Regional Economic Impacts of Local Transit Financing Alternatives: Input-Output Results for Portland

JAMES G. STRATHMAN AND KENNETH J. DUEKER

Mass transit providers are facing mounting pressure to extend the scope of local financing in the wake of reductions in federal operating subsidies. In this study are discussed the economic impacts in the Portland, Oregon, metropolitan area associated with generating $1 million in local transit funding from the following seven alternative sources: personal income, property, retail sales, gasoline sales, downtown parking, payrolls, and a transit fare increase. An input-output model of the metropolitan area is used to estimate the change in sectoral output that would result from transferring resources from nontransit activities to transit operations. Aggregate economic activity declines for all seven financing alternatives, although net increases are calculated for a number of individual sectors. Overall, the reduction in economic activity was minimized with a gasoline tax and maximized with a fare increase. Although the value of external transit benefits was not considered in the analysis, a rationale for evaluating these benefits in light of the study results was outlined.

In the 1980s, transit providers in the United States face a worsening predicament: preserving service in the wake of planned phaseouts of federal operating subsidies. The loss of federal funding has underscored the need to secure additional revenues through either higher fares or increases in state and local subsidies. The growth of transit system deficits since 1979 suggests, however, that the effort to replace federal subsidies with locally based financing has been less than successful.

The pressure to increase farebox yields marks a turnaround from the 1970s, when "(t)he movement toward lower and more simplified fare structures . . . was encouraged by nearly all government agencies involved in transportation planning, as well as by many rider groups and other transit advocates" *(1)*. Alternatively, attempts to expand already sizeable local and state contributions are being met with hesitancy, skepticism, or outright opposition, apparently signaling the perception that social benefits associated with mass transit are in tune with the level of financial support already committed. In short, local transit agencies are generally finding themselves mired in budgetary crises, with their options being reduced to substantial reorganization and service cuts.

Interest in the subject of local transit assistance is motivated by uncertainty regarding its economic impacts. Even in the simple situation where the externalities associated with transit use are ignored, it is not clear who would gain and who would lose when local financial assistance is provided to mass transit. Moreover, it is not clear whether total economic activity in an area would increase or decrease if such a transfer were made. Finally, the extent to which aggregate and disaggregate economic impacts would vary with alternative local transit financing options is also unknown.

In this paper, these questions are addressed and the results of an input-output analysis of the economic impacts of seven local transit financing alternatives are reported. The alternatives include dedicated taxes on gasoline, property, personal income, downtown parking, retail sales, and employers' payrolls. The final alternative involves a transit fare increase. The basic question posed in the analysis is the following: What would be the net economic impact of a $1 million increase in transit operating assistance generated by each of the financing options, and how would this impact be distributed across the sectors of the local economy? The net impact is defined as the difference between the direct, indirect, and induced gains associated with the change in transit operating expenditures and the losses stemming from the reduction in expenditures that results from financing the subsidy.

The analysis pertains to the Portland tricounty metropolitan area and conditions as they existed in 1984. The U.S. Forest Service IMPLAN model is used to estimate the direct, indirect, and induced impacts of the financing alternatives. This model is derived from the 1977 national input-output model and utilizes a conventional nonsurvey coefficient adjustment procedure to permit analysis at the county and multicounty level. The model was aggregated to 25 sectors for this study, and includes an endogenous household sector.

The framework used in the analysis is partial in that it does not deal with a number of elements that would be contained in a comprehensive study of the costs and benefits of transit service. For example, the organization of the transit system is taken as given, and no effort is made to assess the structure of service delivery or the outlays made by a transit agency in providing service. Second, it is assumed that the input factor prices faced by transit providers are unaffected by subsidies, and thus factor payments are characterized by fixed coefficients. Third, equity-related issues associated with the distribution of costs and benefits with respect to income, space, and time are not considered. Fourth, costs and benefits to transit users (e.g., safety, convenience, cost, and travel time) and nonusers (e.g., congestion relief, air quality, and safety) are also ignored, although in the final section the threshold values that external transit benefits must achieve to generate a potential Pareto improvement are estimated.

