FEDERAL RESERVE BANK OF PHILADELPHIA

Ten Independence Mall
Philadelphia, Pennsylvania 19106-1574
(215) 574-6428, www.phil.frb.org

Working Papers

Research Department

WORKING PAPER NO. 98-7

TRANSPORATION INVESTMENTS IN THE PHILADELPHIA METROPOLITAN AREA: WHO BENEFITS? WHO PAYS? AND WHAT ARE THE CONSEQUENCES?

Richard Voith
Federal Reserve Bank of Philadelphia

March 22, 1998

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Julie Northcott-Wilson, Sonia Survanshi, and Vikram Tekriwal provided excellent research assistance. Financial assistance from the Pew Foundation is gratefully acknowledged. The views expressed here are solely those of the author and do not necessarily represent the views of the Federal Reserve Bank of Philadelphia or of the Federal Reserve System.

ABSTRACT

In this paper, we examine the geographic distribution of transportation investments as well as the question of who pays for the investments in the Philadelphia metropolitan area, focusing on differences between the city and its surrounding Pennsylvania suburban counties. We present estimates of total, per capita, and per user benefits of highway investments, as well as fees generated by highway users at the county level. We also examine the combined highway and transit investments in the suburbs as a whole and in the city.

There are three central findings in this analysis: 1) highway capital expenditures in the Greater Philadelphia region are significantly higher on a per capita basis in the Pennsylvania suburbs than in the city of Philadelphia. Over the 10 years from 1986-1995, expenditures benefitting suburban residents are estimated to be $1,041 per capita, about 2.5 times as large as those benefitting city residents, which were $424 per capita. 2) Total highway user fees generated differ significantly across communities because of different auto ownership rates. User fees do not, however, have differential effects on the attractiveness of communities because the user fees that individual drivers pay are the same across communities. 3) The per user differences between Philadelphia and its suburbs are smaller than per capita differences. Per user differences affect the degree to which car travel is favored in the city versus the suburbs, but it does not capture the location effects of investment in transportation infrastructure.

The difference in per capita expenditures is likely to have a significant effect on the competitive position of the city of Philadelphia relative to its suburbs. Highway investments have provided an economically significant, although not overwhelming, incentive for suburban rather than city locations for people and firms. We estimate that the highway investment differential reduces employment in the city by about 40,000 jobs.

I. Introduction

In recent years, a plethora of studies have examined economic impacts of public investments in infrastructure, many of which focus on transportation investment. In particular, these studies have examined how public investments affect the overall economy of countries, states, and metropolitan areas. But despite the large number of studies, the extent to which there are significant net aggregate impacts remains under debate. Earlier studies of the net effects of public infrastructure on productivity found relatively large impacts (see Aschauer (1989), Munnell (1990), or Garcia-Mila and McGuire (1992) for examples), but most recent analyses have found that the returns to public investments in infrastructure do not exceed private returns, and thus do not play a special role in the aggregate economy (see Holtz-Eakin (1994), Holtz-Eakin and Schwartz (1995), Crihfield and Panggabean (1995) or Garcia-Mila, McGuire, and Porter (1995) for examples).

Even if the net economic impacts of transportation investments are relatively small, these investments may have important impacts on the geographic pattern of economic activity in a metropolitan area. Moreover, if investments in transportation infrastructure induce inefficient patterns of development, the potential positive effects of these investments will be reduced. While the debate continues about the extent to which public investments in transportation *caused* the rapid pace of decentralization in most U.S. metropolitan areas, there is general agreement that extensive highway investment is necessary, if not sufficient, to sustain today's low density patterns of development.[1] There are good theoretical reasons to expect that transportation

[1]See Transportation Research Board (1995) and the references therein for a discussion of the role of highway and transit investments in decentralized land use patterns. Many economists argue that the decentralized pattern of land use reflects the rising incomes (Mieszkowski and

investments can play an important role in the pattern of economic development. The basic models of urban economics suggest that the density of economic activity is a function of transportation costs: lower transportation costs result in more dispersed metropolitan areas, all other things held constant. Not only are transportation investments likely to affect the overall spatial density of a metropolitan area, but they are also likely to affect the choices of communities for business and residential locations. Communities with better transportation infrastructure are likely to be more attractive to people and firms than communities with declining infrastructure.

There is considerable evidence that investments in transportation infrastructure have significant effects on the relative attractiveness of local communities, which ultimately determines the level of local economic activity and, in turn, local land values. Studies of transportation investments generally find that locations close to large investments in transportation infrastructure enjoy increased land values.[2] Direct analysis of the effects of transportation investments on development patterns, rather than on land prices, is generally less

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Mills (1993)) coupled with the intrinsic preferences of Americans for low density life-styles (Downs (1992)). On the other hand, it is not clear that Americans' choice of low density development is not, in part, a reflection of the fact that transportation investments and other policies, such as the tax treatment of owner-occupied housing (see Gyourko and Voith (1997)), have made low density development a low cost alternative, and hence these development patterns reflect prices as well as preferences. For an interesting perspective on the role of highway investments on patterns of land use in travel both in the U.S. and overseas, see Transportation Research Board (1997).

