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Donor States and Donee States: Investigating Geographic Redistribution of the US Federal-Aid Highway Program 1974-2008

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Abstract

In 2009, the US government spent more than $42 billion on the federal-aid highway program. Most of this money was raised from motor vehicle taxes, whose proceeds are deposited in the highway trust fund. Federal motor vehicle user taxes flow into the fund and aid expenditures flow out from it to build and maintain highways and other transportation infrastructure. With so much money at stake it should be no surprise that expenditure decisions are the subject of intense political debate. Chief among these debates is the conflict between donor states, whose residents pay more in highway user taxes than the state receives in federal highway aid and donee states, whose residents pay less in highway user taxes than the state receives in highway aid. While this geographic redistribution has been masked recently by infusions of general fund revenue into the trust fund, the debate nevertheless continues. This paper attempts to understand why some states are donors and others are donees by simultaneously testing four hypotheses about the geographic redistribution of federal highway dollars that relate to a state's highway need, economic condition, level of urbanization, and representation on the key Congressional oversight committees. The analyses show that redistribution does not favor states with larger highway systems, more highway use, or lower median incomes, all of which are different indicators of need. Instead, states that are less urban and better represented on the four key Congressional committees generally benefit from redistribution. These findings indicate that the user tax revenues are not used in places where they are most needed. Thus they provide little empirical support for any compelling policy argument for continued geographic redistribution of federal highway user tax dollars.

Keywords Donor States and Donee States, Highway Policy, Federal Highway Trust Fund, Geographic Redistribution

Introduction

The US federal highway program is primarily funded by highway user taxes whose proceeds are deposited in a dedicated trust fund, called the highway trust fund. Federal highway aid expenditures then flow from the fund to build and maintain highway and other transportation projects around the country. However, there is no guarantee that money is returned to the state from whose taxpayers it is collected. The highway program creates winners and losers. Some states pay more in highway user taxes than they receive in federal highway aid; these states are called donor states. Other states receive more in aid than they pay in user taxes; these states are called donee states. Donor state representatives have long pressed for a more equitable distribution of federal highway dollars, usually citing general fairness concerns. As then-Ohio Senator Howard Metzenbaum stated in 1991:

> *"What we have here is a debate about numbers. It has to do with the fact that a number of States have been shortchanged over a period of years, and there may very well have been a reason for that to have occurred, because some of the Western States did not have as much tax revenue, had longer highways, so that kind of arrangement was made… (but today) the basic issue has to do with the fairness and equity of some States getting 85 cents on the dollar and some States getting $2 and $3 and $7 on the dollar paid in." (Congressional Record 1991: 7401)*

Representatives from donor states have long complained about the perceived unfairness of their treatment. Their complaints helped delay passage of the two most recent pieces of federal surface transportation authorizing legislation until compromises could be negotiated among the various states' Congressional representatives. They wanted a larger proportion of their residents' user tax payments returned to them in highway aid. They have typically used

transportation program reauthorization as a time to forge coalitions of similarly situated states, raise the banner of state equity, and argue for a more equitable distribution of federal aid dollars. Their complaints led to the insertion of a provision in the Safe, Accountable, Flexible, Efficient Transportation Equity Act- A Legacy for Users (SAFETEA-LU) in 2005 that requires states to receive a 92 percent minimum guaranteed return (in the form of federal highway aid) of their residents' highway user tax payments. This represents an increase over the 90.5 percent return required under SAFETEA-LU's predecessor, the Transportation Equity Act for the 21st Century (TEA-21), but less than the 95 percent return sought by fourteen donor states affiliated with the States' Highway Alliance for Real Equity (SHARE).

In recent years, the highway trust fund has been supported by an infusion of non-highway user tax revenue from the federal general fund, as highway user tax revenues have not kept pace with increased federal aid expenditures. General fund support has been particularly important in the past decade, as Congressional reluctance to increase federal motor fuel tax rates combined with cost inflation and increased vehicle fuel efficiency have gradually reduced the highway trust fund's ability to fund transportation projects. In 2009 alone, $7 billion in general fund revenue was added to the highway trust fund's highway account, which is used to finance the federal highway program (Federal Highway Administration 2011, Table FA-5). These general fund infusions have meant that nearly all states have received more total federal money for highway projects than their residents paid into the highway trust fund in any given year, thus rendering the donor-donee debate a moot issue for many observers (Kirk 2004; US Government Accountability Office 2010). However, other observers have correctly noted that general fund infusions have merely masked but not eliminated the geographic redistribution of user tax revenues that continues to take place. For example, Utt (2011) notes that 28 states received less in federal user tax-derived aid than their residents paid in user tax revenue in 2009, with one state (Texas) receiving aid equivalent to only 83.5 percent of the taxes paid.

Thus, geographic redistribution of user tax money is still a fact in the federal highway program, despite the ongoing infusion of non-user tax revenues into the fund.

The donor state controversy raises one important policy question: why are some states donors and other states donees? Related to this is the question: does geographic redistribution serve any compelling public policy rationale? And finally: if geographic redistribution does not serve any compelling public policy rationale, why does it continue?

There are a number of potential explanations for the geographic redistribution of federal highway user tax revenues. Historically, redistribution was necessary to build a national highway network, most notably the interstate highway system. However, the interstate highway system was completed about 20 years ago, while geographic redistribution continues. Other alternate explanations for redistribution range from attempts to address different states' varying highway needs, defined in a number of different ways, to political considerations that often fall under the label of pork barrel politics, to what might be called simple programmatic or institutional inertia. For example, geographic redistribution might serve as a means of aiding states with more extensive highway systems or more highway system use, both measures of highway need. Or, redistribution might benefit lower income states and/or states that do not have the state fiscal resources they need to maintain their highway systems. Each of these explanations could be categorized as equity-based policy arguments for geographic redistribution. Alternately, geographic redistribution might benefit states that have had representation on the key congressional committees that write the nation's transportation legislation. This explanation would fit in with political science theories about pork barrel and redistributive politics. Finally, redistribution may simply be the result of legislative inertia, a product of the highway program's earlier history as a predominantly rural-oriented highway program. Perhaps rural states are the beneficiaries of redistribution by virtue of their overrepresentation in the Senate and the legislative structure's tendency toward policy inertia?

This paper tests these various potential explanations for geographic redistribution in order to understand the logic and/or consequences of redistribution. The analysis shows that, at different periods over the last three decades, variables associated with all of these hypotheses were related to a state's user tax-derived aid apportionment, its net aid distribution, and its ratio of user tax-derived aid apportionments to user tax payments. The last two variables serve as measures of geographic redistribution, which is the primary focus of our study. Both measures were negatively associated with indicators of highway need, positively related to a state's income, negatively associated with its degree of urbanization, and, generally positively associated with its representation on the Congressional committees that oversee the highway program. These findings provide little empirical support for any compelling policy argument for continued geographic redistribution of federal highway user tax dollars.

Donors versus donees and federal highway aid apportionment

The program at the center of the donor state debate is the federal highway program, which is one of a handful of programs financed primarily by highway user taxes (Federal Highway Administration 1999). The proceeds from federal taxes on fuel, tires, oil, and other items used by the traveling public are deposited into the federal highway trust fund. The revenues deposited in this fund are then distributed among the states in the form of financial assistance for highway, transit, and other transportation projects. Historically, highway user taxes have provided the bulk of the money used to support the highway program, which is funded from the highway trust fund's highway account. But in recent years the highway trust fund has been bolstered by the infusion of some general fund revenues derived from other tax sources. In 2009, user tax sources provided $27 billion in revenues to the federal highway trust fund's highway account, which funds federal aid highway projects, while an additional $7 billion in general fund revenues were transferred into the account (Federal Highway Administration 2011,

Table FA-5). General fund transfers have become more common in recent years because federal highway user tax revenues have not kept pace with increased federal aid expenditures (Congressional Research Service 2004; US Government Accountability Office 2010; Utt 2011). The primary reason for this funding deficit is Congressional reluctance to increase federal highway user taxes for almost 20 years, which has weakened the highway trust fund's purchasing power in the face of general price inflation and increased motor vehicle fuel efficiency. But even with these recent general fund transfers, the bulk of federal highway revenues still come from motor vehicle user taxes, which is in keeping with the rationale for having a highway trust fund in the first place—as a repository of funding for a user tax-based highway finance system (Brown 1998; Federal Highway Administration 2011, Table FA-5).

