

**The Effects of Federal Transit Subsidy Policy on Investment Decisions:
The Case of San Francisco's Geary Corridor**

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Abstract

In the United States, federal funding for public transit often accounts for a large proportion of a local agency's budget, especially for capital investments. For this reason, local governments can be expected to plan a portfolio of projects that maximize federal contributions. This study examines the financial effects of federal transit subsidy policy on local transit investment decisions. Data from a System Planning Study for the Geary Corridor in San Francisco are used as an illustration. It is found that federal transit subsidy policy provides financial incentives for local decision-makers to select capital-intensive investment options that may not be efficient or effective. While federal financial incentives are not the only factor influencing local investment decisions, some reform of the current subsidy policy may be necessary to reduce the incentive for ineffective use of public resources.

Introduction

Since the 1960s, the U.S. government has provided financial support for public transit and stipulated conditions governing the allocation of subsidies from other levels of government. Along with many other contributing factors, federal subsidy policies have played an important role in shaping local transit investment decisions even as federal subsidies have gradually decreased as a proportion of public support for transit projects. How does federal transit subsidy policy influence new transit service investment decisions by local governments? This question has been raised frequently but rarely has it been addressed empirically.

Over the past two decades, research on federal transit subsidy policies has largely focused on the effects of policy on transit cost and productivity.¹ Some researchers (e.g. Barnum and Gleason, 1979) found that a higher level of subsidy is associated with a higher level of effectiveness and that subsidies helped reverse declines in transit service and ridership. Most, however, have concluded that federal subsidy policy has encouraged service expansion and lower fares while inducing higher operating costs and lower labor productivity (Pucher, et al., 1983; Pucher and Markstedt, 1983; Cervero, 1984a, 1984b; Pickrell, 1986; Wachs, 1989; Li, 1992; Moore, 1993; Obeng, et al., 1995). Some studies further suggest that federal transit subsidy policy, which has a long history of favoring capital over operating subsidies, may have induced early retirement of bus fleets and encouraged investments in capital intensive but inefficient transit services (Hilton, 1974; Gomez-Ibanez, 1985; Frankena, 1987; Wachs, 1989; Cromwell, 1989; Kain, 1988, 1990; Pickrell, 1992; Obeng and Azam, 1995). However, little

¹ Research related to this subject also examines the impacts of transit investments on land use, air quality, and travel behavior. For more information on effects of transit investments, see Cervero (1994), Cervero and Landis (1997), among many others.

research has empirically documented how federal subsidy policy affects local investment decisions on new transit services and whether it leads to the selection of inefficient and ineffective alternatives for new transit services. Research on these questions is timely as the “reauthorization” of the Transportation Equity Act for the 21st Century (TEA-21), which was passed in 1998, is being considered now.

This paper explores the possible effects of federal transit subsidy policy on local transit investment decisions. We argue that several factors, including the need to balance political interests, the financial constraints of local governments, the division of financial responsibilities among governments at various levels, and the distinctive characteristics of the American political system, have motivated local decision-makers to weigh heavily the financial incentives provided by federal transit subsidy policy. Because federal transit subsidy policy favors capital over operating subsidies, it may encourage a preference for capital-intensive transit investments. However, a capital-intensive transit investment may not be the most efficient and effective option.

In the following sections, we first discuss the importance of federal subsidies in local investment decision-making. Following the discussion, we illustrate the potential effects of federal transit subsidy policy using data from the Geary Corridor System Planning Study (GCSPS) in San Francisco. The final section summarizes findings and their implications.

While limited, a case study is appropriate given the absence of systematic data on local transit investment decisions in the U.S. and variations in policy effects due to different locational factors. The case study can provide some evidence on the possible effects of federal transit subsidy policy and shed light on the mechanisms through which federal subsidy policy influences local transit investment decisions.

The importance of federal financial subsidies in local decision-making

Federal policies can influence local transit investment decisions by providing financial incentives or disincentives for transit investments since financial considerations are important when making local transit investment decisions. The importance of federal financial factors in local decision-making can be examined by analyzing the nature of transportation decision-making in the U.S. and the distinct structure of federal transit subsidy programs.

Numerous studies have demonstrated that the transportation planning and decision-making process in the U.S. is pluralistic, resource allocative, consensus-seeking, problem-simplifying, and uncertainty-avoiding (Meyer and Miller, 1984). In the case of transit investment decisions, the goals of proposed investments and alternatives are identified through a planning process in which policymakers, planners, and stakeholders interact, and the final investment decision is made on the basis of consensus among the parties involved in the process. Such a transit investment decision-making process is inherently political and extremely complicated. It involves many stakeholders with dramatically different visions and conflicting interests. The selection of alternatives to be considered, the assumptions and analytical methods to be used in the evaluations, the criteria chosen for comparisons of transit investment options, and the final investment decisions are all reflections of political power and products of complex political interactions aiming to achieve consensus among diverse interest groups (Wachs, 1995).

Because of the nature of such a decision-making process, politics plays a key role in shaping transit investment decisions. Several political factors create pressures and motivate local government decision-makers to make financial considerations an important criterion in making transit investment decisions. Such factors include the needs for balancing the interests of different groups and political constituencies and for accomplishing policy goals, the division

of financial responsibility between the federal and local governments, local financial constraints, and political motivations.

The Needs for Balancing Political Interests and Fulfilling Federal Requirements

Many communities often have conflicting interests when it comes to transit investment decisions. A classic example of conflict is the spatial distribution of the benefits and costs of transit services. Too often, communities that most need transit are in central cities, while most revenues for supporting transit services are raised from suburban communities. Transit investment decisions must consider such a conflict and balance the demand and interest of inner cities and suburban communities. Besides the mismatch between transit demand and resources for providing the services, each community may have different preferences for public transportation. This is evidenced from the results of a survey of voters in Arlington, Texas, in 2001, with regard to their preferences for types of transit services. Residents in the northern areas of the city near commuter rail service to Dallas and Fort Worth preferred transit services connecting to the rail line, people in the southern areas tended to favor bus services connecting to park-and-ride facilities near highways, and others preferred bus services connecting neighborhoods with major activity centers in Arlington (Cole & Li, 2001).

In addition to preferences and needs, there are different priorities among different community groups. Transit must compete with other public services for limited city budgets, including street repair and maintenance, police, schools, museums, parks, etc. For example, in the case of a tax election in the City of Arlington, transit supporters perceived transit services as an urgent need for the city, while opponents considered street repair a more urgent priority (Rushing, 2002).