[2]See TRB (1995) for a discussion of studies that consider the impact of highway investment on land value. Studies finding positive impacts of transit investment include McDonald and Osuji (1995) as well as those of Voith (1993), Voith (1991), and Boyce et al. (1976), which document the effects of transportation investments on property values in the Philadelphia area.

conclusive, although it tends to suggest that highway investments do guide development patterns.[3] It is difficult to measure the development impacts of highways, however, because development often occurs in anticipation that the highway system will be expanded in the future to meet the needs of the development, as has historically been the case.

To the extent that investments in transportation infrastructure are locally funded (and to the extent that we ignore equity issues and cross-jurisdictional externalities), geographic differences in infrastructure investment should be of little concern from an economic efficiency perspective.[4] Communities choose their desired level of investment and derive the benefits of their investments or the benefits of not investing--which is current consumption. The spatial distribution of transportation investments and the resulting spatial distribution of people and firms are the outcome of the efficient free market.

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[3]A recent review of highways and development patterns (TRB (1995)) argues that it is difficult to make unequivocal statements about the effects of highways on development patterns. The weight of the evidences suggests, however, that highways do guide development patterns. (See, for example, Hansen et al. (1993) or Rephann and Isserman (1994)). As noted in TRB (1997), the full land use effects of highway investments are just now being manifest, and this might account for lack of conclusiveness of earlier statistical studies. With respect to transit, Cevero, Landis, and Landis (1995) found modest positive development impacts for BART in San Francisco; Green and James (1993) found somewhat larger, but still moderate, development impacts for the Washington Metro; but Bollinger and Ihlanfeldt (1997) found no net increase in development for MARTA in Atlanta.

[4]If transportation investments are not locally funded, the price communities pay for their infrastructure may not reflect the true costs, and there will be an inefficient level of infrastructure provided. If there is too much infrastructure investment in areas where the benefits are small, or if infrastructure simply induces people and firms to change locations, resulting in the obsolescence of existing infrastructure, aggregate returns to public infrastructure will be reduced. Similarly, cross-jurisdictional externalities may also generate inefficient levels of infrastructure provision. Haughwout (1997) argues that these cross-jurisdictional externalities are important. In particular, he finds that investments in local city infrastructure have important positive effects on the land values of suburban neighbors.

In practice, however, transportation investments derive a large fraction of their funding from non-local sources. Federal and state governments play important roles in the financing of most transportation projects. Transportation investments funded from non-local sources are likely to have a greater positive impact on local economic activity than they would have if the taxes of local residents were increased to pay for the investment. Thus, the allocation of federal and state funds within metropolitan areas can shift the relative attractiveness of local communities within the metropolitan area. Communities fortunate enough to be net recipients of public funds for infrastructure will have an advantage in competing for people and firms, and communities that fail to receive transportation investments and pay taxes or user fees that are spent in other communities will be at a disadvantage.

While the impacts of transportation investments on local land markets have been well documented, there has been considerably less research on the actual spatial distribution of transportation investments and sources of investment funds within metropolitan areas. In this paper, we examine the geographic distribution of transportation investments as well as the question of who pays for the investments in the Philadelphia metropolitan area, focusing on differences between the city and its surrounding Pennsylvania suburban counties. We present estimates of total, per capita, and per user benefits of highway investments, as well as fees generated by highway users at the county level. We also examine the combined highway and transit investments in the suburbs as a whole and in the city. Our findings can be summarized as follows.

Over the 10 years from 1986-1995, highway investment in the Pennsylvania suburbs of Philadelphia totaled $2.16 billion, or $1,006 per capita; highway investments in the city of

Philadelphia totaled $0.90 billion, or $566 per capita. Per capita highway investments were 78 percent higher in the suburbs than in the city. When adjusting these data using a simulation model of who uses several of the major highway investments, expenditures benefitting suburban residents were $1,041 per capita, about 2.5 times as large as those benefitting city residents, which were $424 per capita. Even when transit investments, which are skewed toward the city on a per capita basis, are included in the analysis, per capita transportation investments benefiting suburban residents exceed those benefitting city residents by 47 percent.

On the revenue side, the rate at which highway users generate user-fee revenue is roughly equal across counties, since gas taxes, registration fees, etc., are the same regardless of county of residence. Because car ownership rates in the suburbs are much higher than those in the city, suburban counties generate more highway user fee revenue than the city, and the relationship between highway infrastructure investment and fees generated per highway user differs across city and suburbs. On a per highway user basis, user fees generated by suburban drivers are 2.14 times greater than investments per user.[5] For city drivers, this figure rises to 2.58. The difference in highway investment relative to user fees is a disincentive for auto use in the city relative to the suburbs.[6]

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[5]These figures are based on the simulated expenditure data.