Indeed, highway user taxes have long been characterized as being the functional equivalent to fees levied on travelers for using the highway system (Bramlett 1982). The user-fee view of highway user taxes was an important argument used by proponents for a creating a federal highway trust fund in 1956 and it is a critical part of the donor state debate today (Brown 1998; Utt 2011). One logical interpretation of the user fee view of motor vehicle taxes is that the proceeds of the taxes should be used to fund projects that benefit the individuals who pay the tax, the users of the transportation system. This has indeed been the historic position of most key stakeholder groups involved in federal highway policy debates (Brown 1998). A second, related, interpretation is that, barring any compelling policy rationale, the money raised from taxpayers should be used to build and maintain facilities in the places where the revenues are raised, to the maximum extent possible. In this view, user tax revenues would therefore not be redistributed at all, or perhaps redistributed only in furtherance of an explicit compelling national policy goal, such as the creation of the national interstate highway system. This latter interpretation is generally reflective of the donor state view of the issue.

Of course, while user tax revenues have historically largely been reserved to fund transportation projects, save for a short time when some trust fund revenues were diverted

toward deficit reduction in the 1990s, revenues have been geographically redistributed over the entire history of the federal highway trust fund. This is the crux of the donor-donee debate, with so-called donor states receiving less in aid than they contribute in user tax revenues and donee states receiving more in aid than they contribute in taxes. Figure 1 shows average annual federal highway aid apportionment (by state), expressed in constant 2005 dollars per capita (calculated from Federal Highway Administration 1974-2005, Tables DL-1C and FE-221). The map panels correspond to time periods covered by five different pieces of surface transportation authorizing legislation. Authorizing legislation defines the various transportation programs and their eligibility requirements, sets the overall funding levels, and establishes the formulas (and other mechanisms) by which program funds are apportioned to the states. The upper left panel displays the average annual aid apportionments (per capita) from 1974-1982, the period between passage of the 1973 Federal-Aid Highway Act (FAHA) and the 1983 Surface Transportation Assistance Act (STAA). The upper right panel covers 1983-1991, the period between STAA and the 1991 Intermodal Surface Transportation Efficiency Act (ISTEA). The left panel in second row covers the ISTEA era (1992-1998). The right panel in second row covers the TEA-21 era (1999-2005). The lower left panel covers the SAFETEA-LU era (2006-2008). Each era reflects different compromises around the donor state issue, as we will note shortly. The panels show that states with the highest annual per capita aid apportionments include the upper plains states, West Virginia, Vermont, Alaska, and Hawaii. The spatial pattern has changed slightly over time.

(Figure 1)

From the creation of the highway trust fund in 1956 until 2005, fourteen states (California, Florida, Georgia, Indiana, Michigan, Missouri, New Jersey, North Carolina, Ohio, Oklahoma, South Carolina, Tennessee, Texas, and Wisconsin) received less in total highway aid than their

residents paid in total highway user taxes. Of these states, Texas had the lowest return ratio (0.88). In 2005 alone, eleven donor states received $485 million less in aid apportionments than their residents paid in user taxes (Federal Highway Administration 1974-2005, Table FE-221). Over the period from 1956 to 2005, 35 states (plus the District of Columbia) had return ratios that exceed 1. Seven states (Alaska, Hawaii, Montana, North Dakota, Rhode Island, South Dakota, and Vermont, plus the District of Columbia) received more than twice as much in highway aid apportionments as their residents paid in user taxes. Of these states, Alaska had the highest ratio (6.66). In 2005 alone, 39 donee states (plus the District of Columbia) received $5.2 billion more in apportionments than their residents paid in user taxes (Federal Highway Administration 1974-2005, Table FE-221). The specific states classified as donors or donees fluctuates from year to year, but the general membership of each group has been remarkably stable over time.

The pattern of donor and done states is produced by the imbalance between user tax revenues paid and user tax funded federal aid received. Tax revenues paid are a function of vehicle ownership, vehicle use, and federal tax rates. Aid received is the result of a Congressionally-established aid apportionment process that encompasses formula funding and discretionary funding of various category types (Congressional Research Service 2004). A small, and growing, proportion of the federal highway trust fund revenue is distributed through Congressional earmarks, which are projects specifically designated by members of Congress.[1] But most of the highway trust fund money is distributed, through apportionment formulas, to the states for their federal-aid highway projects. These formulas include factors that correspond to politically negotiated definitions of a state's federal aid need within each of the highway program categories plus so-called minimum apportionment rules that are designed to facilitate a more equitable geographic distribution of aid expenditures among the states.

[1] Recent House rules have imposed an earmark moratorium since 2010. However, some congress members have grown increasingly agitated by this idea and the discussion is continuing.

Under SAFETEA-LU, highway formula funding factors include a state's total population, urbanized area population, population in air quality non-attainment areas, vehicle miles traveled on the interstate system, vehicle miles traveled on the federal-aid highway system, highway lane miles, highway centerline miles, and highway fatalities, among other factors (Federal Highway Administration 1974-2005, Table FA-4A). However, prior to applying these formulas, a process called minimum apportionment is frequently used to provide each state with a minimum level of funding in each program category. Minimum apportionment entered the federal highway program in 1921 when there was concern that less populated states would not have the resources available to maintain professional state highway departments in the absence of a minimum level of ongoing funding (Brown 2003). In response, Congress enacted a provision whereby each state would receive a minimum of 0.5 percent of the federal aid being expended in a program—before the apportionment formula was applied. The net result was that in a typical highway program category, 25 percent of total funding (0.5 percent times 50 states) could be distributed without regard to the formulas that have been negotiated to reflect a state's need for that funding. Minimum apportionment still plays a role in all the major federal highway programs. Under SAFETEA-LU, the 0.5 percent minimum apportionment provision is present in seven highway programs (Federal Highway Administration 1974-2005, Table FA-4A). In an eighth program, the minimum apportionment is reduced to 0.25 percent. In the ninth program, recreational trails, half of program funding is apportioned on an equal basis among the states. Thus, the desire for geographic equity among the states is a strong feature of the highway program.

Political negotiations over minimum guaranteed returns

Donor state representatives grudgingly accepted the need for geographic redistribution while the basic national highway infrastructure, especially the interstate system, was put in

place in the 1960s and 1970s (Congressional Record 1982; Congressional Record 1991; Congressional Record 1998). By the early 1980s, however, the interstate system was virtually complete. Since then, donor state representatives have become much less tolerant of redistribution, and they have used reauthorization as a time to demand more equitable treatment (Weingroff 2001). They were among the leading proponents of proposals in 1982, 1991, and 1998 to change the factors used in the formulas to apportion federal aid (Brown 2003). They have also sought to more directly affect the geographic distribution of federal highway dollars through the use of a relatively new rule called the minimum guaranteed return, or equity bonus, which is designed to increase the state's ratio of user tax payments to aid received to a legislatively specified minimum ratio (US Government Accountability Office 2010). Perhaps not surprisingly, donee state representatives have been among the leading proponents of maintaining the programmatic status quo.

Donor state complaints prompted the enactment of the first minimum guaranteed return as part of STAA signed in 1983. In the period immediately prior to STAA, there were significant differences in the return ratios of the various states, as the first column in Table 1 indicates. Under STAA, states were guaranteed a minimum return of 85 percent of the highway user tax revenues their residents pay into the highway account of the highway trust fund. However, this requirement exempted most highway program funding categories from the calculation (STAA 1983). The result was that some states continued to receive less than an 85-percent return (see column 2 of Table1). The arrangements negotiated under STAA remained in place under its 1987 successor, the Surface Transportation and Uniform Relocation Assistance Act (STURAA 1987).

(Table 1)

Dissatisfaction with this arrangement prompted donor state representatives to band together during the next reauthorization to demand a 95 percent guaranteed return applied to a much larger number of federal aid highway program categories (Congressional Record 1982; Congressional Record 1991; Congressional Record 1998; Weingroff 2001). The completion of the interstate highway program, whose ongoing construction was one of the primary policy arguments used to support geographic redistribution, gave added impetus to their efforts. As part of the legislative compromise that produced ISTEA in 1991, they settled for a 90 percent minimum guaranteed return, but one that exempted funds allocated as part of Congressional highway project earmarks from the calculation (ISTEA 1991). Despite the ISTEA changes, some states still fell short of a 90 percent return (see column 3 of Table 1). When it came time to reauthorize ISTEA, donor state representatives drew up their own bill that called for a 95-percent guaranteed return and included all highway program expenditures in the calculation (Fischer 1998a; Fischer 1998b). Many donor state representatives and allied interest groups formed SHARE as a vehicle to advocate their case for more equitable treatment. On the other hand, the donee state representatives responded with their own bill that would have exacerbated the redistribution problem by more heavily weighting factors such as a state's land area and its level of tax effort in the apportionment formulas (Congressional Record 1982, 1991, 1998; Fischer 1998a; Fischer 1998b). A stalemate ensued that helped delay passage of a new federal authorizing law for one year.