Moreover, many cities have to meet a growing list of government mandates, such as requirements to provide costly services under the Americans with Disabilities Act (ADA) and the Clean Air Act Amendments (CAAA). In order to balance the interests of various groups and communities and to fulfill requirements of federal mandates, local governments must always look for financial resources. Hence, financial considerations become key factors in transit investment decisions.

Division of Financial Responsibility

The division of financial responsibility between the federal and local governments and the difficulty of local governments in raising money for transit services also make external financial resources attractive. Transit services in the U.S. have long been provided by local governments with financial support from the federal and state governments. Historically, local governments have been mainly responsible for financing transit operations while the federal government has assisted with capital costs. This can be seen from the history of federal subsidies since the 1960s. For example, the federal government did not provide any operating assistance until 1975 and has gradually withdrawn its support for transit operations since the 1980s. On the other hand, federal capital assistance has risen to more than 90% of federal transit expenditures (Figure 1).

[Figure 1 about here]

The declining importance of federal subsidies in transit operation is shown in Table 1. Over the years, the level of available resources for local transit operations from the federal government has been shrinking, making transit operation ever more dependent upon state and local subsidies.

[Table 1 about here]

Local Financial Constraints

Although local governments have responded to declining federal support for transit operation with locally enacted dedicated tax sources, their ability to raise money is not unlimited. Local taxes often require approval by voters. While certain tax-based propositions have been popular, some cities and counties have difficulty raising or retaining taxes for transit projects (Goldman and Wachs, 2001). For example, voters in Kansas City rejected a tax-based proposition that would have extended two existing one-half percent sales taxes from January 1, 2001 through December 31, 2015 that would have been used for light rail construction and operation and for other transportation infrastructure. Similar rejections have occurred in Sonoma County, California; San Antonio, Texas; Chandler County, Arizona; and Miami-Dade County, Florida in recent years (Center for Transportation Excellence, 1994~2000). Voters in the City of Arlington, Texas, have rejected several tax increases for public transit over the past twenty years, making the city well known as the largest city without public transit in the U.S.²

Besides the difficulty of raising taxes for transit operations, some approved measures have faced challenges. For example, Proposition C, a half-cent sales tax for transportation programs was challenged in court after it was approved by Los Angeles County voters in 1990 on the basis of claims that the measure did not comply with Proposition 13, which requires two-thirds of the voters to support a special-purpose tax increase (Hager and Stein, 1992). Los Angeles County voters also passed a measure in 1998 to bar the use of local sales tax revenues to expand the local subway program (Center for Transportation Excellence, 1998). These examples all demonstrate that financial constraints frequently dominate transit investment decisions. The

² For list of transit tax elections before 1994, see “Urban Mass Transportation Planning” by Alan Black (1995).

problems of financial constraints and equitable allocation of resources exert strong pressures on local decision-makers to seek external financial resources.

Political Motivations

The American political system also motivates local decision makers to make financial considerations a central criterion. The federal resources brought into local jurisdictions and miles of track built are often used as performance measures by politicians seeking election or by the media evaluating candidates. For example, in responding to the question: “how would you pay for new mass transit expansion projects” by radio station WAMU³, Terry Lierman, a candidate running for the 8th Congressional District seat in Maryland in the 2000 Election responded that he would “take the lead to ensure that Montgomery County's traffic problems get the attention in the transportation appropriation bill and funding that is long over due” (WAMU, 2000). Similarly, in a newspaper article discussing his nomination for the position of U.S. Secretary of Transportation by President Bush in January 2001, Norman Mineta was credited with helping win federal funding for Santa Clara County’s light-rail system and other projects (Cabanatuan, 2001). Because of the nature of political competition, the desire to maximize financial support from the federal government is rational and not unique to transportation.

In summary, balancing various interests, local financial constraints, the division of financial responsibility among several levels of government, and other aspects of the American political system put pressure on local decision-makers to maximize the receipt of external funds through the decision-making process. Because of financial need, political goals, and the

³ WAMU is a public radio station for National Public Radio (NPR) news and information in the greater Washington D.C. area.

availability of significant external funding from the federal government, the incentive or disincentive provided by federal transit subsidy policy could have significant influence in shaping local investment decisions.

Case study of the Effects of Federal Transit Subsidy Policy

To what extent does federal transit subsidy under TEA-21 influence local decision-makers to choose one transit alternative over another? How do our hypothesized factors play out in reality? Would federal transit policy prompt the selection of less efficient and effective alternatives? The remainder of the paper explores these questions using the Geary Corridor as an example. The Geary Corridor is used because it is both unique and representative. On the one hand, it is one of the most heavily used transit corridors in the U.S. On the other hand, because the GCSPS consists of many common components of a typical planning process such as the involvement of stakeholders and the public in setting goals and scoring alternatives, this corridor is also quite representative of the corridor planning process.

In the following, we first describe the GCSPS, analyze political interests involved in the process of forming project objectives, and explore financial constraints facing Muni and city political leaders at the time the study was conducted. We then present the major structure of transit programs under TEA-21 and illustrate the financial responsibilities of the federal and local governments given the provisions of TEA-21. Finally we compare the efficiency and effectiveness of transit investment options to assess the effects of TEA-21 on local investment decision-making.

The Geary Corridor System Planning Study

The GCSPS was completed by Merrill and Associates in 1995 after the corridor was

identified by the San Francisco Municipal Railway (Muni) in 1993 as one of four rail corridors⁴ for major improvements. Like many corridor studies, the planning process for the Geary Corridor included such steps as forming planning goals and objectives, developing transit alternatives, evaluating alternatives, and making recommendations. A main component in the process of forming planning goals and objectives was a public participation program that involved all groups in the corridor. Working with Muni Service Planning staff, the consultant team involved Geary Corridor stakeholders in the public participation process. Some examples of stakeholders were the Geary Sub-committee of the Citizen's Advisory Committee of the San Francisco County Transportation Authority, transit service providers such as the Bay Area Rapid Transit (BART) District and community groups including Asian and African American communities in the corridor and business groups such as the Geary Merchant Association, the Golden Gate Democratic League, etc. Through a series of outreach activities, including public and special meetings, newsletters, surveys, transit tours, and telephone and fax input hotlines, the consulting team was able to develop a set of goals and objectives that reflected the interests of stakeholders. Among the goals and objectives, reducing travel time along the corridor and enhancing equity in access to transportation reflected the interests of transit users and various communities, especially ethnic communities, people with

⁴ The four corridors are the Bayshore, Geary, North Beach, and Van Ness (Muni, 1995). Bayshore Corridor was identified as the first priority corridor. A light rail alternative was selected as the "Locally Preferred Alternative" for the Bayshore Corridor in 1998. Muni is currently constructing the light rail line, which has been renamed the Third Street Light Rail Project (Muni, 2001). Geary Corridor was named as the next highest priority corridor for "fixed guideway" transit improvements.

socioeconomic disadvantages and the mobility impaired. Other goals and objectives, such as providing access to the central business district and to areas where business activities were vital, revealed the interests of businesses likely to be served by the transit services. The goals and objectives also included the views and interests of environmental groups, transit service providers, and planning communities. In addition, financial objectives were emphasized, in particular to minimize construction cost and to match proposals with available funds.