[6]Note that per capita user fees are substantially greater than federal and state infrastructure expenditures in both the city and the suburbs. This does not imply, however, that highway users in Philadelphia are paying more in user fees than is spent on highways because state and federal infrastructure expenditures comprise only about 58 percent of total expenditures on all highways by all levels of government. Our highway infrastructure expenditures include most, but not all, state and federal infrastructure spending. Given this fact, and given that total state and federal infrastructure expenditures comprised 58 percent of total highway expenditures during the period 1986-95, user fees generated appear to be roughly similar to total expenditures on highways for residents of Greater Philadelphia. See Tables SF-21 and HF-2 in Highway

It is likely that the greater excess of user fees over infrastructure investment and the much greater rate of highway investment per capita in the suburbs increase the attractiveness of suburban communities. In turn, more attractive suburban communities draw higher income residents with higher rates of car ownership and use. These considerations imply that user fees follow investment, so differences in net subsidies (per capita expenditures minus user fees) across communities will not reflect underlying location incentives inherent in the highway program. Because user-fee rates are similar across communities, differences in expenditures per capita, and to a lesser extent expenditures per vehicle, drive people's and firms' location choices.

The patterns of highway investment and finance have economically significant negative implications for the competitive position of the city of Philadelphia. The higher level of highway investment in the suburbs relative to the city is likely to have a negative effect on the number of jobs located in the city and is also likely to contribute to the ongoing sorting of higher income households into the suburbs and the lower income households in the city. While we cannot provide estimates of the magnitude of the sorting effect, we estimate that the highway investment differential reduces employment in the city by about 40,000 jobs.

The following sections of the paper present the details of this analysis. Section 2 discusses some local considerations in Pennsylvania's system of transportation investment and finance. Section 3 presents data on the distribution of highway expenditures by county, in aggregate and on a per capita basis. In section 4, we examine who uses major highway investments and make adjustments to the highway expenditures based on usage. Section 5

Statistics Annual for data on state and federal highway expenditures and total highway expenditures in Pennsylvania for all levels of government.

presents estimates of state and federal user fees paid by residents of each county. Section 6 discusses the implications of differences between expenditures and user fees for the city and the suburbs. Section 7 presents transit investment data with a rough breakdown between city and suburbs. Per capita expenditures, including both highway and transit investment, are presented for the average suburban and city resident. Section 8 concludes.

II. Local Considerations in Transportation Investment and Finance: Pennsylvania

Highways are by far the largest component of investment in passenger transportation, although in older metropolitan areas like Philadelphia, there is significant transit investment as well. Most federal highway expenditures are funded through the highway trust fund, whose revenues are derived from gasoline taxes and other user fees. In Pennsylvania, most state highway investments are funded through gasoline taxes, vehicle registration fees, and other user fees. Local governments usually fund highway investments from general revenues. Transit investment, at all levels of government, is funded through general revenues and other dedicated tax sources, but is not based on user fees.[7]

Just because the primary sources for highway transportation investment in Pennsylvania are either highway user fees (at the federal and state levels) or local government revenues does not mean, however, that the beneficiaries of transportation investments also fund the investments. Even in a regime in which all non-local funding is based on user fees, there can be large implicit subsidies that favor one community over another. A highway project may be

[7]This is not strictly true because operating revenues are sometimes used to pay debt service on borrowing used for investment in transit infrastructure.

funded by user fees collected across a wide geographic area, but the users of a particular highway investment may be primarily local. Costs for individual highway projects can therefore exceed net new user-fee revenue generated by the project.[8] On the other hand, evaluating the intrametropolitan distribution of the benefits of transportation investments and funding of these investments is more complicated than simply knowing where the new highway project is located and the governmental source of the funds for the project, because the beneficiaries of transportation investments may not live in the same community where the investment is located.

With respect to highway investments in Pennsylvania, the differential effects of transportation investments across communities are the result of the allocation of user-fee revenues and not differential user fees across communities. Because gasoline taxes and other user fees are the same for all Pennsylvania communities, they cannot be the base cause of differential impacts.[9] However, communities can generate vastly different levels of user fees per capita because of differing levels of car use and ownership. Because communities receiving large investments in highway transportation are likely to generate more car use, these communities will eventually generate higher rates of user fees as well. On the other hand, communities receiving less highway investment will likely have a population that owns fewer cars and uses them less frequently and thus generates less user-fee revenue on a per capita basis. Thus user fees follow investment, so investment differentials are likely to be more important determinants of land use impacts than differences in implicit subsidies across communities.

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[8]See Voith (1989) for a discussion of how individual highway investments may have wide divergences in costs and user fees, and the potential consequences of this divergence.

[9]The same cannot be said for transit, where fares and subsidy rates differ widely across communities.

After all, the tax rates for auto use are the same in all Pennsylvania communities.