When TEA-21 was passed in 1998, it contained a slightly higher minimum guaranteed return provision (90.5 percent), which affected all highway program categories (TEA-21 1998). Many apportionment formulas were also changed to include factors more closely related to population, highway mileage, and highway use, on the grounds that they were better indicators of a state's general highway need (Federal Highway Administration 1999a; Federal Highway Administration 1999b). These developments raised the possibility of significant changes in the return ratios of

the various states. However, TEA-21 also contained a “hold harmless” provision that protected states from a dramatic decline in their apportionments from the ISTEA levels (TEA-21 1998).

Between 1998 and 2005, geographic redistribution continued, although not to the same degree as in the past, and so did donor state complaints (see column 4 of Table 1). With the passage of SAFETEA-LU in 2005, donor states were again unable to achieve their desired 95 percent minimum return, but they negotiated a provision whereby the minimum return increased to 92 percent (SAFETEA-LU 2005). However, as in the case of TEA-21, SAFETEA-LU also included a hold harmless provision that protects the long-time donees from being adversely affected by a dramatic change in their apportionment levels. For a long time, Congress had been able to include such hold harmless provisions in both TEA-21 and SAFETEA-LU by increasing total highway spending, in part by drawing down the unexpended funding balances that had accumulated in the highway trust fund. In recent years, as the unexpended balances dried up, ever larger general fund infusions into the highway trust fund accounts have facilitated this process (US Government Accountability Office 2010; Utt 2011).

There are a number of ways to measure the donor state phenomenon, but the most basic measure is perhaps what is called the return ratio. The return ratio is the ratio of federal aid apportionments taken from the highway account of the federal highway trust fund to user tax payments paid into the highway trust fund. This ratio is the subject of the equity bonus provisions in recent federal transportation legislation that is designed to address the donor state issue. The money difference between aid apportionments and tax payments can be thought of as the state’s net return. Donor states receive a negative net return and donee states receive a positive net return. Table 1 shown earlier reports the various return ratios for the states under the surface transportation laws in place between 1974 and 2008. Figure 2 expresses the annual difference between federal aid apportionment and highway user tax payments, or the net return, on a per capita basis in constant 2005 dollars (Federal Highway Administration 1999, Tables DL-1C and FE-221; US Bureau of Labor Statistics 2007). The map panels are in the same order

and cover the same periods as Figure 1, which examined the pattern of aid apportionment, shown earlier. The panels show that the biggest net federal aid recipients tend to be located in the interior of the country, in the sparsely populated states of the Plains and in the non-contiguous states of Alaska and Hawaii. The spatial distribution of net losers has changed over time, but has tended to include states in the South and Midwest.

(Figure 2)

Differing explanations for geographic redistribution

The complaints of donor state representatives speak largely to issues of equity and fairness, but they also raise the question as to why redistribution occurs. Resource redistribution is often necessary to serve important social (and policy) purposes. Resources are often redistributed among individuals to aid the poor, to limit the concentration of wealth, or to provide equality of opportunity for differently situated individuals (Rawls 1971). Resources can also be redistributed among places to aid states with high program needs, help poor states or localities invest in desired projects or programs (fiscal equalization), to maintain a national system (like the interstate system), to compensate states or localities for the benefits outsiders derive from their investments (correcting for so-called benefit spillover), and to provide for the needs of the national defense (Break 1980; Brown 2003; Gramlich 1997). These are all policy rationales for redistribution that could be used to justify the unequal treatment of states in a program like the federal highway program, regardless of its dependence on user tax finance. So perhaps some or all of these rationales might help to explain the pattern of donor and donee states in the federal highway program. If so, this pattern of redistribution could be justified on some explicit policy grounds.

But there are other explanations for redistribution that are less easy to justify. Most of these so-called functional explanations boil down to politics and/or simple institutional and/or programmatic inertia. Some scholars argue that well-situated politicians and/or interest group representatives have shaped the highway program to benefit themselves and/or their constituents, to the detriment of others and even of national needs as a whole. This is the crux of the pork barrel hypothesis in political science (Stein 1995). A different but related explanation posits that politicians, bureaucrats, and interest groups have used some combination of programmatic inertia and/or differences in legislative institutional structures to maintain the status quo—because it benefits themselves or their constituents (Lee 1999). Program origins might also play a role in perpetuating a particular distribution of funds. At its inception, the federal highway program was a rural one, so one hypothesis is that the donor state issue is a reflection of underlying urban versus rural distinctions among the states (Brown 2003). So perhaps the pattern of donor and donee states is the product of political influence and/or simple legislative inertia. If so, this pattern of redistribution would be much harder to justify on policy grounds.

Some of these explanations for redistribution in the federal highway program have been tested in the scholarly literature. For example, there have been efforts to evaluate the fiscal equalization rationale for redistribution. In a simple correlation analysis, Lem (1996) found that the redistribution of federal highway aid runs counter to fiscal equalization. He found that resource-poor states tend to be donor states. There have also been many studies of the importance of political representation in resource allocation decisions (for example, Adler and Lapinski 1997; Stein 1995; Lee 1999). Maddox (1997) found that political representation correlated positively with total federal transportation (highway plus transit) aid in a particular funding year. For every member on the House Committee on Transportation and Infrastructure, states received $2.94 more per capita; for every member of the Senate Environment and Public Works committee states received $4.65 per capita. However, that study tested apportionment

itself but not the difference between taxes paid and aid received, which is the crux of the donor state issue.

In this paper, we test four specific hypotheses that relate to policy-based and functional explanations for redistribution. We test whether a state's donor or donee status is related to its highway system need, its general economic status, its level of urbanization, and its political representation on the Congressional committees that oversee the highway program. The first two hypotheses correspond to policy-based rationales for geographic redistribution while the last two hypotheses correspond to more functional explanations. We discuss these hypotheses in more detail below.

Highway system need

One explanation for geographic redistribution is that it is an attempt to assist states with greater highway needs. If true, states with larger highway systems and/or more motor vehicle travel per capita should receive more federal highway aid per capita and also be beneficiaries of redistribution. We sought to explicitly test these propositions. We define highway system need on the basis of two measures: 1) highway system extent and 2) highway system usage. We define highway system extent using total highway lane miles by state for each year. We define system usage as the Vehicle Miles Traveled (VMT) per capita in each year. We found that this measure produced stronger model results than several alternatives, including VMT per highway lane mile and VMT per licensed driver.

Aid poorer states

Another explanation for geographic redistribution is to assist poorer states. If true, poorer states should receive more federal highway aid per capita and also be beneficiaries of redistribution. We define a state's wealth using a relative measure, per capita income (in 2005

dollars). A more ideal measure, used in the study by Lem (1996) would be state fiscal capacity, but this measure is not available for the entire study period included here.

Rural bias and programmatic inertia

A third for geographic redistribution is that a pro-rural state bias exists and that more urbanized states are losers in the donor-donee contest. If true, states that are less urban (more rural) should receive more federal highway aid per capita and also be beneficiaries of redistribution. The federal highway program began as a rural program, so an anti-urban or pro-rural bias might merely be a reflection of programmatic history that has remained in place due to legislative inertia and/or the disproportionate representation that less urban and/or lower population states have in the US Senate. We define the degree of urbanization in a state using the percent rural population.

Political representation and the pork barrel hypothesis

Finally, the pork barrel hypothesis in political science assumes that politicians direct federal largesse to their constituents in order to guarantee their reelection. If applicable to the highway program, states represented on the key committees should receive more highway aid per capita than those that are not, and also be beneficiaries of redistribution. We define political representation on the basis of how a state was represented on each of the four Congressional committees (under US Senate and US House of Representatives) that have oversight of the federal highway program, and on the level of seniority that the state's representative(s) held on the committee.