Center for Urban Studies, Portland State University, Portland, Oreg. 97207.

Studies addressing the preceding elements indicate that each would have a bearing on the outcome of a comprehensive analysis of transit service, and thus it is important to keep the limitations of the assumptions in mind. The evidence related to the organization of transit service *(2)*; the effects of subsidies on operating costs and factor prices *(1, 3–5)*; the equity impacts related to income *(6–8)*, space *(9)*, and time *(10)*; and, finally, externalities *(11)* suggest that the results presented in this paper represent only one of a number of criteria against which transit subsidies should be evaluated.

The remainder of the paper is organized as follows. In the next section the methodological framework for the analysis and the approach used to determine the net direct impacts of the alternative financing options are described. The net direct, indirect, and induced changes in sectoral output and household income associated with each of the alternatives are then presented. Finally, the rationale for providing transit operating subsidies in light of the results is explained.

METHODOLOGY

The framework for estimating the economic impacts of the transit financing alternatives can be traced to Metzler *(12)*, who first addressed the issue of taxes and subsides in input-output analysis. He posed the following question: Supposing one input-output sector is subsidized by the proceeds of a tax imposed on the other sectors in the system, what effect would this transfer have on aggregate economic activity and the cost of production of the taxed sectors? Metzler reasoned that if a taxed sector was an intensive user of the output of the subsidized sector, its direct losses (from paying the tax) could be offset by secondary gains in the form of lower cost inputs directly and indirectly obtained from the subsidized sector. However, he demonstrated that overall the secondary benefits derived from a subsidy could not outweigh the cost of the tax.

The approach described here differs from Metzler's in several respects. First, the taxes associated with the transit financing alternatives are, with the exception of the payroll tax and the business share of the property tax, imposed on the household sector. This sector resides in the final demand component of the model, and the direct effect of a tax would be to reduce disposable household income. In this case, the analysis must address whether the effects of the reduction of disposable income would be offset by gains from the transit provider's disposition of the subsidy. Second, Metzler's results hold for a closed input-output system, which does not characterize a typical urban economy. The present study uses an open model, and thus the results are subject to the influence of two factors not contained in Metzler's analysis: the ability of households and sectors to "export" a part of the tax burden through deductibility *(13)*, and the potential to retain a relatively large share of the direct, indirect, and induced economic activity generated by transit agency layouts versus the activity foregone by paying for the transit subsidy. The latter effect, of course, would work in the other direction if the "leakages" associated with transit outlays exceeded those associated with the foregone activity resulting from the tax.

The direct losses associated with the alternative taxes are defined in terms of the reduction in sectoral final demands that would follow the imposition of the tax. The composition of the changes in final demand varies according to the tax under consideration and corresponds to one of three general formats:

1. Reduction in Total Disposable Income. The direct effect of the property and income tax alternatives on households is to reduce their disposable income by the amount of the tax minus the value of federal and state taxes avoided as a result of deducting the transit tax from household taxable income. The value of this deduction is the portion of the tax that is exported, and is a function of the households' real marginal federal and state income tax rate. This rate is equal to the marginal nominal tax rate multiplied by the propensity to itemize *(14)*. The real reduction in household income from these taxes is then allocated across the final demand sectors on the basis of sectoral consumption propensities. These propensities are of the fixed coefficient type, and assume that the income elasticity of demand for the output of each sector is equal to 1.0.

2. General Increases in Prices. The direct effect of the payroll tax and the property tax paid by business is represented by an increase in the prices of goods and services produced in the urban economy. Price increases to final consumers are estimated using an approach suggested by Leontief and Ford *(15)*. This procedure estimates price effects through a system of standard value added equations.

$$p' = v' \cdot (I - A)^{-1}$$

where

p' = a vector index of the change in sectoral prices;
v' = a vector of the change in value added coefficients resulting from the transit tax, taking into account the deductibility of the tax from taxable corporate income at the federal and state levels; and
$(I - A)^{-1}$ = the Leontief inverse.