III. Philadelphia Area Highway Investments

In this section, we present data on the federal and state capital expenditures for highway construction and maintenance from 1986-1995. The data are from summary reports from the State of Pennsylvania Department of Transportation (PENNDOT), Center for Program Development and Management. Because these data cover a 10-year span, they provide a picture of the long-run distribution of highway expenditures across the Pennsylvania counties of the Philadelphia metropolitan area.[10]

Table 1 displays state, federal and total highway capital expenditures for each of the four suburban counties: Bucks, Chester, Delaware, and Montgomery; all the suburban counties combined; the city of Philadelphia; and the metropolitan area totals. During the 10-year period, over $3 billion dollars were invested in highway transportation in the metropolitan area. The federal share of this investment was roughly 50 percent, and although there are some differences across suburban counties, both the aggregate suburban federal share and the city federal share were about 50 percent. At the county level, the highest expenditures for projects were in Delaware County, which received $901.7 million in highway investment. Among the other three suburban counties, Montgomery received $560.5 million, Chester $383.4 million, and Bucks $310.5 million, for a suburban total of $2.156 billion. Highway expenditures in Philadelphia, at $897.9 million, exceeded those of all suburban counties except Delaware, but overall total

[10]The dollar figures presented in this paper are in nominal terms, but there are no substantive changes in the conclusions if the analysis is done in constant dollar terms.

suburban investments were 2.4 times larger than those in the city of Philadelphia.

When examined on a per capita basis, suburban investments in highway infrastructure are also larger than city investments. Table 2 shows total highway investments, 1990 population, per capita, and per user highway investment by county, for all suburbs, the city, and the metropolitan area.[11] Expenditures per capita totaled $1,647 in Delaware County, followed by $1019 in Chester, $827 in Montgomery, and $574 in Bucks, for suburban average per capita investment of $1,006. Philadelphia, which in 1990 had a population that was roughly 2.3 times larger than that of the next largest county, received only $566 per capita in highway investment, or 56 percent of the suburban average. Highway investment per capita was about one-third of that of Delaware County, but roughly comparable to that of Bucks County.

In sum, while the total amount of highway capital expenditure in the city of Philadelphia was greater than all but one suburban county, these expenditures were far less than the total spent in the suburbs as a whole and, on a per capita basis, were dramatically less than all suburban counties except Bucks.

Expenditures per user in Philadelphia are not as dramatically different from those of its suburban neighbors. As is evident in Table 3, which shows vehicle registration by suburban county, suburban total, city, and metropolitan area, the rate of vehicle registrations in Philadelphia, at 0.30 per capita, is less than half that of the suburbs, 0.61 per capita, and vehicle registrations in the city have been declining.[12] The low rate of vehicle registrations in the city

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[11]The "per user" figures are actually per registered vehicle.

[12]Vehicle registrations have been declining over time in the city for a number of reasons: population has been declining; vehicle ownership costs are high as a result of high auto insurance and other factors; income has grown less rapidly among city residents; and relatively low auto

raises the per user city highway expenditures, $1,887, to a level higher than that of the suburban average, $1,643. On the other hand, the relatively high rate of vehicle ownership in Bucks County results in the lowest per user expenditures, $969, among the city or the suburban counties. Delaware County had the highest per user expenditure--$2,821.

IV. Who Benefits from Highway Investment in the Philadelphia Metropolitan Area?

In evaluating who benefits from highway investments, we focus on who uses the highway and ignore indirect benefits such as increased local land values associated with increases in residential and business development. A reasonable starting point for allocating the direct (to user) benefits of highway investments is to assume that the primary beneficiaries of expenditures reside in the county where the expenditures occur. Under this assumption, the geographic location of the highway expenditures presented above is a good indicator of who benefits from the investments, and the average level of benefits to individuals depends on per capita highway expenditures in their county of residence.

For roads that are primarily used locally, the county where the expenditure is located is probably a good indicator of who benefits, but frequently, many of the users of a highway may reside in a county other than where the highway is located. Given the level of highway commuting to the city of Philadelphia from suburban counties, and given the amount of cross-county commuting--some of which passes through the city of Philadelphia en route to another suburban destination--it is important to analyze who is using major expressways to determine who actually benefits from the investment. For example, there have been major investments in

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infrastructure investment may have reduced the benefits of auto ownership in the city.

highways located in the city of Philadelphia, but these highways clearly serve as routes to the city--and through the city--for residents of the suburban counties.

To more closely address the issue of who benefits from highway expenditures, we conducted origin and destination simulations on four of the major highway investments undertaken during our sample period.[13] Because each of these projects is a limited-access highway, these highways are likely to serve longer trips and therefore are likely to have a high percentage of users from counties other than the county where the expressway is located. The investments include I-95 (Delaware Expressway), I-76 (Schuylkill Expressway), and I-676 (Vine Street Expressway) from I-95 to I-76. Each of these projects is located in the city; we use the simulation model to estimate the degree to which these highways are used by residents of the four suburban counties. The other major investment we examined was I-476 (The Blue Route) from I-95 to the Pennsylvania Turnpike. I-476 is located primarily in Delaware County, but about 13 percent is in Montgomery County. We chose to examine this route to get an estimate of the extent to which city residents use expressways located outside the city.

Table 4 shows estimated expenditures on each of the four highway investments listed above.[14] As is clear from the table, the investment in each of these projects was large;

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[13]These simulations were done by the Delaware Valley Regional Planning Commission (DVRPC) using their TRANPLAN regional trip generation model. Both work and nonwork travel are included in the simulations. Six simulations were conducted in total, with I-76 and I-95 each being divided into two segements. The estimates from these simulations were later combined to correspond with our highway investment data.