The analysis discussed later examines each of these hypotheses simultaneously. Prior to embarking on the analysis, our suspicion, based largely on previous scholarship in this area by ourselves and others, was that the combination of the program's rural origins and the pattern of

Congressional representation were the more likely explanations for the pattern of geographic redistribution over time.

Empirical analysis

Data

Our analysis focuses on the period from 1974 to 2008. We select 1974 as the starting point for our analysis because it is the first year that reflects apportionment decisions made as part of 1973's Federal-Aid Highway Act. We select 2008 as the ending year because this is the most recent year that we can collect data for all variables in the model from the Federal Highway Administration (FHWA). We stratified this time period into five sub-periods that correspond with different legislative compromises about the donor state issue. The first period, 1974 -1982, was affected by the Federal-Aid Highway Act of 1973, and represents the era before the first compromise. The second period, 1983-1991, represents the era of the first compromise (85 percent minimum return) enacted as part of the Surface Transportation Assistance Act of 1982 (STAA). The third period, 1992-1998, represents the era of the second minimum return (90 percent) enacted as part of the Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA). The fourth period, 1999-2005, represents the era of the third minimum return (90.5 percent) enacted as part of the Transportation Equity Act for the 21st Century (TEA-21). The last period, 2006-2008, represents the most recent era of the fourth minimum return (92 percent) enacted as part of the Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (SAFETEA-LU).

Highway data is obtained from the annual Highway Statistics series (Federal Highway Administration 1974-2005). The variables included: highway lane miles (by state) (Table HM-

48), vehicle miles traveled (by state) (Table VM-3), payments into the highway account of the highway trust fund (by state) (Table FE-221), apportionments from the highway account of the highway trust fund (Table FE-221), and return ratio (Table FE-221). We also obtained annual total population data (by state) from Highway Statistics (Table DL-1C). We use total highway lane miles (by state) and vehicle miles traveled per capita (by state) as measures of highway system extent and usage.

Additional data is obtained from the US Bureau of Labor Statistics, US Census Bureau, and Congressional Directory. The Bureau of Labor Statistics variable is the consumer price index, which we used to adjust all money variables to 2005 dollars (US Bureau of Labor Statistics 2007). The Census Bureau variable is the percent rural population (by state) (US Census Bureau 1995; US Census Bureau 2007).

The political science literature suggests that committee membership on key Congressional committees might help to explain the geographic pattern of federal expenditures, and thus could influence the pattern of geographic redistribution among the states. Two pairs of Congressional committees exercise considerable influence over federal highway policy: authorization committees and appropriations committees. The authorization committees, the House Committee on Transportation and Infrastructure (CTI) and the Senate Environment and Public Works (EPW) Committee, take the lead roles in writing the transportation reauthorization legislation (i.e. FAHA 1973, STAA 1982, ISTEA 1991, TEA-21 1998, and SAFETEA-LU 2005). Authorization legislation defines the various programs and their eligibility requirements and establishes the formulae (and other mechanisms) by which most program funds are apportioned to the states for all the years that the legislation is effective. Thus, authorization committee members might be influential in determining how highway funds are redistributed among the states over the duration of each reauthorization. The two appropriations committees, the House Appropriations (HAPP) Committee and the Senate Appropriations (SAPP) Committee, take the

lead roles in writing annual appropriations legislation that appropriates funds for federal programs each year, including the highway program. While appropriations committees work under the general framework established by authorizing legislation, they also exercise some discretion over how funds are appropriated among programs and projects annually, including some project earmarks. Thus, these legislators might also exercise some influence over the pattern of geographic redistribution.

The data from the Congressional Directory (1973-2008) consists of the membership on these four Congressional Committees. We first collect four variables on the number of members (by state) on each committee for each year. Four "chair" variables are also collected to designate the state which the chair of each committee represents in every year. We further hypothesize that the seniority of a state's representatives on these committees is another good indicator of political influence, based on discussion in the political science literature. In the model, we include one seniority variable for each of the two authorization committees—terms of service (House)/ranking (Senate). In cases where multiple committee members from the same state were present, we only include the most senior member's attributes. Terms of service (House) variable is categorized by the sum of consecutive and non-consecutive terms of service, with the greater number of term of service assumed to provide higher weight in the decision making arena.[2] Senate ranking is based on the beginning date of present service, where a higher ranking is assigned to a senator the longer he/she has been in office continuously.[3] We obtain seniority data from the Congressional Directory.[4]

[2] Also, while consecutive terms of service are generally considered to be of higher status than non-consecutive terms of service, this was not taken into account in this paper. For example, a representative with 13 terms non-consecutive terms of service is considered to influence outcomes with the same impact as a representative with 13 terms consecutive. Both of the representatives with 13 terms of service are considered more influential in the decision making process than those representatives with 12 or fewer terms of service (regardless of whether their 12 or fewer terms were consecutive or not).

[3] This variable does not take into account previous service interrupted by appointment to another position, unsuccessful re-election, or any other event that might have forbid the congressman the ability to serve continuously. Also, it is normal that several senators will share the same rank due to a commonly shared beginning date of present service.

All membership variables related to the authorization committees are measured at a base year, which reflects the year in which the reauthorizing decisions and formulae were made for each reauthorization period. For this reason, the base-year authorization committee member information is held constant through the effective years of the respective reauthorization. For authorization committee membership, the base year for FAHA is 1973; the base year for STAA is 1982; the base year for ISTEA is 1991; the base year for TEA-21 is 1998; the base year for SAFETEA-LU is 2005. Differently, all membership variables related to the appropriation committees are measured for each year. Note that appropriation committee membership variables reflect the prior year, because appropriations legislation affects each subsequent fiscal year (ex. 1995 membership for 1996 fiscal year appropriations).

Model specification

We estimate Clustered Data Models that predict our dependent variables (appropriation per capita in 2005 dollars, net return per capita in 2005 dollars, and return ratio) as functions of variables measuring state highway need (extent and use), state economic condition (per capita income in 2005 dollars), degree of urbanization (percent rural population), and political representation. The first dependent variable is federal aid apportionment by state (in 2005 dollars per capita) for each year. This variable serves as the numerator in calculating the annual return ratio, and is a direct outcome of the legislative process. We express this variable on a per-capita basis to take into account differences in state population. The second dependent variable is net return by state (in 2005 dollars per capita) for each year. This variable is the difference between the aid apportionments from the user tax and the payments into the user tax

[4] Seniority data for base-years 1998 and 2005 were available for online viewing through the Governmental Printing Office (http://www.gpo.gov/fdsys/browse/collection.action?collectionCode=CDIR). For base years 1973, 1982, and 1991, data were obtained through print versions of the respective congressional directories.

by state for each year. We then divided the difference by the state population in the year. The third dependent variable is the return ratio by state for each year. This variable is the aid apportionments from the user tax divided by the user tax payments (by state) for each year.[5] This variable is the specific focus of the minimum return rules enacted in STAA, ISTEA, TEA-21, and SAFETEA-LU. Each model is estimated for the 1974-2008 period as well as for each of the five legislation reauthorization periods separately, in order to identify any changes associated with the various donor-donee legislative compromises.

We use two different model specifications in our analyses: fixed effect clustered data model and random effect clustered data model. These two model specifications use different assumptions and methods in addressing the time-varying effect across our clusters (i.e. year). We include both of them in our analyses to test whether our findings are subject to changes in the model specification. In addition, Hausman (model specification) tests are conducted to determine which model specification is a better fit for our data. The detailed model specifications are shown as below.

1) Fixed Effect Clustered Data Model

$$y_{ti} = \beta' \mathrm{X}_{ti} + \lambda_t + u_{ti} \qquad \text{where } t=1,\ldots,T. \qquad i=1,\ldots,N.$$

t represents year, which is the cluster in the model. *i* represents state. $X_{ti,}$ is a k×1 vector of independent variables (including highway need, economic condition, degree of urbanization, and political representation), β' is a 1×k vector of parameters (including intercept). λ_t is a scalar constant representing the effects of unobserved time-varying variables that are peculiar

[5] In 2008, the highway account of the Highway Trust Fund received 8.017 billion dollars from the general fund (Table FE-210, at http://www.fhwa.dot.gov/policyinformation/statistics/2008/fe210.cfm). The state apportionment and return ratio provided in Table FE-221 for this year included this transfer amount. To be consistent with other years, we calculate the apportionment that is derived from trust fund user tax revenues only. To do this, we subtract out the transfer money and apportion the reduction based on each state's share of overall apportionments to estimate the new apportionment and return ratio for each state in 2008.

to the t[th] year in more or less the same fashion across all states. The residual term, u_{ti}, represents the effects of the omitted variables that are peculiar to both the year cluster *t* and the individual state *i*. We assume u_{ti} is uncorrelated with *X* and is independently identically distributed with mean zero and variance σ_{μ}^2. That is, $E\mu_{ti} = 0$, and $E\mu_{ti}\mu_{sj} = \sigma_{\mu}^2$ if t=s and i=j, and $E\mu_{ti}\mu_{sj} = 0$ otherwise.