Given the vector of sectoral price increases, final demands can then be adjusted on the basis of sectoral price elasticities. These price elasticities were set at −1.0.

3. Selective Price Increases. The gasoline, parking, and retail sales taxes are limited to particular items consumed by households. Changes in sectoral final demands resulting from the gasoline and parking taxes were based on price elasticities reported by Dahl *(16)* and Pickrell and Shoup *(17)*. A price elasticity of −1.0 was applied to goods subject to the sales tax.

The direct losses associated with a fare increase are represented by the change in final demand resulting from the reduction in real household income of transit users faced with higher travel costs. For travelers whose demand for transit declines on the basis of the fare elasticity *(18)*, the change in travel cost (assuming that these riders switched to automobiles) was estimated and allocated to the final demand sectors.

The direct gains from the financing alternatives are represented by the transit agency's disposition of the subsidy in the form of operating outlays for goods and services. The sectoral distribution of these outlays was determined by allocating the itemized operating expenditures reported in the agency's fiscal 1984 budget *(19)*. Outlays for labor and material were distinguished, with labor expenditures treated as an increase in household income and expenditures for materials allocated to the appropriate final demand sectors. Corresponding with the partial export of the tax burden is a leakage of operating outlays associated with several fringe benefits (F.I.C.A. and unemployment insurance), in addition to taxes paid by transit employees.

The net value of the direct impacts is finally determined by taking the difference between the increases and decreases in sectoral final demands that follow from each of the financing alternatives. The major methodological steps involved in determining the final demand changes are discussed in the following paragraphs.

Gasoline Tax

Reported gasoline sales in 1984 in the three counties of the study area totaled 482,368,600 gallons at an average pump price of $1.22. Using a price elasticity of –0.2 *(16)*, a tax rate of 0.0017 would be required to generate $1 million in revenues. The direct impact of this tax would include losses to sectors producing and selling gasoline, sectors producing and selling related products, and households.

The reduction in demand for gasoline resulting from the tax was estimated to total 164,000 gallons, equivalent to approximately $200,000 in retail sales. Because the input-output model is specified in producer prices, this value must be partitioned to allocate the sales margin to wholesalers and retailers, and the remainder to the original producing sector. A retail-wholesale margin of 0.21, a composite average *(20)*, was adopted. Reductions of $42,000 and $158,000 for retailers and producers, respectively, were derived.

The reduction in gasoline consumption in turn triggers a reduction in the direct demand for other products consumed in the operation of automobiles: repairs and maintenance, tires, oil, accessories, and expenditures for parking and tolls. The outlays for these items were derived from FHWA data *(21)* covering the operating cost per mile of an intermediate-sized automobile. The reduction in gasoline consumption was converted to a reduction in total miles traveled using an estimate of average efficiency of 13.8 mpg. The corresponding reduction in outlays for the items noted previously totaled $142,000. The itemized outlays comprising this total were allocated to the appropriate final demand sectors.

The cost to households from the gasoline tax was defined to equal the real cost of the tax minus the savings from the reduction in travel cost. The real cost of the tax equals the nominal tax minus the proportion exported as a result of deductibility. This proportion was set at 0.166 *(14, 22)*, resulting in a real tax cost of $834,000. The savings to households from reduced travel comprises avoided outlays for gasoline and other operating expenses, with the value of tax deductibility netted from the price of gasoline. Travel cost savings totaled $338,000, leaving a net direct cost to households of $496,000. This cost was allocated to final demand using the household sectoral consumption coefficients contained in the input-output model. The sum total of the direct cost to all parties was $838,268.

Property Tax

Because assessment records from the three counties reveal that residential property accounts for 66 percent and commercial and industrial property 34 percent of the total nonagricultural assessed valuation, the tax liabilities required to generate $1 million were apportioned accordingly.