[14]These data are from PENNDOT, Center for Program Development and Management. The figures may not reflect the total cost of a project because the entire project may not have taken place within our sample period. We constructed alternate estimates of the project costs using PENNDOT disbursements for individual contracts for each project and found similar, although not exactly identical, expenditure figures.

expenditures during our sample period ranged from $86.4 million to $578.1 million. Taken together, these expenditures total slightly more than $1.2 billion dollars and account for more than 39 percent of the total highway capital expenditures in the Pennsylvania part of the metropolitan area from 1986-1995.

Rather than allocate the expenditures on each highway to the residents of the county in which the highway is located, we use the simulation model to give us the share of highway users from each of the five Pennsylvania counties, including the city of Philadelphia. We then use these shares to allocate the $1.2 billion of highway expenditures on these projects according to usage shares to each of the counties. Assuming the beneficiaries of the remaining highway investments are primarily local, we recompute estimated total highway expenditures and per capita expenditures by the county of the highway user.

The estimated shares of users by county for each of these highways, based on the DVRPC simulation model, are shown in Table 5. The percentage of people using each highway originating from the city of Philadelphia and the Pennsylvania suburban counties is shown in rows one through five. The total percent of users who are Pennsylvania suburban residents and the percent originating in New Jersey, are shown in rows six and seven respectively.

Examination of Table 5 reveals that for the three major highway investments in the city of Philadelphia, a substantial fraction of the users are residents of other counties. The fraction of Philadelphia residents ranges from a low of 43.8 percent on I-95 to a high of 47.0 percent on I-76. Use of these highways by Pennsylvania suburban residents ranged from 30.5 percent for I-76 to 36.8 percent for I-95. Each of the suburban counties except Chester County makes extensive use of at least one of the highways located in Philadelphia. New Jersey residents also use these

highways extensively. In addition to the highways located in Philadelphia, the county of origin of users of I-676, the Blue Route, is shown as well. This highway is used primarily by residents of Delaware and Montgomery counties, with Pennsylvania suburban residents accounting for 83.2 percent of all users. Philadelphia residents accounted for only 10.5 percent of Blue Route users.

We use the data on estimated user shares by county to recalculate the distribution of highway investments across counties. In doing so, we make the following assumption: the benefits of highway investments other than the four examined above accrue to residents of the county where the investment is located. This assumption is designed so that the results of the analysis provide an upper bound on the level of highway investments directly benefiting Philadelphia residents. Essentially, the assumption implies that the remaining highway investments are primarily local or, alternatively, that city and suburban residents derive the same level of benefit from using highways (other than the four specifically analyzed) outside of their county. It is likely, however, that city residents' use of suburban highways is less than suburban residents' use of city highways for a number of reasons. First, the rate of car ownership among city residents is less than half--0.30 cars per capita--that of their suburban neighbors, 0.61 cars per capita. Second, Philadelphia residents disproportionately work in jobs located in the city. About 80 percent of Philadelphia residents work in Philadelphia, while only 59 percent of suburban residents work in their home county.[15] Finally, the low share of city residents using I-476, which is only 6 miles from the western boundary and 4 miles from the southern boundary of the city, suggests that city residents are less likely to use suburban highways than vice versa.

[15]U.S. Census of Population, Social and Economic Characteristics, Table CP-2-40.

Table 6 shows total, per capita, and per user expenditure on highways by resident county of the user, reallocating the shares of expenditures on the four highways above and assuming that the beneficiaries of the remaining investments accrue to residents of the county where the highway is located. The most striking aspect of Table 6 is the low per capita investment in highway infrastructure used by city residents compared with the suburban rate of investment beneficial to suburban residents. If we adjust for usage patterns on the four major highways, the per capita spending on highways for Philadelphia residents is $424 while the expenditure for suburban residents is $1,041, almost 2.5 times as large as the city rate. Unlike the unadjusted numbers, in which one county--Bucks--had a rate of per capita expenditure similar to that of the city, all Pennsylvania suburban counties have dramatically higher rates of per capita highway investment. After we adjust for usage, per capita highway investments in Bucks County were 1.9 times larger than the rate in the city while Chester, Delaware, and Montgomery counties were 2.8, 2.6, and 2.6 times greater than the city, respectively.

With respect to expenditures per user, Philadelphia's average, at $1,414, is lower than the suburban average of $1,700 when using the adjusted expenditures, despite Philadelphia's low auto ownership rate. All suburban counties except Bucks have higher expenditures per user, and Bucks, with a rate of $1,354, is relatively close to the Philadelphia rate. The adjusted figures stand in contrast to the unadjusted figures in which Philadelphia expenditures per user exceeded the suburban average.

