional seats are present this affects the maximum levels of disproportionality and, hence, the amount of federal dollars allocated to regional projects.

Figure 8: Regional Federal Dollars and Percentage of Regional Seats



Conclusion

In summary, these are the finding of this study.

- If we consider the ideal assembly size to be given by the equation $S = P^{1/6}T^{1/2}$, then the governing boards of most MPO boards are smaller than what is actually present.
- If the equation n = (1/log S – 1/log T)/(1/log P- 1/ log T) tells us the degree at which an assembly is balanced in terms of one person one vote and one territory one vote, then the boards of directors of MPOs are on the average are balanced in favor of the cities (or territories).
- When MPO boards are balanced, they have a higher number of at-large or regional seats, which create a better balance in favor of one-person one vote.
- There is reason to believe that regional seats are distributed on a token basis in MPO governing boards because the numbers of regional seats increase slowly from a baseline value as the number of territorial units increase.
- Because MPOs have a paucity of regional seats, this results in them having a high degree of disproportionality when using the Loosemore-Hanby index. This is because there is a direct relationship between the percent of regional seats and the upper threshold that disproportionality can take.
- The degree of disproportionality and imbalance that exists in MPO governing boards is highly related to the percent federal transportation funds that are allocated to regional projects. That is, the lower the disproportionality, the greater amount of federal funds that are spent on regional projects. Therefore, even if the amount of regional seats are allocated as a token gesture, they tend to have a significant impact on the amount of regional federal dollars spent on regional projects.
- The obvious solution to fix the problem is to increase the number seats in most MPO boards to enhance the balance towards one-person one vote. The easiest way to do this is to add more regional seats that represent the total population at large.
- The degree to which MPO cooperate on a regional basis on other issues besides transportation, in general, probably relates to the extent they program regional transportation projects. As a result, this has real and serious ramifications for communities that extend beyond the direct and indirect consequences of transportation infrastructure. It also provides lessons learned for other types of governments that rely on interregional cooperation to regulate collective goods (such most types of natural resources - including the atmosphere).

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