The impact of the property tax on households is again lessened by the effect of deductibility, resulting in a real tax cost of $550,000. The commercial and industrial tax burdens are also reduced by deductibility. Data on 1984 corporate filings provided by the State Legislative Revenue Office revealed that 0.502 of this total is exported from the metropolitan area, leaving a real direct tax cost of $169,000. This total was allocated to the commercial and industrial sectors of the input-output model on the basis of their relative capital intensities *(23)*. The changes in the sectoral value added coefficients resulting from the real tax costs were then determined. The corresponding effect on sectoral prices was then estimated according to Leontief and Ford's method *(15)*.

The value of total final demand—by households, government, capital formation, and exports—sums to approximately $13 billion in the input-output model. Using a price elasticity of –1.0, reductions in sectoral final demands corresponding to the sector-specific price increases were determined. The change in the value of total final demand resulting from the sectoral price increases totaled $283,000. The sum total effect of the property tax was estimated to be $833,781.

Personal Income Tax

The impact of the personal income tax on households was determined by netting out the fraction exported due to deductibility. This decrease left $834,000, which was allocated to the final demand sectors using the model's household consumption coefficients.

Parking Tax

The Portland central business district contains approximately 21,200 off-street parking spaces, and in 1984 they generated nearly $16.5 million in revenue. Assuming a price elasticity of –0.3 *(17)*, it was determined that a tax cost of the parking tax includes both a reduction in parking revenues and an increase in parking costs. The reduction in parking revenues totaled $300,000. The increase in parking costs is equal to the real tax cost minus the value of the reduction in the demand for parking, or $534,000. This cost was allocated to final demand on the basis of the household sectoral consumption coefficients, whereas the loss in parking revenues was absorbed by the service sector. The total cost of the tax was $834,000.

Retail Sales Tax

The sales tax was defined to apply to all retail expenditures with the exception of food purchased for home consumption, medicine, and drugs. The Consumer Expenditure Survey (CES) of 1972–1973 *(24)* offers the only source covering household consumption patterns that is sufficiently disaggregated to permit estimation of the direct effect of a sales tax with these exemptions. CES data for the Western Region were used to allocate the real tax burden to the appropriate expenditure categories, and reductions in expenditures were calculated using a price elasticity of −1.0. The changes in expenditures were then allocated to the appropriate final demand sectors. Considering again the effects of deductibility, the direct impact of the sales tax on household disposable income was $834,000.

Payroll Tax

The payroll tax was defined to apply to wage and salary payments made by firms to individuals employed in nonagricultural and nonpublic activities. Considering deductibility, the direct impact of this tax totaled $498,000. This cost was allocated on the basis of the sectoral distribution of wage and salary payments in the input-output model. Changes in sectoral value added coefficients were then determined, and the corresponding changes in sectoral prices were estimated. Changes in the value of final demand resulting from the increase in prices were recovered in the same manner as described for the business property tax. The change in the value of final demand was calculated to be $961,567.

Fare Increase

Data supplied by TRI-MET show that in 1984 the system served 36.8 million originating riders at an average fare of $0.49, generating farebox revenues of approximately $18 million. Assuming a fare elasticity of −0.29 *(18)*, a fare increase of slightly more than 8 percent would be required to increase fare revenues by $1 million. This increase would also lead to a reduction of 863,000 originating riders.

The direct impact of the fare increase would be threefold: (a) higher costs for users of the transit system; (b) higher costs for riders who leave the system; and (c) an increase in sales corresponding to an increase in automobile travel.

The increase in travel cost for transit users following the fare increase was estimated to be $1,424,700. It was assumed that riders who left the system would still undertake the same number of trips and would travel by automobile. The increase in travel cost for this group was defined to be the difference between automobile operating costs and the amount that had originally been paid for transit, or

$$(T \cdot 1/vo \cdot D \cdot C) - F$$

where

- T = the number of trips diverted from transit as a result of the fare increase;
- vo = the vehicle occupancy rate;
- D = the average trip length;
- C = automobile operating costs per mile; and
- F = the average transit fare before fare increase.