2) Random Effect Clustered Data Model

$$y_{ti} = \beta' \mathrm{X}_{ti} + \lambda_t + u_{ti} \qquad \text{where } t=1,\ldots,T. \qquad i=1,\ldots,N.$$

t represents year, which is the cluster in the model. *i* represents state. X_{ti}, β', μ_{ti} are the same as in fixed effect model. What makes this random effect model different is that we treat the time-varying effects λ_t as random variables. We assume λ_t is distributed with the variance-covariance matrix as $\sum_{\lambda}: E(\lambda_t\lambda_s) = \begin{cases} \lambda_{\alpha}^2 & t = s \\ \lambda_{\alpha_t}\lambda_{\alpha_s} & t \neq s \end{cases}$

Empirical results

A snapshot of the past three decades

We first apply these two model specifications to test our four hypotheses using data that cover the entire period of 1974-2008. As shown in Table 2, the fixed effect models and random effect models have similar coefficient estimates. Models (1) and (2) in Table 2 presents the results for fixed effect and random effect models that examine the relationship between apportionment per capita and variables representing our four hypotheses. The results show that a state with 1 percent more highway lane miles on average received 31 dollars less

apportionment per capita, suggesting that states with higher extent of highway system have gotten less per capita appropriation. States with more highway usage (measured in VMT per capita), higher per capital income, and more rural population also received higher apportionment on a per capital basis. Among committee membership variables, the results show that states with more representatives on the Senate Environment and Public Works Committee (EPW) and the Senate Appropriations Committee (SAAP) received more apportionment. The chair of the SAPP committee was able to help his own state to get a substantially larger apportionment, roughly 98 dollars more per capita. In addition, the two seniority variables suggest that the terms of service and/or ranking of those committee members were also positively associated with the aid apportionment of their representing states.

(Table 2)

Models (3) and (4) in Table 2 presents the results for fixed effect and random effect models that examine the relationship between net return per capita and variables representing our four hypotheses. The results are similar to Models (1) and (2): states with fewer highway lane miles received higher net return per capital; richer states and more rural states received higher net return; states with more representatives on the Senate EPW committee and the Senate SAAP committee received higher net return; states for which the chair of SAPP committee and the chair of EPW committee represent always received substantially higher net return; in addition, seniority (measured in terms of service) of the CTI committee members also increased the net return for the states they represent. A notable difference in the net return models is that states with more highway usage (measured in VMT per capita) received less net return per capita, although previous models (1) and (2) show that these states received larger apportionment per capita. This is reasonable because states with more intense highway usage paid more into the Trust Fund and also received more from the Fund, but they still experienced a net loss.

Models (5) and (6) in Table 2 presents the results for fixed effect and random effect models that examine the relationship between return ration and our explanatory variables. The results are very similar to the net return models (3) and (4). States with higher extent and usage of highway system tended to have lower return ratio. States with higher per capita income and more rural population tend to have higher return ratio. In addition, the committee membership variables suggest that states with better political representations (i.e. number of representatives, chair, seniority) in the authorization and appropriations committees generally fared better.

It is very clear that, in the past three decades, the geographical redistribution of Federal-aid highway program has been disproportionately benefiting states that have higher per capita incomes, have less extensive highway networks and/or less highway usage per capita, less urban population, and better political representation on the four authorization and appropriations committees. These results clearly indicate that redistribution cannot be justified on general equity or need-based rationales. Rather, the political power of each state and perhaps a lingering pro-rural orientation that is reflective of either the program's rural origins and/or the overrepresentation of rural states in the US Senate are more likely to be explanations for this inequitable redistribution.

Note that Models (1) (3) (5) use fixed effect model specification and Models (2) (4) (6) use random effect model specification. As we discussed in the model specification section, the major difference between fixed effect model and random effect model is that they use different assumptions and methods in addressing the time-varying effect across our clusters (i.e. year). Therefore, we include both specifications in our analyses. A quick comparison of the coefficient estimates between fixed effect models and random effect models show that the differences are only marginal, both statistically and economically. However, Hausman (model specification) tests suggest that random effect model specification fit our data better than the fixed effect. In the following session where we compare differences across the five legislation reauthorization

periods, we only discuss results based on the random effect models. In addition, we also conduct Likelihood-ratio test to see whether heteroskedasticity exists across clusters. The test finds no heteroskedasticity across clusters (i.e. years).

Comparing five legislation reauthorization periods

Since the authorizing legislation experienced four changes over the entire period of 1974-2008, we are very interested in testing whether our previous findings for the entire time period also hold true for each of the five legislation reauthorization periods. In other words, we are interested in understanding whether the various donor-donee compromises enacted over the years have affected these general patterns in significant ways. We thus stratify our data into five periods that correspond to the five legislations: FAHA period 1974-1982, STAA and STURAA period 1983-1991, ISTEA period 1992-1998, TEA-21 period 1999- 2005, and SAFETEA-LU period 2006-2008. We use the same (random effect) models to jointly test our four hypotheses in each period to determine whether the explanations on the geographic redistribution of Federal-aid highway program have ever changed.

1) Apportionment per Capita (2005 dollars)

Table 3 presents the results of random effect models that examine the relationship between apportionment per capita and variables representing our four hypotheses in each of the five legislation reauthorization periods. Across all five periods, states with more highway lane miles have always received less apportionment on a per capita basis. It seems the appropriation of Federal-aid highway money has always favored states with less extensive highway networks. However, VMT per capita has been positively related to the apportionment in all periods, suggesting that states with more intense high way usage have consistently received more apportionment per capita. Results for per capita income and percent rural population were also

consistent across different periods. They were found to be positively affecting the state apportionment, indicating that states with higher per capita income and higher percentage of rural population have always received more per capita apportionment than other states.

(Table 3)

Results for political representation were mixed. Number of representatives on the Senate EPW Committee is positively associated with apportionment per capita for 1974-1982, 1992-1998, and 1999-2005. Number of representatives on House Appropriations Committee was negatively associated with apportionment per capita for 1974-1982 and 1999-2005, but the number of representatives on Senate Appropriations Committee was positively associated with apportionment per capita for 1983-1991, 1999-2005 and 2006-2008. Those states represented by the chairs of the CTI committee and SAPP committee received more apportionment per capita (whenever the result was statistically significant). Seniority variables (ranking and terms of service) showed weak and mixed impact on apportionment across the five different periods.

2) Net Return per Capita (2005 dollars)

Table 4 presents the random effect model results for net return per capita, the first of our two measures of redistribution. Across all five periods, highway lane miles were always significantly and negatively related to the per capita net return, implying that states with more developed highway systems are less likely to be donees. Results for VMT per capita were statistically significant for the 1983-1991 and 1992-1998 periods, with a negative relationship to the per capita net return. This suggests that states with more intense highway usage are more likely to be donors. In all five periods, per capita income and percent rural population consistently and positively affected per capita net return, suggesting that states that have higher per capita income and more rural population are more likely to be donees.

(Table 4)

Results for political representation in this series of models show more consistent results than in Table 3. Number of representatives on the EPW Committee was a very consistent and strong factor for states to get a larger net return in each period. Number of representatives on the SAPP Committee also had a consistently positive impact on net return in all periods. Chairs of the CTI Committee, EPW Committee, and SAPP Committee generally were able to help their representing states to get a larger net return in different periods (whenever the estimates were statistically significant). Seniority variables (ranking and terms of service) show weak and mixed impact on net return across the five different periods. In general, our analysis suggests that political representation, particularly in the Senate, have made states better off in getting a larger net return per capita.

3) Return Ratio

Table 5 presents the random effect model results for return ratio, our second measure of redistribution. Across the five periods, highway lane miles and Vehicle Miles Traveled per capita were once again consistently and significantly affecting the return ratio. States with more developed highway systems and more intense highway usage had a substantially lower return ratio in almost all five periods, and thus were less likely to be donees. In addition, per capita income and percent rural population have shown consistent and strong positive impact on return ratio, implying that states with higher per capita income and more rural population have been able to get a substantially higher return ratio in almost all five periods.