V. User Fees: Who Pays for Highway Investment?

Federal and state funds contribute in roughly equal proportions to highway investments in

the Philadelphia metropolitan area. Both federal and Pennsylvania highway funds are generated primarily by user fees. For the federal government, the primary source of revenue for the Highway Trust Fund is the gasoline tax, which is basically a user fee because it increases with increases in highway use. The Commonwealth of Pennsylvania's Motor License Fund derives its revenue from gasoline taxes, vehicle registration fees, and other fees. Fees paid to the Motor License Fund increase with highway usage and car ownership. The fact that the primary sources of both federal and Pennsylvania funds for highway investment are user fees, however, does not necessarily imply that user fees are matched to expenditures at the county level. In this section, we present estimates of the user fees generated in each county in the Pennsylvania part of the Philadelphia metropolitan area.

Estimating highway user fees generated in each county is difficult and necessarily somewhat imprecise because data on the primary source of user-fee revenue--federal and state gasoline tax receipts--are not available at the county level.[16] Fortunately, we can estimate county level user fees using data on gasoline tax revenues at the state level, federal and state gas tax rates, and vehicle registrations, which are available at the county level. Our basic approach is to use state data to calculate average state and federal user fees per registered vehicle and apply these averages to vehicle registrations by county to obtain estimates of county-level user fees.

Table 7 shows federal, state, and total user-fee revenue generated in Pennsylvania annually, 1986-1995. Additionally, it shows these data per registered vehicle. User fees per registered vehicle have risen considerably over the period, primarily because of significant

[16]It is virtually impossible to directly estimate county gasoline tax revenues because the gasoline tax revenue is collected at the distributor level, before it is sent to gasoline retailers in the counties.

increases in gasoline tax rates, both at the federal and state levels. As is shown in Table 8, federal gas taxes rose from 9.1 cents per gallon in 1986 to 18.4 cents per gallon in 1995. Similarly, Pennsylvania tax rates increased from 12 cents per gallon to 22.35 cents per gallon over the same period.

Using the average state user-fee revenue per registered vehicle in conjunction with vehicle registrations by county, shown in Table 3, we can obtain estimates of the federal and state user fees generated in each of the five counties. Federal, state, and total user fees generated in each county are shown in Table 9. Because all of the estimates are based on statewide averages for user fees per vehicle, individual drivers in each county have identical user fees. Philadelphia, which had the largest number of vehicle registrations, is estimated to have generated the most user fees over the sample period. Still, if Philadelphia had vehicle ownership rates similar to those of the suburbs, aggregate Philadelphia user fees would be double the estimate shown in Table 9.

The estimated level of Philadelphia user fees may be a lower bound for user fees actually paid by Philadelphia residents. Because of the high cost of owning a vehicle registered in Philadelphia, it is likely that a significant number of Philadelphia residents illegally register their vehicles in neighboring suburban counties. To the extent that this occurs, Philadelphia user fees will be understated, and, by the same token, suburban user fees will be overstated. In addition, there is the possibility that Philadelphians disproportionately use unregistered vehicles. Once again, this would result in an understatement of Philadelphia user fees because these individuals still pay gasoline taxes, which are the largest component of user fees. In this case, however, estimated suburban user fees are not overestimated. Unfortunately, we do not have good

evidence on the actual magnitudes of illegally registered vehicles or the use of unregistered vehicles.

VI. Differences in Highway Investment and User Fees: What Are the Implications?

The suburbs receive much larger per capita investments in highways than does the city, but the city, on the other hand, pays less user fees, in aggregate. What are the implications of this pattern of highway investment and finance? To evaluate this issue, we need to keep in mind three important considerations: 1) for an individual car owner, user fees are roughly the same across city and suburb, so that the structure of user fees cannot create favorable incentives for either the suburbs or the city; 2) differences in the size of infrastructure investment relative to user fees can, however, affect individuals' demand for automotive travel relative to other modes that differ across communities; 3) differences in the level of infrastructure investment per capita across communities creates incentives for people with a greater demand for cars, either because of income or preference, to locate in communities with higher investment levels. Firms, seeking to be near their workforce, will make similar choices.

These three considerations imply that highway user fees will follow highway investment, so that the relationship between highway investment per capita and user fees per capita in any community will not provide insight into the relative impacts of highway investment and finance on the city and on suburban communities. Because user fees follow highway investment, new highway construction can make user fees rise in one community and fall in another, even if there is no net new user-fee revenue associated with the investment. User fees may be unchanged, but the location of the fees' beneficiaries changes. Thus, when evaluating the impacts of highway

spending on the location of residences and firms, we should focus on differences in investment levels and ignore user fees . After all, the prices they confront in terms of user fees are the same across location.

The differences in highway investment between suburban per capita investment and city per capita investment reported in this paper are likely to be economically significant, but not overwhelming, considerations in people's location choices. If we assume a typical three-person household, suburban households enjoyed an additional $185 in highway investments annually.[17] How large an effect can this annual differential have on the patterns of local activity?