Such financial concerns were expected, given the financial constraints that Muni faced then. This is evident from a report by city budget analyst Harvey Rose in 1995. According to Rose, Muni faces an annual operating budget deficit of \$66 million by 2006, assuming that fares will not rise and that general fund contributions increase at an annual rate of 3.5 percent. Rose suggested two basic approaches to reducing deficits: raising transit fares and finding new sources of money. Predictably, both approaches were troublesome. As pointed out by Rose, any financial bailouts face serious political obstacles. Increasing fares would be difficult, given the fact that fares had been raised not too long before. Other financial options, such as introducing a sales tax, special transit tax, private vehicle tax increase, and property tax, were suggested. However, a citywide transit tax would likely encounter political resistance. For example, in a report to the Chamber of Commerce, San Francisco transit consultant Richard Swanson suggested a citywide transit tax to address Muni's financial deficits. However, the proposal received a cool greeting from then-Mayor Frank Jordan and business interests. Proposals to tax downtown businesses for Muni support in 1994 also died in the face of public hostility. Proposals to raise the sales tax, impose vehicle license and registration surcharges, increase Bay Bridge tolls, impose a county or regional gas tax, or dedicate funds that the airport might owe the city also faced certain opposition from the affected communities (Dietz, 1995). With such

financial constraints, it was not surprising that city decision-makers sought external funds to support their various proposals.

Based on the established goals, objectives, and inputs from the public participation program, the consultant team reduced the original thirty-one potential alternatives to seven for evaluation. The seven alternatives consisted of one Transportation Systems Management (TSM) alternative, two subway-surface light rail alternatives (2A & 2B), three subway-surface electric trolley bus alternatives (3A, 3B & 3C), and an all-surface light rail alternative (4). The TSM alternative retained existing transit services with minor modifications, including the replacement of existing articulated diesel buses with low floor diesel buses and the conversion of existing traffic signals to demand-activated devices at some locations in the corridor. The two subway-surface light rail alternatives replaced existing diesel bus services on Geary Boulevard with partial subway light rail service. Alternative 3A included dual mode buses operated on the surface and in underground tunnels in the corridor. Alternatives 3B and 3C included low floor articulated electric trolley buses operated in the corridor through different lengths of subway. Alternative 4 was a light rail system in which trains travel on a surface median between 39th Avenue and Gough Street, and in mixed flow or semi-exclusive lanes on the rest of the line. All six non-TSM alternatives also included improvements that were part of the TSM alternative.

The system planning study recommended advancing all alternatives but one, 3A, into the Major Investment Study phase of the federal implementation and funding process (Merrill & Associates, 1995). The six alternatives were regrouped into four in the final recommendation: the TSM alternative, a surface/subway light rail alternative including two options (2A and 2B), a surface/subway electric trolley bus alternative with two options (3B and 3C), and the all surface

light rail alternative (#4).⁵ Recognizing the financial limitations and the steep competition for federal and state transportation funding, Muni's governing board at the time, the Public Transportation Commission (PTC), accepted the report and elected not to move forward until a viable financial plan could be developed.

While the PTC did not select a preferred mode and alignment at the time, "Muni envisions a surface/subway LRT line serving this (Geary) corridor," as indicated in a newly released document entitled "A Vision for Rapid Transit in San Francisco" (Muni, 2002).

Provisions of TEA-21

What would be the financial responsibilities of the City of San Francisco and the federal government under TEA-21 for the surface/subway options, as compared to other options? To answer this question, one must understand the distinctive structure of the federal transit subsidies under TEA-21. TEA-21 provides \$36 billion of guaranteed funding for transit programs over the six-year period that started in 1998. Under this law, transit funding is distributed among various programs. Each program has requirements for eligible uses and allocation criteria. Major assistance programs for traditional transit services include the urbanized and non-urbanized area formula programs (Section 5307 and Section 5311) and the capital investment program (Section 5309). Funding for these three programs accounts for about 94 percent of the total guaranteed funds. Formula funds are non-competitive and allocated to urbanized and non-urbanized areas on the basis of factors such as population, population density, bus miles, rail miles, passenger miles, *etc.*⁶ The funds can be used for planning, engineering, and design of transit projects,

⁵ According to the San Francisco Countywide Transportation Plan (CTP) draft report, only three non-TSM alternatives were recommended in a system level study by Muni (SFCTA, 2001).

⁶ An urbanized area is an incorporated area with a population of 50,000 or more, as designated by the U.S. Department of Commerce, Bureau of the Census.

transit capital investment and operating assistance. TEA-21 eliminates operating subsidies for areas with populations over 200,000, but also revises the definition of "capital project" to include a wider range of projects eligible for federal transit formula funds. For example, some of the former operating expenses, such as preventive maintenance, are redefined as capital expenses. Federal capital subsidy may cover as much as 80 percent of a project's capital cost. The maximum federal share for transit operating assistance is 50 percent of the net operating cost (U. S. Department of Transportation, 1998, 2000a).

The capital investment program provides assistance for three primary activities: new and replacement buses and facilities, modernization of existing rail systems, and new fixed guideway systems. Like the Inter-Modal Surface Transportation Efficiency Act (ISTEA) of 1991, funds under the capital investment program were divided into 20 percent for bus and bus-related activities, 40 percent for fixed guideway modernization, and 40 percent for new fixed guideway systems or extensions to existing fixed guideway systems. The federal share for these activities can be up to 80 percent. Funds are allocated on a discretionary basis except for fixed guideway modernization activities, for which funds are allocated by a statutory formula to urbanized areas with rail systems that have been in operation for at least seven years. Although there is a fixed amount apportioned to the capital investment program each year, there is no limit to the number of projects that a state or local government can apply for, or to the maximum amount that a project can request.