(Table 5)

Results for political representation in this series of models are similar to those in Table 4. Number of representatives on Senate EPW Committee was a significant factor for states to get a substantially higher return ratio in 1974-1982, 1992-1998, and 2005-2008. The number of representatives on the SAPP Committees also showed consistent and positive impact in four

periods. Chairs of the four Committees had weak impact, but in general they were able to help their representing states to get a larger return ratio in different periods (whenever the estimates were statistically significant). And seniority variables (ranking and terms of service) once again showed weak and mixed impact. In summary, states with better political representation, particularly in the Senate, have generally fared better in getting a higher return ratio per capita.

Discussion and conclusion

The model results for apportionment per capita reflect legislative expenditure decisions, without considering revenues raised, while those for net return per capita and return ratio directly relate to the issue of geographic redistribution of federal aid dollars. The first set of models shows that aid apportionments have been positively related to a state's highway usage, per capita income and percent rural population, but negatively related to highway extent. Political representation show mixed results, but in general, states with better representation in the four committees, particularly in the Senate, were able to receive larger apportionment on a per capita basis. Note that although states with more intense highway usage were able to receive more apportionments than other states, their net return and return ratio were still substantially lower in most legislation reauthorization periods, as discussed next.

The other two sets of models are directly related to the issue of geographical redistribution, and thus have the most direct policy relevance. The results for highway need (extent and use), economic condition (per capita income in 2005 dollars), and degree of urbanization (percent rural population) were very strong and consistent across all five periods. Both sets of models show that the redistribution is positively linked to income and a state's percent rural population, negatively linked to highway extent and highway usage. States with less developed highway system, less intense highway usage, higher per capita income, and more rural population have

benefitted from redistribution over the past three decades, even while authorizing legislation has changed four times. These findings suggest that our first two hypotheses—to satisfy highway needs and to aid poorer states—are not good explanations for the geographic redistribution of Federal-aid highway dollars. Given that these are the most easily justified policy rationales for redistribution, this poses serious questions about the continued presence of redistribution in the federal highway program. In short, the donor state criticisms are well founded. On the other hand, states that were better represented on the key Congressional committees, particularly in the Senate, have generally received more highway aid per capita than those that were not, and also have been beneficiaries of redistribution. The importance of the rural population variable, and in a positive direction, indicates that the highway program's rural origins and/or the overrepresentation of rural states in the Senate are also important contributors to the redistribution that we see today. Neither of these are compelling policy reasons for the continued existence of geographic redistribution, particularly given the highway program's predominantly user tax financial support.

Congress is in the midst of ongoing debates about the future of the federal highway and other surface transportation programs. These debates occur against a backdrop of declining revenues, particularly from highway user taxes, escalating highway needs, and a lack of public and/or political sentiment to increase tax rates. Given these circumstances, it is essential that the user tax revenues be used in the places where they are most needed. This study would appear to indicate that this is not presently the case, at least when need is defined on the basis of the extent and/or use of a state's highway system. More careful reflection on the logic, purpose, and results of geographic redistribution would appear to be in order. This single study can't provide all the answers, but perhaps it could help provide some structure to the policy conversation about these critical issues.

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Legislation

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Surface Transportation Assistance Act of 1983 (PL 97-424)

Surface Transportation and Uniform Relocation Assistance Act of 1987 (PL 100-17)

Intermodal Surface Transportation Efficiency Act of 1991 (PL 102-240)

Transportation Equity Act for the 21st Century (1998) (PL 105-178)

Safe, Accountable, Flexible, Efficient Transportation Equity Act-- A Legacy for Users (2005) (PL 109-59)

Fig. 1 Map of Highway Trust Fund Apportionment by State (2005 dollars per capita), (calculated from the Federal Highway Administration 1974-2004, Tables DL-1C and FE-221, US Bureau of Labor Statistics 2007)

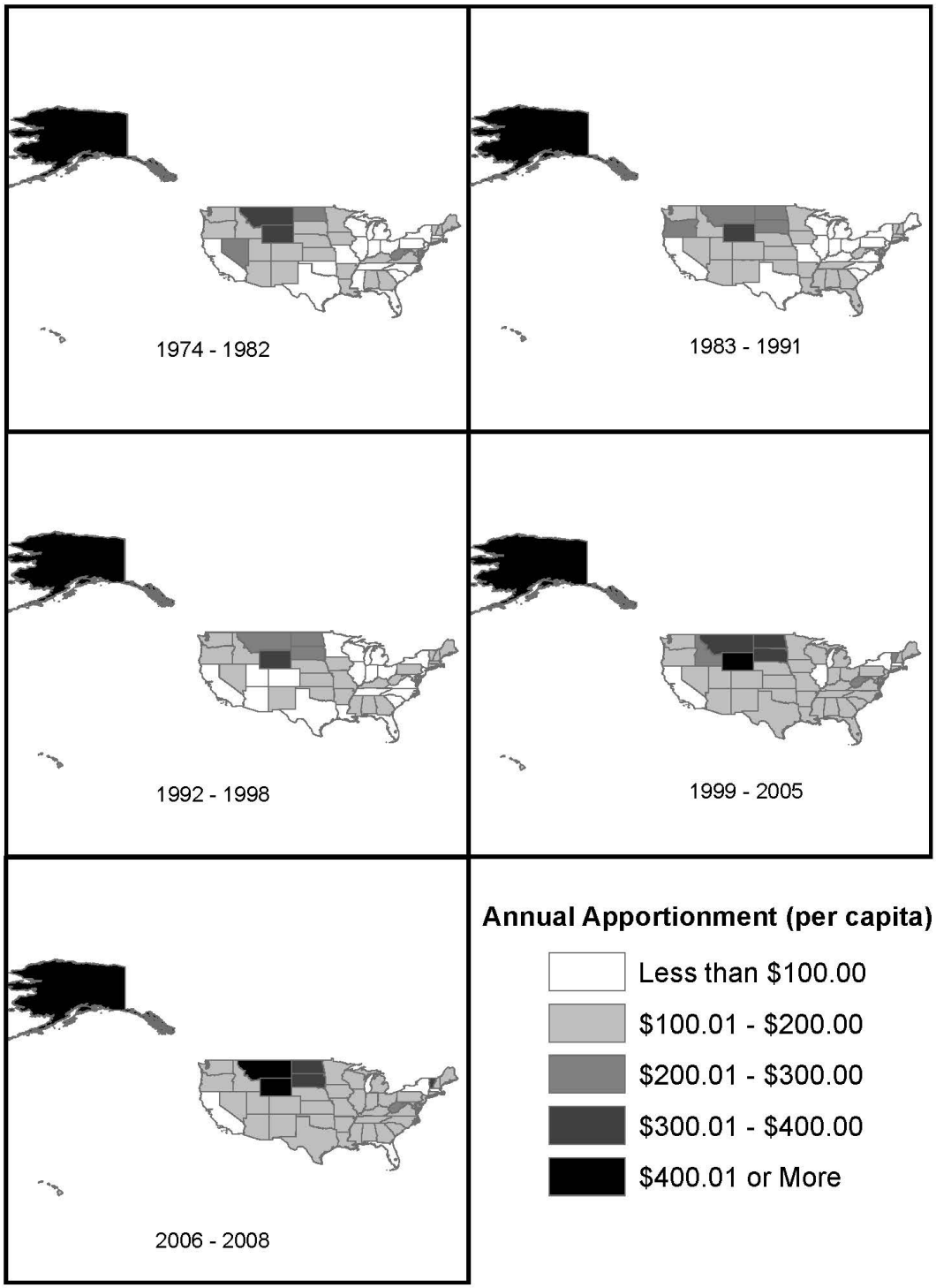

Fig. 2 Map of Highway Trust Fund Net Return by State (2005 dollars per capita), (calculated from the Federal Highway Administration 1974-2004, Tables DL-1C and FE-221, US Bureau of Labor Statistics 2007)