Data for 1984 provided by the Metropolitan Service District, the agency responsible for transportation planning in the Portland metropolitan area, show an average vehicle occupancy of 1.4 persons and an average trip length of 6.5 mi. The FHWA data on vehicle operating costs per mile for an intermediate-sized automobile (excluding the cost of insurance) were used. Adjustments were made for the deductibility of gasoline taxes, giving an operating cost of $0.109/mi. The net increase in travel cost was found to equal $13,900, giving a total increase in travel cost for transit users and former users of $1,438,600. This value represents a reduction in household disposable income and was allocated to final demand using the model's household sectoral consumption coefficients.

The decline in total household outlays is partly offset by an increase in sales associated with greater automobile use. The vehicle operating expenditures noted previously, which equaled $437,000, were allocated to the sectors associated with automobile maintenance and repair, tires, accessories, fuel, oil, and parking. The combined effect of the reduction in household disposable income and the increase in sales serving vehicle operation gave a total of $1,001,601 as the direct impact of the fare increase on final demand.

TRI-MET Expenditures

With an operating budget augmented by a local subsidy of $1 million, transit agency outlays are assumed to expand in accordance with the pattern that existed in the fiscal 1984 budget. The expenditures for goods and services total less than $1 million, however, because payments made by the agency for social security and unemployment insurance, and taxes paid by transit employees, do not qualify as disposable expenditures in the input-output model. These items amount to 4.3, 1.1, and 15.8 percent, respectively, of total operating outlays. After accounting for these leakages, the $788,500 that remains represents the direct outlays made by the agency. Of this total, $461,200 represents an increase in transit employee disposable income, and this value was allocated to final demand using the household sectoral consumption coefficients. The remaining $327,300 in outlays for goods and services consumed for transit operations was itemized and allocated to the appropriate input-output sectors.

Table 1 presents a summary of the total final demand changes associated with the seven transit financing alternatives along with the increase in transit operating outlays. In all cases, the reduction in final demand associated with providing the operating subsidy exceeds the increase associated with transit operating outlays. The difference is noticeably larger for the payroll tax and fare increase than it is for the other alternatives. The total effects of these changes and their distributional consequences are reported in the next section.

TABLE 1 TOTAL FINAL DEMAND CHANGES

Financing Alternative	Amount ($)	Financing Alternative	Amount ($)
TRI-MET	+788,500	Parking tax	−834,000
Gasoline tax	−838,268	Sales tax	−834,000
Property tax	−833,781	Payroll tax	−961,567
Income tax	−834,000	Fare increase	−1,001,601

RESULTS

The net change in sectoral final demands associated with the alternative transit financing schemes is given in Table 2. The value of total final demand declines for each alternative, and the sectoral distribution of the reduction varies according to the type of tax under consideration. Despite the aggregate declines, net increases in final demand are observed in a number of sectors for each financing alternative.