One feature of TEA-21 is that the competition for funding under this program is extremely political, as most of the money is designated by Congress for specific projects. Therefore, in order to be competitive, applicants must have the support of congressional delegates from their local jurisdictions. Without such support, it is almost impossible to get

funding under this program, even when a community has successfully completed the required steps in the major capital investment planning and project development process and been recommended by the Federal Transit Administration (FTA) to the Congress. This funding allocation process and the distinctive structure of the federal funding policy both open up opportunities for and encourage local governments to compete for federal assistance for new transit investments.

Financial Shares Under TEA-21

Based on the provisions of TEA-21, we analyze the financial responsibilities of governments for the six alternatives to explore whether the federal transit subsidy policies do provide financial incentives for local governments to invest in more expensive alternatives. To do so, we estimated the annual operating costs of the alternatives, annualized their capital costs, and applied the federal subsidy policies to derive the financial shares of the federal and local governments.

To estimate the annual operating costs of the alternatives, we developed three cost estimation models using a cost allocation method and operating cost and service statistics obtained from Muni's data in the National Transit Database Reporting System (Muni, 1994). The cost allocation model is widely used in transit planning practice. The key assumption of the model is that each operating cost item can be assigned or allocated to a specific operating statistic. The basic form of the model is that the cost of a route or a service equals the sum of a few unit costs of service statistics times the corresponding quantities of those statistics, such as vehicle miles or hours, or peak vehicles. This can be expressed in equation (1):

$$\text{Estimated Operating Cost} = \sum_{i=1}^N u_i * X_i \quad (1)$$

where

i = a particular measurable service characteristic which represents the scale of operations;

N = number of service characteristics included in the model;

X_i = quantity or value of characteristic i in the analysis;

u_i = unit cost of characteristic i ;

To derive the unit costs of service data, we first assigned the operating cost items reported in the database to relevant service measures for each mode, summed up the costs in each category, and divided the costs by the service measurements. That is:

$$u_i = \frac{(TC_i)}{X_i} = \frac{\sum_{j=1}^n C_j}{X_i} \quad (2)$$

where:

TC_i = the total operating cost associated with service characteristic i ;

j = a particular class of function and expense object, such as labor for vehicle maintenance, or materials and supplies for vehicle maintenance, *etc.*;

C_j = cost of j , such as cost of labor for vehicle maintenance, or cost of materials and supplies for vehicle maintenance, *etc.* These costs are associated with a service characteristic i , which is revenue vehicle miles or hours in this particular example.

n = number of class of functions and expense objects associated with a particular service characteristic i .

By using the cost allocation method and Muni's data, three models were developed:

$$\text{Motor Bus: } OC = 2.45 * RVM + 40.64 * RVH + 76923.97 PV \quad (3)$$

$$\text{Trolley Bus: } OC = 2.04 * RVM + 41.87 * RVH + 63473.21 PV \quad (4)$$

$$\begin{aligned} \text{Light Rail: } OC = 4.90 * RCM + 69.37 * RCH + 121544.32 * PV \\ + 376023.71 * ST + 114899.35 * RM \quad (5) \end{aligned}$$

Where OC is annual operating cost, RVM stands for annual revenue vehicle miles, RVH represents annual revenue vehicle hours, RCM is annual revenue car miles, RCH is annual revenue car hours, PV represents maximum number vehicles in operation during the peak hour period, ST stands for number of subway stations, and RM denotes route miles.

Table 2 shows estimates of service input, output, and consumption for each alternative by the GCSPS. In addition, the GCSPS also provides design components such as rail stations and route miles for each alternative. Based the GCSPS data, we were able to derive the annual operating costs of the alternatives.

[Table 2 About Here]

The annual capital cost estimates of the alternatives were calculated based on the detailed capital components of each alternative, and their costs and economic lives provided by the GCSPS.⁷ A 7 percent discount rate was used in the calculation. The annual capital cost estimates were also adjusted to FY 1994 constant dollars.

In addition, we assumed that the preventive maintenance costs for motor bus, trolley bus, and light rail would be 28, 25, and 42 percent of their annual operating costs, respectively.

These percentages were derived from Muni's 1994 National Transportation Database Report.

The 1994 Report also indicates that the state subsidy accounted for about 10 percent of the total

⁷ See Tables 5A ~ 5G in GCSPS.

operating revenue. Since the state's contribution is relatively small, we included the state subsidy with local costs in order to focus on the effects of federal subsidy policy.

Based on these estimates, we calculated the financial shares of the federal and local governments for each alternative. As described before, the maximum federal share of cost is 80 percent of a project's capital and preventive maintenance costs. The rest is the responsibilities of state and local governments. The results are shown in Table 3. As one can see from the table, the federal share of annual total cost would be about 66 ~ 69 percent, or \$52 ~ \$68 million, for the surface/subway light rail options. The federal shares range between 61 ~ 65 percent, or \$36 ~ \$49 million for the trolley bus alternatives and 60 percent, or \$32 million for the surface light rail alternative. The federal financial share of the annual total cost would only be 35 percent or \$7 million for the TSM alternative. These numbers indicate that the surface/subway light rail alternatives would generate the most financial support from the federal government both in terms of absolute amount and percentage of total annual costs. Although the surface/subway light rail alternatives also require the highest amount of state and local matches among all the options, the increase in such matches (that is the difference in local matches between the surface/subway light rail alternatives and other options) is far less than the increase in federal subsidy. In addition, the increase in state and local matches required for capital intensive-investments is often justified by local economic benefits such as jobs created by rail capital investment and other multiplier effects of large transit investment. This makes the surface/subway light rail alternatives more attractive than other options.

[Table 3 About Here]

Performance Comparison of Transit Alternatives

How good would the surface/subway light rail alternatives be as compared to other options? Would they still be the preferred choices of Muni in the absence of federal financial incentives? To answer this question, it is necessary to compare the efficiency and effectiveness of the alternatives and evaluate them based on the objectives of transit investment. The efficiency and effectiveness of the alternatives can be compared using inter-modal performance indicators.

Inter-modal performance indicators are a set of standardized indicators that measure the efficiency and effectiveness of all transit modes (Lem, Li, and Wachs, 1994). Inter-modal performance indicators incorporate the principles of life cycle costing and the variation of vehicle capacity among transit modes. With inter-modal performance indicators, service input is measured by total costs including capital and operating costs. Service output is measured by revenue vehicle capacity miles and hours, which is equal to the products of revenue vehicle miles or hours and the vehicle capacities (seats and standees) of the transit modes. Service consumption is measured both by unlinked passenger trips and passenger miles. Each performance indicator is calculated as a ratio between two measures of service input, output, or consumption.