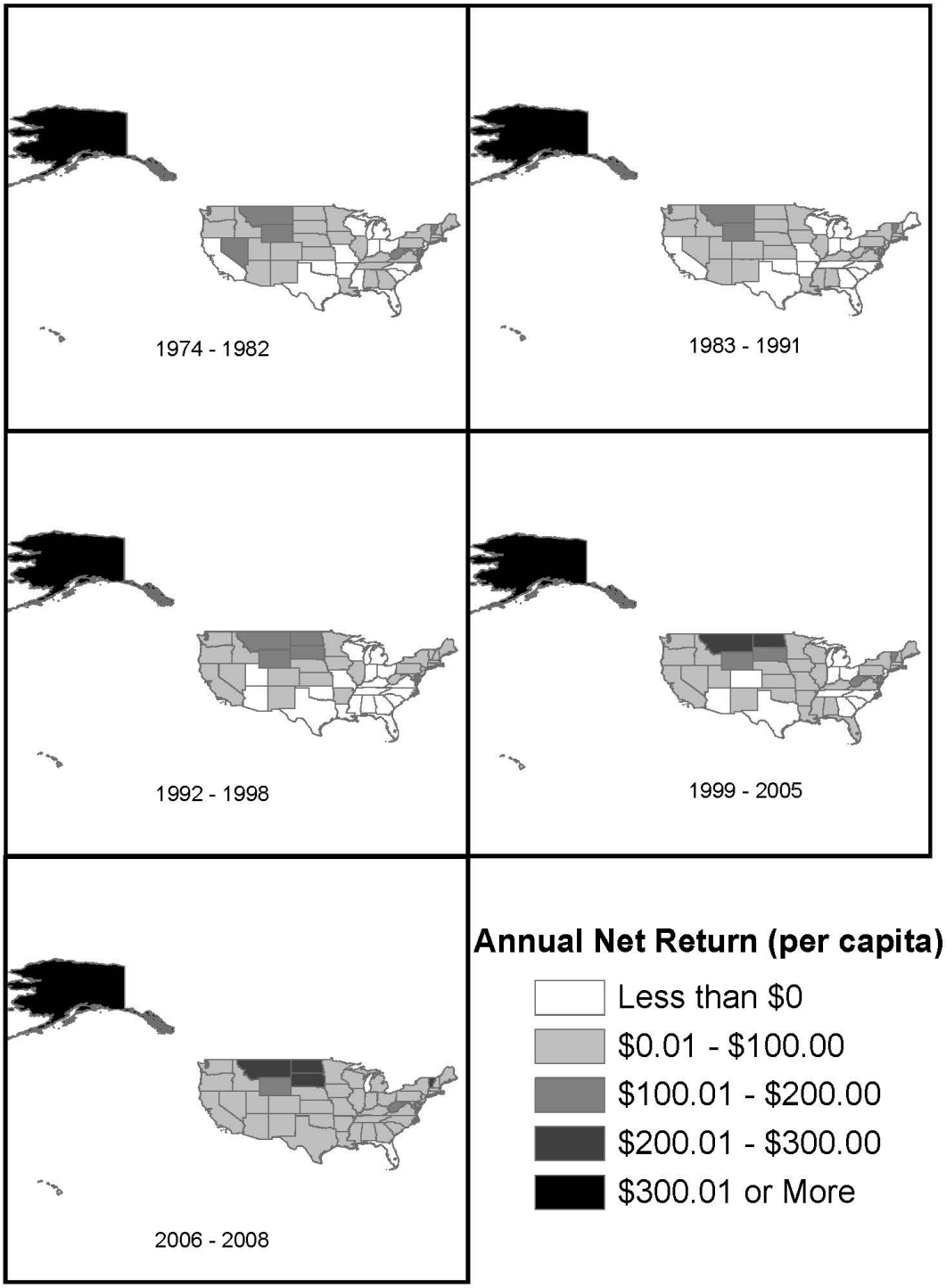

Table 1. Trust Fund Highway Account Return Ratio of Apportionments to Payments by State

State	FAHA 1974-1982	STAA and STURAA 1983-1991	ISTEA 1992-1998	TEA-21 1999-2005	SAFETEA-LU 2006-2008
Alabama	1.13	1.23	0.88	1.15	1.14
Alaska	8.73	5.60	5.69	6.64	4.17
Arizona	1.36	1.19	0.88	0.95	0.96
Arkansas	1.01	0.88	1.00	1.15	1.20
California	0.77	0.94	1.02	1.03	1.08
Colorado	1.28	1.58	1.05	1.00	1.01
Connecticut	1.67	2.28	1.80	1.56	1.52
Delaware	1.70	1.43	1.48	1.81	1.87
District of Columbia	7.99	5.33	3.96	4.12	5.49
Florida	1.04	0.90	0.85	1.04	0.94
Georgia	1.21	0.90	0.82	0.97	0.99
Hawaii	3.57	4.93	3.77	2.32	2.09
Idaho	1.58	1.97	1.47	1.58	1.55
Illinois	1.27	1.17	1.06	1.01	1.10
Indiana	0.77	0.92	0.85	0.95	0.98
Iowa	1.13	1.32	1.05	1.09	1.03
Kansas	1.27	1.11	1.03	1.15	1.15
Kentucky	1.23	1.04	0.86	1.03	1.06
Louisiana	1.46	1.22	0.87	1.00	1.12
Maine	1.21	0.98	1.19	1.08	1.14
Maryland	1.83	1.62	1.05	1.07	1.02
Massachusetts	1.14	2.04	2.18	1.07	1.10
Michigan	0.81	0.96	0.87	0.99	1.06
Minnesota	1.26	1.32	1.16	1.05	1.20
Mississippi	0.93	1.00	0.87	1.06	1.14
Missouri	1.03	0.94	0.85	1.03	1.13
Montana	2.62	2.15	2.08	2.41	2.50
Nebraska	1.08	1.30	1.05	1.07	1.12
Nevada	2.05	1.46	1.08	1.09	1.05
New Hampshire	1.52	1.33	1.18	1.20	1.21
New Jersey	0.89	1.09	1.08	0.97	1.00
New Mexico	1.54	1.18	1.17	1.21	1.17
New York	1.23	1.33	1.25	1.35	1.28
North Carolina	0.90	0.89	0.88	0.99	1.00
North Dakota	1.87	1.82	2.07	2.37	2.26
Ohio	0.76	0.92	0.91	0.98	1.05
Oklahoma	0.67	0.93	0.87	1.02	1.21
Oregon	1.38	1.04	1.08	1.12	1.21
Pennsylvania	1.12	1.16	1.19	1.30	1.28
Rhode Island	2.19	2.99	2.18	2.50	2.80
South Carolina	0.93	0.95	0.80	0.98	1.00
South Dakota	1.80	1.87	2.06	2.38	2.24
Tennessee	1.17	0.97	0.84	0.99	1.04
Texas	0.74	0.91	0.82	0.95	0.94
Utah	1.89	1.69	0.97	1.11	1.00
Vermont	2.27	2.18	1.63	2.09	2.86
Virginia	1.48	1.07	0.90	1.07	1.03
Washington	1.66	1.65	1.21	1.09	1.15
West Virginia	2.57	1.68	1.51	1.92	2.00
Wisconsin	0.89	0.88	0.99	1.15	1.17
Wyoming	1.94	1.65	1.56	1.57	1.52

1) the average return ratio for each period is calcuated using the total apportionment by state in each period divided by the total state payin in each period.
2) In 2008, the highway account of the Highway Trust Fund had 8.017 billion dollars transfer from the general fund. This amount was excluded in our calculation.