One way to approach this question is to assume that the benefits from highway investments are valued dollar for dollar by consumers. In this way, we can get an idea of the importance of the differential highway investments by comparing them to another city-suburban differential--the city wage tax--whose effects have already been analyzed. The Philadelphia city wage tax for city residents currently stands at roughly 4.79 percent. If we use the Philadelphia per capita income for 1990--$12,091-- and again assume a three-person household, the wage tax costs the average Philadelphia household $1737 per year. The difference in highway investments from city to suburb, $185 per household, is a little more than 10 percent of the wage tax. Inman (1992) estimates that a 10 percent reduction in the wage tax--which is roughly the value of the highway subsidy differential--would result in an employment increase of 40,000 jobs in the city. Thus, a reasonable guess as to the impact of differential highway investment rates between the city and suburbs would be a net loss of 40,000 jobs for the city. Note that the Philadelphia wage

[17]Here we are using the differences in dollar values between city and suburb presented in Table 6. The difference is $617 per capita over the 10-year period, or $1,851 for a family of three. On a straight-line basis, this amounts to roughly $185 per year.

tax is deductible from income for federal tax purposes, effectively reducing the rate for higher income people and resulting in a smaller annual outlay. So the highway differential may be somewhat larger than the 10 percent assumed above, and therefore, the highway differential may have larger employment impacts.

In addition to employment impacts, the highway investment differentials are likely to increase the geographic sorting of high- and low-income people between city and suburb. Highway investments are more highly valued by people who own cars, and car ownership increases with income. Differential investments in highways make suburban locations relatively more attractive to current city residents with cars than for those without cars. Thus, differential investments in highways across city and suburbs should result in a higher concentration of high-income households in the suburbs and a higher concentration of low-income households in the city.

From the perspective of job and residence location, it is fair to characterize the differences in suburban and city highway expenditures as potentially having economically significant, although not overwhelming, negative effects on the competitive position of the city, both through its likely effect on jobs and through its differential effects on location across income classes.

VII. Do Transit Infrastructure Expenditures Offset the Highway Differentials?

There is a significant amount of transit infrastructure investment in the Philadelphia metropolitan area. Over the sample period, total transit infrastructure investments totaled $1.73 billion, compared with $3.1 billion in highway investments. While it is not possible to identify

transit investment on a county-by-county basis, we can trace transit investment by division of the Southeastern Pennsylvania Transportation Authority (SEPTA); these expenditures can then be roughly allocated to the suburbs and the city.

Table 10 shows transit investment by SEPTA function and our allocation of these investments to suburban and city residents. Regional rail and suburban transit expenditures are allocated to the suburbs while the Light Rail, Subway Elevated, and Surface divisions were allocated to the city.[18] Multimodal and support infrastructure were allocated on a proportional basis. Using this allocation, $852 million was invested in projects benefiting suburban residents and $878 million in projects benefiting city residents. On a per capita basis, transit investments in the city were roughly 1.4 times larger ($554) than those in the suburbs ($398). Combining the transit investments with the highway investments results in a total transportation infrastructure per capita spending of $978 in the city and $1,439 for the suburbs, a difference of $461 per capita. Thus, including transit in our analysis does not qualitatively change the findings of the analysis that focused only on highway expenditures.

VIII. Conclusions

There are three central findings in this analysis: 1) transportation capital expenditures in the Greater Philadelphia region are significantly higher on a per capita basis in the Pennsylvania suburbs than in the city of Philadelphia. The difference in per capita expenditures is likely to

[18]These allocations give only rough approximations of who actually benefits from the investments. For example, about 30 percent of regional rail riders are city residents, while the Light Rail division operates significant lines in the suburbs as well as in the city. In addition, relatively large numbers of suburban residents use the two subway lines to center city.

have a significant effect on the competitive position of the city of Philadelphia relative to its suburbs. 2) Total highway user fees generated differ significantly across communities because of different auto ownership rates. Highway user fees do not, however, have differential effects on the attractiveness of communities because the user fees that individual drivers pay are the same across communities. 3) The per user differences between Philadelphia and its suburbs are smaller than per capita differences. Per user differences affect the degree to which car travel is favored in the city versus the suburbs, but it does not capture the location effects of investment in transportation infrastructure. In sum, highway investments have provided an economically significant, although not overwhelming, incentive for suburban rather than city locations for people and firms.

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Table 1
State and Federal Highway Transportation Investments
1986-1995

County	State ($000)	Federal ($000)	Total ($000)
Bucks	192,786	117,711	310,497
Chester	254,522	128,865	383,387
Delaware	382,664	519,054	901,718
Montgomery	261,764	298,712	560,476
Suburban Total	1,091,736	1,064,342	2,156,078
Philadelphia	443,771	454,087	897,858
Metro Total	1,535,507	1,518,429	3,053,936

Source: PENNDOT: Center for Program Development and Management

Table 2
Population and Per Capita Highway Investments
1986-1995

County	Expenditure ($000)	1990 Population	$ Per Capita Expenditure	$ Per User Expenditure
Bucks	310,497	541,174	574	969
Chester	383,387	376,396	1,019	1,846
Delaware	901,718	547,651	1,647	2,821
Montgomery	560,476	678,111	827	1,207
Suburban Total	2,156,078	2,143,332	1,006	1,643
Philadelphia	897,858	1,585,577	566	1,887
Metro Total	3,053,936	3,728,909	819	1,708