In this study, seating capacities were assumed to be 56 for an articulated bus or a trolley bus, and 68 for a rail car. Total capacity of vehicles was assumed to be 150 percent of the seating capacities for bus and trolley, and 300 percent of the seating capacity for rail. Based on the characteristics of service design and estimated patronage provided by the GCSPS, as well as these vehicle capacity assumptions, we calculated annual service outputs, which incorporate the variations of vehicle capacities of different modes, and service consumptions of the proposed

alternatives in addition to the annual capital and operating cost estimates described in the above section. Furthermore, we incorporated time savings of the alternatives provided by the GCSPS into the calculations of performance indicators. Specifically, total annual costs of the alternatives were adjusted by their values of time savings.⁸

Figures 2 to 4 show the performance indicators for the six options. As seen from the Figures, the surface/subway light rail options are neither the most cost efficient nor the most effective options. In terms of cost efficiency, which is measured by total annual cost per revenue vehicle capacity mile (\$/RVCM) and total annual cost per revenue vehicle capacity hour (\$/RVCH), the TSM option would be most cost efficient, followed by the all surface light rail alternative (alternative #4). The trolley bus alternatives would be the least cost efficient among all six options (Figure 2). On the other hand, service effectiveness indicators show that the trolley bus alternatives would carry more passenger trips per unit of service output, followed by the TSM alternative and the light rail alternatives (Figure 3). The two cost effectiveness indicators, total cost per passenger trip and total cost per new passenger trip, show somewhat different performance ranking results. As seen from Figure 4, while the cost per passenger trip of the TSM alternative would be the lowest, the TSM alternative would attract the fewest new transit passenger trips, and therefore the cost per new passenger trip would be the highest among all the options. The results of the all-surface light rail option also show a pattern similar to TSM. While the costs per passenger trip of the trolley bus alternatives would be higher than the TSM and the all-surface light rail alternative, the trolley bus alternatives would cost the least for each

⁸ Values of time savings were computed based on information provided in Tables 7 and 10 of the GCSPS. The GCSPS also assumed the time values of \$4.80/hour for work trips and \$2.40 for non-work trips.

new passenger trip. In comparison, the surface/subway light rail alternatives would cost the most per passenger trip on average, but not the least per new passenger trip.

[Figures 2~4 About Here]

The results imply that in the absence of federal financial incentives, the surface/subway light rail alternatives may not be the preferred choices of Muni, if a decision is made rationally on the basis of efficiency and effectiveness criteria. In terms of cost efficiency, the TSM alternative would be the first choice, followed by the all surface light rail option #4. If the investment objective were to be to maximize service effectiveness and attract new passengers at the least cost, the trolley bus alternatives would be Muni's preferred choices. However, if a decision were made on the basis of maximizing the federal financial gain, Alternatives 2B and 2A would be the first and second choices.

Discussion

Numerous studies have found optimistic ridership forecasts and underestimated costs in many light rail projects. For instance, Pickrell (1992) compared actual transit patronage and costs with the forecasted figures for rail transit projects built in Washington, D.C., Baltimore, Miami, Buffalo, Pittsburgh, Portland, and Sacramento. He reported that in almost all these cases, transit ridership was overestimated and the cost was underestimated. The actual total cost per passenger was twice to five times the forecast value. Similar conclusions are also found in studies of rail projects in Los Angeles and Dallas (Kain, 1988, 1990; Moore, 1993; Rubin & Moore, 1996). Some researchers further suggested that federal capital subsidies are part of the explanation for unbounded enthusiasm for rail systems. In some cases, decisions to build rail

dictated the results of technical analyses of transit investment alternatives and voters were misled about costs and performance of alternative systems. (Kain, 1988; Richmond, 1998).

In this study, we did not attempt to judge whether the GCSPS miscalculated the costs and ridership of the alternatives, which is beyond the scope of our study. Instead our analyses are largely based on the data of the GCSPS. However, the results of the foregoing analyses do show that the more capital-intensive surface/subway light rail options envisioned in the document “A Vision for Rapid Transit in San Francisco” tend to be less efficient and effective, but would generate more federal financial support than other less capital-intensive options under the current transit subsidy policies. The findings seem to suggest that the federal subsidy policy would provide an incentive for capital-intensive investments in the Geary Corridor.

Conclusion

While previous studies suggest that federal transit subsidy policy might have induced costly early retirement of capital assets and encouraged expensive transit investments, little prior research has demonstrated how federal subsidy policy affects local transit investment decisions. This study attempts to explain the possible effects of federal subsidy policy on local transit investment decisions, and illustrates these effects using the data from the San Francisco GCSPS.

We argue that due to financial and political constraints, local decision-makers have to include financial considerations among the important criteria in making transit investment decisions. Because federal financial support is a significant external source for local transit investments, federal transit subsidy can shape local transit investment decisions. While federal financial incentives may not completely determine local transit investment decisions, they are a catalyst for capital-intensive investments. When combined with other motivations, federal

financial incentives could lead to inefficient investment decisions. Our illustration shows that based on the data from the GCSPS, more capital-intensive investment alternatives tend to generate larger financial support from the federal government. However, they may not be the most efficient and effective options. The finding implies that federal subsidy policy does provide financial incentives for local governments to invest in more capital-intensive modes. Decisions made on the basis of maximizing federal financial support or minimizing local financial burden may lead to the selection of inefficient and ineffective alternatives.

The relationship between federal policy and local decisions is very complex. The actual effect of federal policy on local decisions depends on local political conditions and structure, as well as special circumstances under which transit investment decisions are made. Although the findings from this case study cannot be generalized to other locations and a more solid conclusion on the issue would have to be reached as more case studies become available, the study does empirically address the question of how federal transit subsidy policy may influence local transit investment decisions and shed light on the issue.

In the past, policy debate has focused on the division of operating and capital funds or eliminating operating funds. In the future, transit subsidy policy debates should focus not only on elevating the requirement of local matches for capital projects, but also on offering rewards to transit operators that provide high-quality transit services to passengers at low costs. In addition, the current funding allocation approach may need reform. With a large proportion of funding earmarked by Congress, the political nature of funding allocation can discourage serious comparison of transit investment alternatives. Without reform, it would also be difficult to implement the Federal Transit Administration's rules for major capital project evaluation and the rating processes, as outlined in federal law (U.S. DOT, 2000b). A more radical alternative to the

current funding allocation approach would be to return a larger proportion of the locally generated money to state and local governments. While this approach may not guarantee that public resources are spent efficiently, it would at least reduce the incentive for inefficient use of public resources, and limit the federal government's involvement in local investment decisions, while maintaining the federal government's role in balancing the needs of areas having limited local funding resources.