Table 2 Model Results for Apportionment, Net Return, and Return Ratio 1974-2008

VARIABLES	(1) Approtionment Per Capita Fixed Effect	(2) Per Capita Random Effect	(3) Net Return Per Capita Fixed Effect	(4) Per Capita Random Effect	(5) Return Ratio Fixed Effect	(6) Random Effect
Highway lane miles(log)	-30.6***	-30.5***	-29.8***	-29.9***	-0.4***	-0.4***
Vehicle miles travel per capita(log)	167.2***	79.8***	-24.3**	-61.4***	-0.7***	-1.1***
Per capita income(log)	231.7***	116.6***	228.7***	175.1***	2.4***	1.8***
Percent of rural population(log)	44.9***	42.4***	50.3***	48.7***	0.4***	0.4***
Num. of representatives on CTI comm.	-8.3***	-8.9***	-8.6***	-8.8***	-0.1***	-0.1***
Num. of representatives on EPW comm.	22.8**	12.2	20.2**	15.4*	0.1	0.04
Num. of representatives on HAPP comm.	-3.2	-3.3	-3.6*	-3.5	-0.01	-0.01
Num. of representatives on SAPP comm.	22.6***	16.2***	19.3***	16.6***	0.2***	0.2***
chair of CTI committee from your state	9.4	24.11	-6.5	1.2	-0.3**	-0.3*
chair of EPW committee from your state	27.7*	18.3	25.3*	21	0.3**	0.3*
chair of HAPP committee from your state	-3.8	-18.2	-3.6	-10.3	0.01	-0.1
chair of SAPP committee from your state	98.3***	98.1***	77.2***	77.2***	0.7***	0.7***
Terms of service of CIT comm. member	2.1***	1.1	2.0 ***	1.5**	0.02**	0.01
Ranking of EPW comm. member	0.3	0.6**	0.2	0.4	0.004	0.01**
Constant	-3,342.9***	-1,370.1***	-1,675.9***	-788.7***	-10.8***	-2.2
Observations	1,750	1,750	1,750	1,750	1,750	1,750
R-squared	0.37	0.31	0.37	0.33	0.4	0.36
Number of year	35	35	35	35	35	35

t-statistics in parentheses

*** p<0.01, ** p<0.05, * p<0.1

1) CTI committee refers to the House Committee on Transportation and Infrastructure.

2) EPW committee refers to the Senate Environment and Public Works Committee.

3) HAPP committee refers to the House Appropriations Committee.

4) SAPP committee refers to the Senate Appropriations Committee.

5) District of Columbia is excluded in the analysis because it has 0 percent rural population. Also, it has no representative in the Senate and only a non-voting member in the House.

Table 3 Random Effect Model Results for Apportionment Per Capita by Legislation Reauthorization Period

VARIABLES	FAHA 1974-1982	STAA and STURAA 1983-1991	ISTEA 1992-1998	TEA-21 1999-2005	SAFETEA-LU 2006-2008
Highway lane miles(log)	-24.6***	-37.8***	-32.2***	-22.2***	-20.9**
Vehicle miles travel per capita(log)	68.5**	205.1***	31.5	151.5***	265.4***
Per capita income(log)	469.8***	53.3	95.3**	59.4	108.5**
Percent of rural population(log)	102.1***	-7.6	36.6***	38.7***	30.9**
Num. of representatives on CTI comm.	1.6	-1.1	-4.8	-1.2	4.3
Num. of representatives on EPW comm.	57.7***	-12.9	127.8***	90.6***	29.2
Num. of representatives on HAPP comm.	-11.6**	-1.1	0.1	-13.0**	-2.9
Num. of representatives on SAPP comm.	9.6	26.5***	11	23.6**	21.6**
chair of CTI committee from your state	-41.5	-64.7**	3.4	45.6	557.3***
chair of EPW committee from your state	47.2	-46.0*	17	8.9	-66.2*
chair of HAPP committee from your state	35.8	-22.6	-31	11.4	1.5
chair of SAPP committee from your state	-3.5	48.9*	58.9**	407.0***	-15.3
Terms of service of CIT comm. member	0.2	2	-3.4**	-0.01	-2.9*
Ranking of EPW comm. member	-1.0**	2.4***	-4.0***	-2.2**	0.1
Constant	-4,770.5***	-1,855.1***	-704.3	-1,549.0**	-3,160.9***
Observations	450	450	350	350	150
R-squared	0.51	0.47	0.35	0.51	0.73
Number of year	9	9	7	7	3

z-statistics in parentheses

*** p<0.01, ** p<0.05, * p<0.1

1) CTI committee refers to the House Committee on Transportation and Infrastructure.

2) EPW committee refers to the Senate Environment and Public Works Committee.

3) HAPP committee refers to the House Appropriations Committee.

4) SAPP committee refers to the Senate Appropriations Committee.

5) District of Columbia is excluded in the analysis because it has 0 percent rural population. Also, it has no representative in the Senate and only a non-voting member in the House.

Table 4 Random Effect Model Results for Net Return Per Capita by Legislation Reauthorization Period

VARIABLES	FAHA 1974-1982	STAA and STURAA 1983-1991	ISTEA 1992-1998	TEA-21 1999-2005	SAFETEA-LU 2006-2008
Highway lane miles(log)	-31.0***	-29.2***	-30.6***	-22.9***	-26.8***
Vehicle miles travel per capita(log)	23.8	-44.4***	-112.3***	-6.2	62.4
Per capita income(log)	478.2***	99.8***	108.9***	81.6**	74.4*
Percent of rural population(log)	94.72***	2.3	38.3***	39.7***	36.7***
Num. of representatives on CTI comm.	0.2	-6.0	-5.4	-3.7	1.5
Num. of representatives on EPW comm.	53.7***	-9.4	101.0***	70.8***	37.4*
Num. of representatives on HAPP comm.	-7.5	-5.1	1.6	-9.0*	0.7
Num. of representatives on SAPP comm.	13.5**	17.4***	6.1	27.5***	20.1**
chair of CTI committee from your state	-36.9	-68.1***	-6.6	18.1	425.2***
chair of EPW committee from your state	51.6*	-5.1	21.4	24.5	-34.1
chair of HAPP committee from your state	28.4	-14.7	-36.4	35.4	9.3
chair of SAPP committee from your state	-7.1	15.5	57.0**	369.9***	-4.1
Terms of service of CIT comm. member	0.8	2.2	-3.3**	1.4	-1.6
Ranking of EPW comm. member	-0.9*	2.1***	-3.4***	-1.9**	-0.2
Constant	-4,493.4***	-245.5	357.7	-438.9	-967.0*
Observations	450	450	350	350	150
R-squared	0.53	0.48	0.39	0.53	0.72
Number of year	9	9	7	7	3

z-statistics in parentheses

*** p<0.01, ** p<0.05, * p<0.1

1) CTI committee refers to the House Committee on Transportation and Infrastructure.

2) EPW committee refers to the Senate Environment and Public Works Committee.

3) HAPP committee refers to the House Appropriations Committee.

4) SAPP committee refers to the Senate Appropriations Committee.

5) District of Columbia is excluded in the analysis because it has 0 percent rural population. Also, it has no representative in the Senate and only a non-voting member in the House.

Table 5 Random Effect Model Results for Return Ratio by Legislation Reauthorization Period

VARIABLES	FAHA 1974-1982	TAA and STURA 1983-1991	ISTEA 1992-1998	TEA-21 1999-2005	SAFETEA-LU 2006-2008
Highway lane miles(log)	-0.4***	-0.5***	-0.4***	-0.3***	-0.3***
Vehicle miles travel per capita(log)	-0.4	-0.8***	-1.9***	-0.9***	-0.4
Per capita income(log)	5.4***	0.8**	1.2***	0.5	0.2
Percent of rural population(log)	1.0***	-0.1	0.4***	0.3***	0.3***
Num. of representatives on CTI comm.	-0.1	-0.1	-0.1	-0.1	-0.01
Num. of representatives on EPW comm.	0.6***	-0.1	0.8**	0.3	0.3**
Num. of representatives on HAPP comm.	-0.1	-0.02	0.02	-0.04	0.04
Num. of representatives on SAPP comm.	0.2**	0.2***	0.1	0.2***	0.2**
chair of CTI committee from your state	-0.4	-1.0***	-0.2	0.01	2.0***
chair of EPW committee from your state	0.5	-0.1	0.1	0.5*	-0.1
chair of HAPP committee from your state	0.5	-0.2	-0.4	0.4	0.1
chair of SAPP committee from your state	0.1	0.2	0.4	3.3***	0.04
Terms of service of CIT comm. member	0.02	0.02	-0.03*	0.02*	-0.01
Ranking of EPW comm. member	-0.01	0.02***	-0.03***	-0.01	-0.002
Constant	-43.5***	6.5*	12.2*	8.5*	7.2*
Observations	450	450	350	350	150
R-squared	0.53	0.49	0.45	0.60	0.69
Number of year	9	9	7	7	3

z-statistics in parentheses

*** p<0.01, ** p<0.05, * p<0.1

1) CTI committee refers to the House Committee on Transportation and Infrastructure.

2) EPW committee refers to the Senate Environment and Public Works Committee.

3) HAPP committee refers to the House Appropriations Committee.

4) SAPP committee refers to the Senate Appropriations Committee.

5) District of Columbia is excluded in the analysis because it has 0 percent rural population. Also, it has no representative in the Senate and only a non-voting member in the House.