Table 3
Vehicle Registrations by County

Year	Bucks	Chester	Delaware	Montgomery	Suburbs	Philadelphia	Metro
1986	297,347	185,620	302,035	438,115	1,223,117	527,565	1,750,682
1987	307,611	193,797	307,948	448,033	1,257,389	517,798	1,775,187
1988	317,875	201,974	313,861	457,950	1,291,660	508,031	1,799,691
1989	320,784	205,721	319,404	463,826	1,309,735	490,892	1,800,627
1990	320,570	207,698	319,618	464,399	1,312,285	475,723	1,788,008
1991	320,410	208,792	319,971	464,707	1,313,880	468,572	1,782,452
1992	324,919	212,568	326,616	469,060	1,333,163	473,451	1,806,614
1993	328,002	216,151	328,816	476,713	1,349,682	474,457	1,824,139
1994	330,989	221,749	328,747	504,220	1,385,705	476,528	1,862,233
1995	326,913	218,436	316,804	521,851	1,384,004	465,209	1,849,213
Average	319,542	207,251	318,382	470,887	1,316,062	487,823	1,803,885
1990 per capita	0.59	0.55	0.58	0.68	0.61	0.30	0.48

Table 4
Selected Major Highway Investments
1986-1995

Project	County	Cost ($000)
Vine St Expressway	Philadelphia	247,731
I-95	Philadelphia	183,928
Schuylkill	Philadelphia	104,245
Blue Route	Delaware	578,111
	Montgomery	86,384
Total		1,200,399

Table 5
Simulation Results: Highway Users by County

County	Highway			
	Vine St	I-95	I-76	Blue Rt
Philadelphia	44.97%	43.75%	47.01%	10.50%
Bucks	14.11%	20.37%	4.03%	7.04%
Chester	3.03%	1.72%	3.36%	7.17%
Montgomery	13.68%	2.24%	15.98%	32.68%
Delaware	4.30%	12.42%	7.09%	36.33%
Suburbs	35.12%	36.75%	30.47%	83.22%
New Jersey	19.91%	19.50%	22.52%	6.28%

Table 6
Simulated Total Expenditures and Per Capita Expenditures

County	Total Expenditures ($000)	Per Capita Expenditures ($)	Per User Expenditures ($)
Bucks	433,902	802	1,354
Chester	445,205	1,183	2,144
Delaware	605,911	1,106	1,896
Montgomery	745,913	1,100	1,606
Suburban Total	2,230,931	1,041	1,700
Philadelphia	672,604	424	1,414
Metro Total	2,903,535	779	1,624

Table 7
User-Fee Revenues and Revenues Per Registered Vehicle

Year	State ($000)	Federal ($000)	Total ($000)	State per Vehicle	Federal per Vehicle	Total per Vehicle
1986	1,487,304	540,202	2,027,506	244.2	88.7	332.9
1987	1,488,731	519,446	2,008,177	240.9	84.0	324.9
1988	1,546,675	570,009	2,116,684	247.3	91.1	338.5
1989	1,601,789	651,495	2,253,284	252.4	102.6	355.0
1990	1,599,351	539,602	2,138,953	250.5	84.5	335.0
1991	1,647,282	628,376	2,275,658	256.2	97.7	353.9
1992	1,819,486	689,882	2,509,368	278.4	105.6	384.0
1993	1,842,303	697,688	2,539,991	279.2	105.7	384.9
1994	1,937,207	788,151	2,725,358	290.0	118.0	408.0
1995	2,032,111	878,613	2,910,724	300.7	130.0	430.7
Total	17,002,239	6,503,464	23,505,703	2639.7	1008.1	3647.8
Average	1,700,224	650,346	2,350,570	264.0	100.8	364.8

Table 8
State and Federal Gasoline Tax Rates

Years	Federal (Cents/Gallon)	State (Cents/Gallon)
1985-89	9.1	12.0
1990	14.1	17.8
1991-92	14.1	22.35
1993-95	18.4	22.35

Table 9
User-Fee Revenue by County

County	Federal User fees ($mil)	State User fees ($mil)	Total User fees ($mil)
Bucks	323.06	844.99	1168.05
Chester	210.09	548.91	759.00
Delaware	321.56	841.53	1163.10
Montgomery	477.78	1247.43	1725.21
Suburban Total	1332.50	3482.86	4815.36
Philadelphia	489.85	1284.65	1774.50
Metro Total	1822.35	4767.51	6589.86

Table 10
Transit Infrastructure Expenditures by Division, City and Suburbs

	City Expenditures $1000	Suburban Expenditures $1000	Total Expenditures $1000
Division			
Light Rail	48,145	0	48,145
Regional Rail	0	581,789	581,789
Suburban Transit	0	134,360	134,360
Subway Elevated	268,076	0	268,076
Frankford Elevated	292,283	0	292,283
Surface	129,329	0	129,329
Multimodal	106,997	103,852	210,848
Support	33,273	32,295	65,568
Totals	878,104	852,297	1,730,400