The distributional impacts of the financing alternatives on sectoral final demands are consistent with what might be expected. A gasoline tax leads to reductions largely concentrated in the petroleum, transportation equipment, and trade sectors, with gains concentrated in finance, insurance, and real estate (FIRE); electrical equipment; transportation, communications, and utilities (TCU); and service sectors due to their relative emphasis in the transit operating budget. The reductions associated with the property tax are attributable to either the capital intensity of a given sector or a sector's relative importance to household consumption. As a result, reductions are concentrated in the trade, service, food products, and FIRE sectors. The largest gains from the property tax are observed for the petroleum products, electrical equipment, and pulp and paper sectors, reflecting their relative importance in the transit operating budget. For the income tax, the major changes in sectoral final demands reflect the relative importance of each sector to households as compared to transit. The largest losses are observed in the trade, services, and food products sectors, while the largest gains are realized in the petroleum, electrical equipment, and TCU sectors. Losses from the parking tax are highly concentrated in the service sector, which includes parking services, whereas the sectoral gains again are attributable to the relative emphasis of transit operating expenditures. The most noteworthy change associated with the sales tax is an increase in trade sector activity, where losses from the tax are more than offset by transit operating expenditures. The largest losses observed for the sales tax are in those sectors supplying goods and services subject to the tax: food and kindred products (as related to food consumed away from home, tobacco, and alcohol); textiles and apparel; transportation equipment; TCU; wood products (i.e., furniture and fixtures); and services. The largest increases are in FIRE (not taxed), petroleum, and electrical equipment. The direct impact of the payroll tax falls disproportionately on labor-intensive sectors, such as trade and construction, whereas gains are observed for sectors that are either not subject to the tax (e.g., agriculture, the public utilities, and local government enterprises) or are relatively capital intensive (e.g., electric services and petroleum). Losses from the fare increase primarily reflect the relative importance of the affected sectors to household consumption: services, FIRE, trade, and food products. The gains are attributable to sectors with an emphasis on servicing transit and automobile transport: petroleum, transportation equipment, electrical equipment, and rubber products.

In Table 2, the sectoral distribution of the direct impacts of the alternative transit financing options varies considerably, even among those alternatives for which the total net change is roughly the same. With this variance, noticeable differences in the magnitude of the indirect and induced effects, given the range in the value of the input-output model's sectoral multipliers, can be anticipated.

Table 3 presents the direct, indirect, and induced changes in net output resulting from the alternative financing options. The range of total impacts is considerable—from a net reduction of

TABLE 2 NET CHANGE IN FINAL DEMAND FOR ALTERNATIVE FINANCING SCENARIOS

Sector	Gasoline Tax ($)	Property Tax ($)	Income Tax ($)	Parking Tax ($)	Sales Tax ($)	Payroll Tax ($)	Fare Increase ($)
Agriculture/forestry/fisheries	−295	−822	−3,235	−625	−7,908	3,628	−8,495
Mining and quarrying	0	−5	0	0	0	−451	0
Contract construction	0	−8,500	0	0	0	−46,100	0
Food and kindred products	−2,678	−11,135	−28,194	5,544	−102,503	−17,453	−73,840
Textiles and apparel	824	6	−3,772	308	−158,646	5,273	−11,995
Wood products	253	−3,025	−3,058	−568	−17,903	−4,866	−8,076
Pulp and paper products	7,287	3,880	4,515	6,975	5,434	734	−442
Petroleum and chemical products	−105,564	53,605	49,966	54,286	61,976	61,022	191,704
Rubber and leather products	1,192	10,403	10,094	10,604	11,512	10,810	25,843
Stone, clay and glass products	−3	−114	−273	−33	394	158	−757
Primary and fabricated metal products	1,097	−5,504	285	1,005	−9,472	−28,473	−1,166
Machinery	−52	−2,621	−357	−87	−16,536	−17,066	−901
Electrical equipment and instruments	34,964	30,017	32,192	34,652	39,031	9,741	27,235
Transportation equipment	−84,332	−4,434	−7,005	−1,365	−106,418	−7,706	129,864
Miscellaneous manufactured products	−121	−399	−1,439	−269	1,814	1,068	−3,796
TCU	34,590	−4,620	15,394	32,434	−39,997	−165	−18,946
Electrical services	6,544	2,277	−654	5,736	17,110	15,484	−13,532
Wholesale-retail trade	−47,251	−75,891	−55,892	11,608	2,321	−206,842	−108,067
FIRE	78,566	−10,714	−3,931	69,299	198,480	−21,652	−151,509
Services	24,656	−17,232	−42,682	−264,022	−17,745	21,693	−163,534
Local government enterprises	1,393	533	−3,406	854	8,437	8,172	−11,991
Federal electric utilities	−52	−141	−357	−87	394	324	−901
State and local electric utilities	−119	−302	−1,166	−236	1,419	1,382	−3,041
Scrap	−77	−224	−990	−180	1,262	1,262	−2,622
Households	−83	−317	−1,535	−246	2,050	2,050	−4,136
Total	−49,768	−45,281	−45,500	−45,500	−45,500	−173,067	−213,101