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Table 1: Sources of Operating Revenue Among U.S. Transit Systems

Sources	Operating Revenue (% of total)					
	1975	1980	1985	1990	1995	1999(P)
Passenger fares (a)	54	39	37	37	37	37
Other operating income (b)	5	4	6	5	15	16
State and local subsidies (b)	32	40	50	52	43	42
Federal subsidies	9	17	8	6	4	4

Notes: P = Preliminary data.

(a) Includes fares retained by contractors; beginning 1991 includes fare subsidies formerly included in "other".

(b) "Local" includes taxes levied directly by transit agency and other subsidies from local government such as bridge and tunnel tolls and non-transit parking lot funds. Beginning 1994, such funds reclassified from "local" to "other".

Sources: American Public Transit Association, *Transit Fact Books*, 1988 & 2000, Washington, D.C.

Table 2. Service Input, Output and Consumption Estimates from GCSPS

Alternatives	Existing	TSM	2A (LR)	2B (LR)	3A (TB,DMB) ¹	3B (TB, Long)	3C (TB, Short)	4 (LR, Surface)
Peak Vehicles:								
LR			36	32				38
TB					23	43	46	
DMB					26			
MB	60	58	15	15	12	15	15	15
Annual RVM:								
LR (CarMile)			1,125,576	1,182,946				1,060,863
TB (VM)					1,140,347	1,289,051	1,222,610	
MB (VM)	1,337,061	1,398,800	398,256	398,256	336,569	398,256	389,383	389,383
Annual RVH:								
LR (CarHour)			123,594	111,534				136,038
TB (VH)					133,880	111,695	119,677	
MB (VH)	181,702	184,370	63,316	63,316	68,395	63,316	63,316	63,316
Total Capital \$ (in 000')	N/A	\$33,033	\$654,076	\$899,774	\$595,289	\$686,705	\$484,835	\$333,885
One-way travel time (minutes)		40~49	28.6	29.1	41	30.6	34.7	34.3
Annual Passengers	19,339,200	19,813,200	24,300,400	25,058,800	21,108,800	25,185,200	23,352,400	22,088,400

Note: TSM = Transportation System Management; LR = light rail; TB = trolley bus; DMB = dual bus mode; long = long segment in tunnel; short = short segment in tunnel; surface = entire alignment at grade.

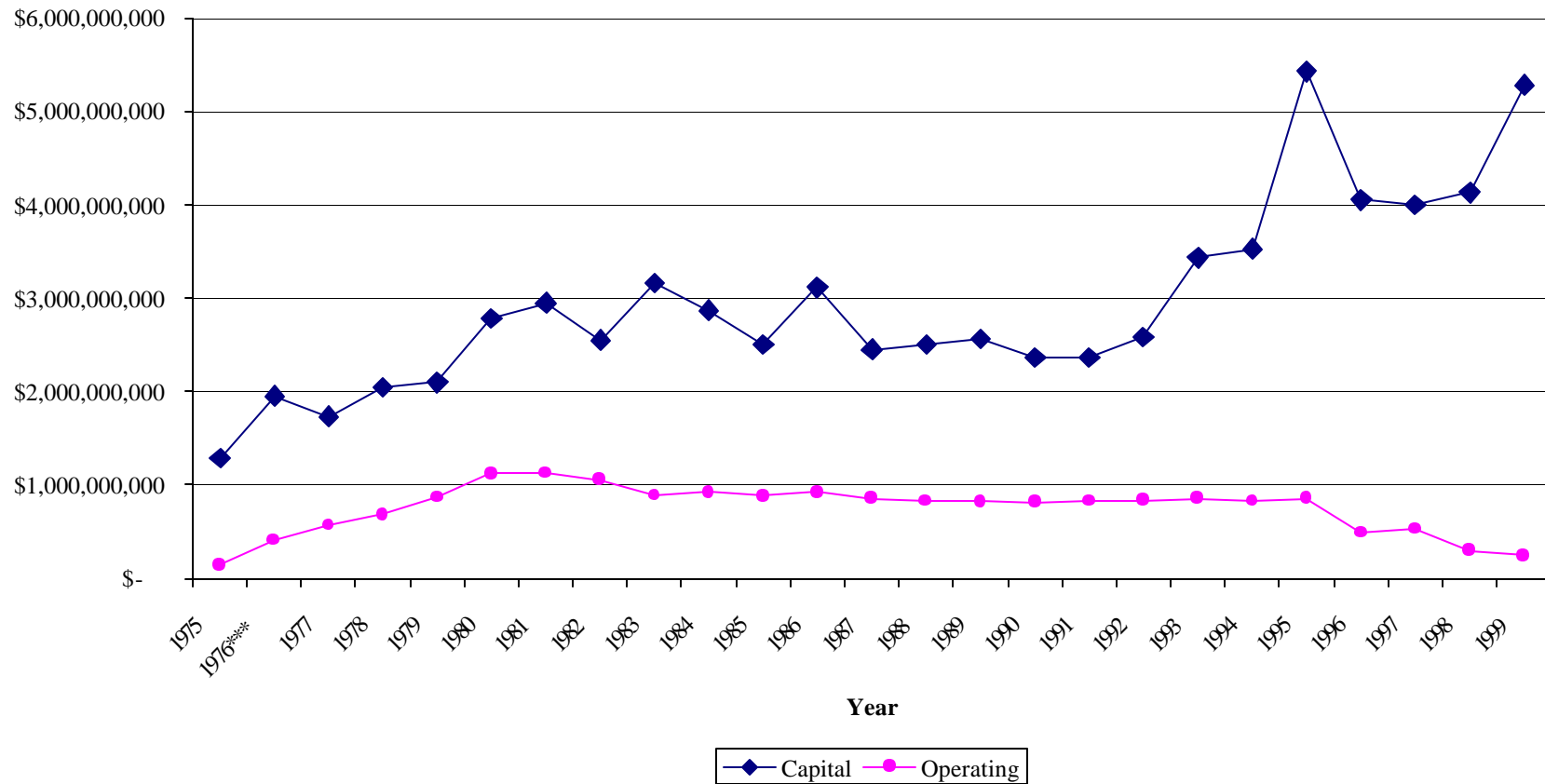
Source: Table D-3, Table D-4, Tables 3 - 4, Tables 5A-5G, "Geary Corridor System Planning Study," by Merrill & Associates, April 1995.