TABLE 3 NET CHANGE IN SECTORAL OUTPUT FOR ALTERNATIVE FINANCING SCENARIOS

Sector	Gasoline Tax ($)	Property Tax ($)	Income Tax ($)	Parking Tax ($)	Sales Tax ($)	Payroll Tax ($)	Fare Increase ($)
Agriculture/forestry/fisheries	−731	−3,483	−8,035	−4,081	−23,148	2,453	22,528
Mining and quarrying	−135	8	35	72	37	−607	141
Contract construction	4,131	−10,051	−1,533	942	11,676	−49,060	−15,365
Food and kindred products	−3,152	−15,480	−35,797	−22,203	−119,623	13,642	−98,673
Textiles and apparel	787	−122	−5,220	−323	−210,412	6,315	−16,488
Wood products	−3,047	−5,282	−4,767	−957	−29,369	−13,074	−9,615
Pulp and paper products	6,615	2,838	2,688	5,580	−188	−4,618	−10,273
Petroleum and chemical products	118,733	60,019	55,848	60,085	64,475	65,152	212,368
Rubber and leather products	681	10,831	10,357	10,581	10,266	10,738	26,574
Stone, clay, and glass products	−1,246	−411	−553	−128	−1,517	−1,851	−938
Primary and fabricated metal products	−9,157	−6,914	−502	1,340	−29,349	−40,399	10,673
Machinery	−2,139	−2,774	−363	−615	−20,582	−19,497	1,900
Electrical equipment and instruments	36,844	32,247	34,641	35,365	39,935	8,223	29,573
Transportation equipment	−89,567	−5,688	−8,659	−6,166	−114,492	−10,061	133,379
Miscellaneous manufactured products	−199	−533	−1,618	−753	1,432	608	−4,472
TCU	−32,550	−9,058	13,043	29,120	35,792	−15,199	−36,930
Electrical services	5,337	792	−2,577	3,289	16,019	11,403	−20,701
Wholesale-retail trade	−54,039	−84,606	−64,944	−7,301	−26,839	−234,510	−136,675
FIRE	−85,513	−25,303	−17,353	49,135	210,099	−62,509	−221,995
Services	21,894	−31,707	−56,389	−295,104	−29,432	−22,870	−221,285
Local government enterprises	1,718	−557	−4,403	−937	8,791	5,117	−17,111
Federal electric utilities	−110	−193	−429	−178	345	176	−1,163
State and local electric utilities	−262	−485	−1,394	−563	1,255	867	−3,898
Scrap	−341	−401	−1,012	−267	275	4	−2,512
Total	−86,789	−96,314	−98,938	−144,785	−204,554	−349,555	−426,017
Household income	−14,660	−45,342	−42,297	−85,247	−68,761	−139,166	−160,480
Percent of total net change	16.9	47.1	42.8	58.9	33.6	39.8	37.7
Multiplier	1.744	2.127	2.174	3.182	4.496	2.020	1.999

$87,000 associated with the gasoline tax to a loss of $426,000 following a fare increase. More interestingly, for the five alternatives whose direct impacts were of similar magnitude—the gasoline, property, income, parking, and sales taxes—a sizeable range is now observed in the total effects. For two of these alternatives (parking and sales), the indirect and induced effects are noticeably greater than the others. This difference suggests that the relative sectoral distributions of the direct tax costs are of some importance apart from their relative total magnitudes.