Table 3. Comparison of Government Financial Responsibilities Under TEA21

	Share of Total Annual Costs			
	Federal (\$)	Local (\$)	Federal (%)	Local (%)
2A (LR, Surface/Subway)	\$52,466,762	\$ 26,671,060	66.30%	33.70%
2B (LR, Surface/Subway)	\$67,968,633	\$30,263,919	69.19%	30.81%
3B (TB, Short)	\$48,617,837	\$25,939,511	65.21%	34.79%
3C(TB, Short)	\$35,720,589	\$22,488,925	61.37%	38.63%
4 (LR, Surface)	\$31,770,136	\$21,194,383	59.98%	40.02%
TSM	\$6,896,711	\$12,798,820	35.02%	64.98%

Note: the numbers are calculated by the authors based on data of the GCSPS and assumptions.

Figure 1: Trends of Federal Subsidies



Notes:

1. Capital subsidies prior to 1986 do not include Sections 8, 26(a)(2), and RTAP grants.
2. Operating subsidies prior to 1986 include only formula operating grants for urbanized areas (Table 21, *1992 Statistical Summaries*).
3. The capital and operating subsidies for fiscal year 1976 include obligations during the transition quarter (TQ) from July 1, 1976 to September 30, 1976. All subsidies are in current year dollars.

Data sources: Tables 19 ~ 22, *1992 Statistical Summaries*. Table 52, *2000 Statistical Summaries*.

Figure 2: Cost Efficiency Indicators

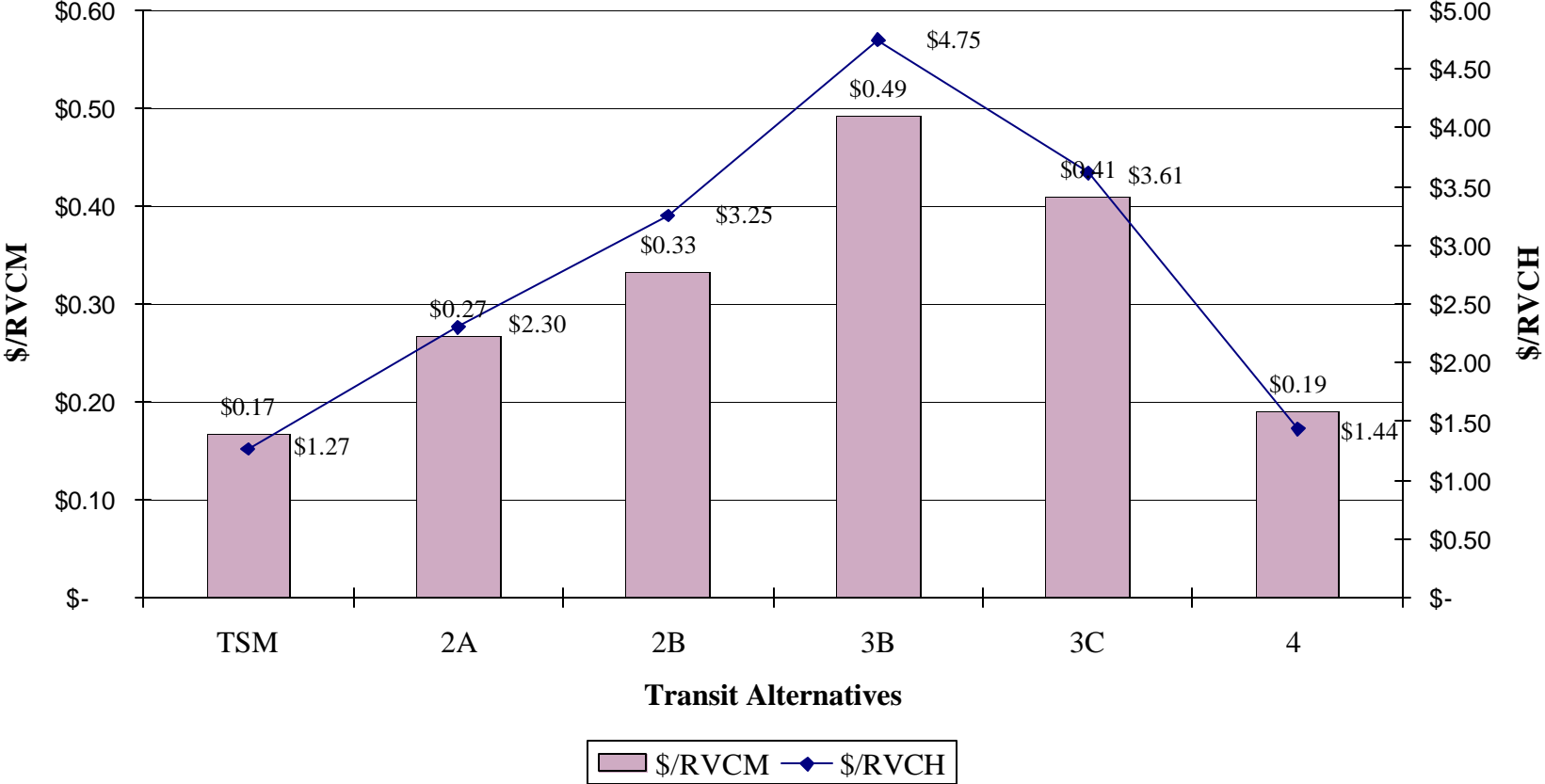


Figure 3: Service Effectiveness Indicators

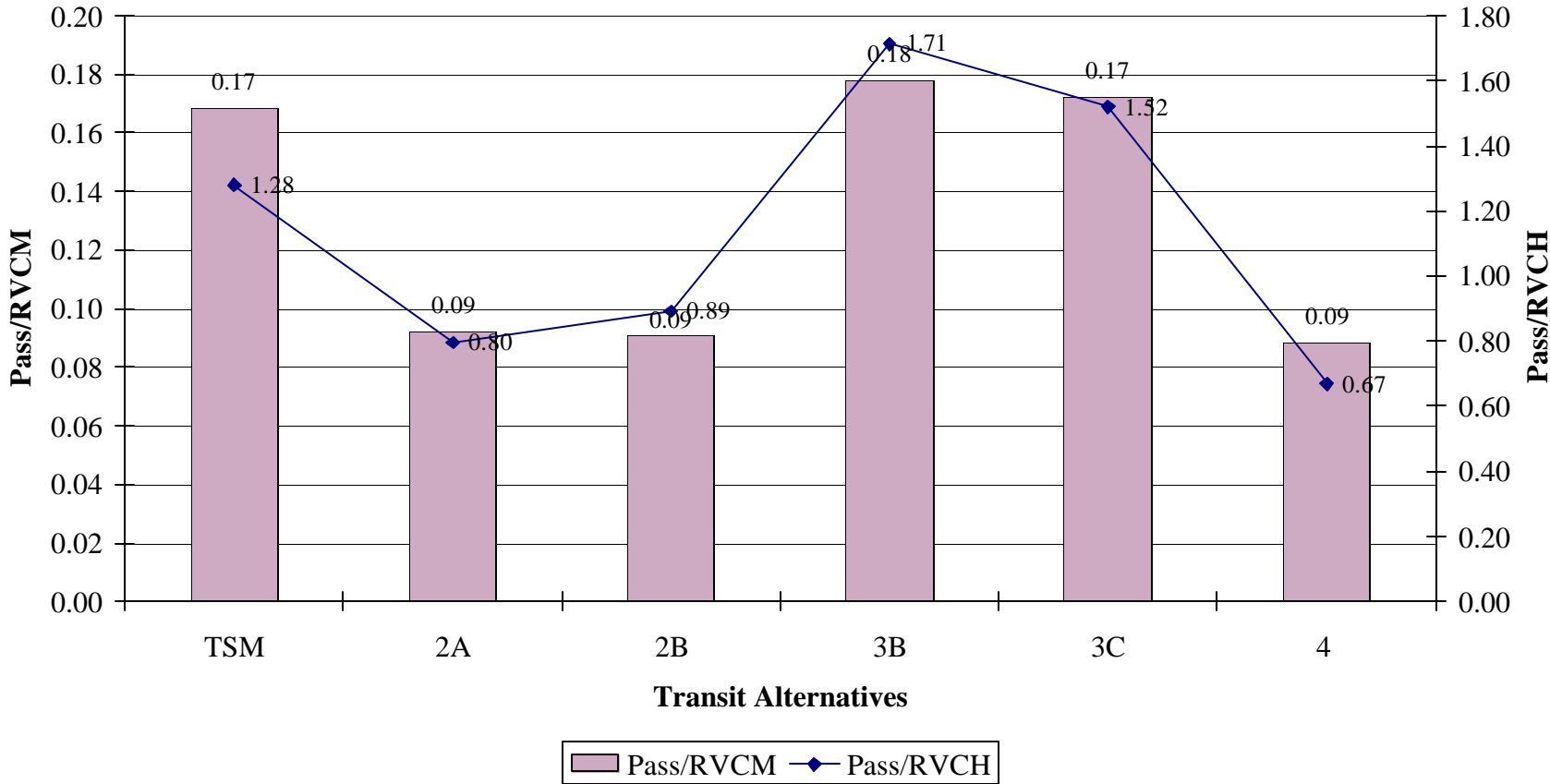
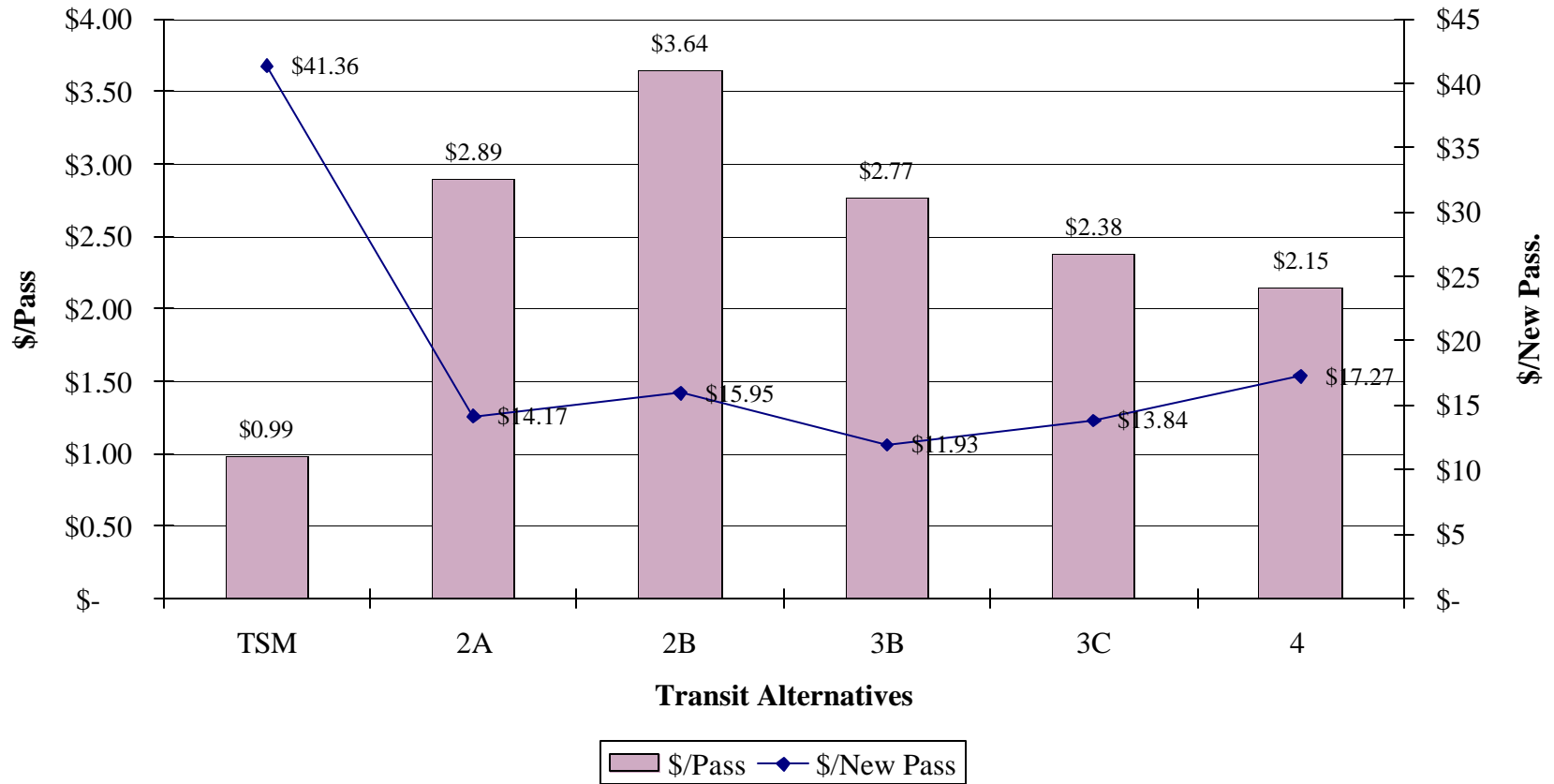


Figure 4: Cost Effectiveness Indicators



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