The sectoral distribution of net gains and losses in total output roughly corresponds to the distribution of final demands, and so a full description of the relative sectoral changes in output would be repetitious. The relative distribution of sectoral final demand changes is important, however, in terms of the relationship between the sectoral concentrations of the direct changes and the corresponding values of the sectoral multipliers. To the extent that the direct changes are concentrated in sectors with large (small) multipliers, the total output impacts will be amplified (dampened). For example, the direct losses associated with the gasoline tax are heavily concentrated in the petroleum and FIRE sectors, whose multipliers are among the smallest in the model. The direct gains from the gasoline tax are concentrated in the electrical equipment, services, and pulp and paper sectors, whose multipliers are relatively large. Thus, the net indirect and induced losses stemming from the gasoline tax are the smallest of all the financing alternatives, absolutely and after accounting for differences in the total value of the direct effects. For the parking and sales taxes, with aggregate direct impacts comparable to the gasoline tax, the situation is reversed, with direct losses concentrated in sectors with large multipliers (services, food products, transportation equipment, textiles, and apparel), and direct gains concentrated in sectors with small multipliers (FIRE and petroleum products).

The direct, indirect, and induced multipliers presented across the bottom row of Table 3 reflect these distributional differences. The multiplier effects of the gasoline, property, and income taxes are substantially lower than those for the parking and sales taxes. The payroll tax and fare increase multipliers are also relatively small, but because the direct impacts of these alternatives are much larger than the others their total output effects remain the largest.

The changes in household income, which are a component of the change in total output, range in rough order of magnitude with total output. Some variation in their share of total output change is, however, evident. Generally, if the changes in total output are concentrated in capital-intensive (labor-intensive) sectors, the share of household income in the total change is lower (higher). For example, the reduction in output associated with the gasoline tax is concentrated in the petroleum, FIRE, transportation equipment, and TCU sectors, all relatively capital intensive. The reduction associated with the parking tax is concentrated in the service sector, which is relatively labor intensive.

CONCLUSIONS

The input-output analysis reveals a considerable variation in economic impacts across the seven financing alternatives. Although the net change in total sectoral output is negative for all the alternatives—from −$87,000 for the gasoline tax to −$426,000 for the fare increase—the range is substantial. This variation results from two general influences. The first, which is evident in Table 2, is primarily associated with variations in the deductibility of the transit tax from personal and corporate income tax liabilities. The second, which is evident in Table 3, is associated with differences in the sectoral multipliers. Variation in these multipliers, in turn, is partly due to the degree to which direct and indirect economic activity includes local production. In effect, part of the transit tax liability is indirectly exported to producers outside the region whose outputs are imported by local producers. This fact largely explains why the gasoline tax fared relatively well, because gasoline is retailed, but not produced, in the region.

One way of interpreting these findings is to return to the assumptions imposed in the introduction and provide a rationale for relaxing them, thereby extending the scope of conditions pertaining to the results.

Until now it has been assumed that the level of transit service has been fixed. This assumption is now relaxed, and a simple situation may be defined that presumes a direct relationship between operating outlays, service levels, and ridership. Thus, a marginal increase in operating outlays is presumed to generate a corresponding increase in transit use. With respect to the 1984 budget, a $1 million transit subsidy would represent a 1.5 percent increase in operating outlays, and if service and ridership were to increase correspondingly 554,000 new originating riders would result. Dividing the changes in total output for the different financing alternatives obtained from the input-output analysis by the number of new riders yields what can be termed the net deficit per originating rider. This value represents a benchmark against which external transit benefits, which have been ignored until now, can be evaluated. To the extent that benefits can be shown to exceed this value, a potential Pareto improvement, characterized as a situation where with costless transfers everyone is at least as well off as before, is achieved. The benchmark values for the transit benefits required to achieve this outcome for the situation outlined previously are presented in Table 4. These values range from approximately 16 cents per originating rider under the gasoline tax to 79 cents per rider under the fare increase.

TABLE 4 TRANSIT BENEFIT REQUIRED TO ACHIEVE A POTENTIAL PARETO IMPROVEMENT

Financing Alternative	Benefit Required Per Originating Rider ($)	Financing Alternative	Benefit Required Per Originating Rider ($)
Gasoline tax	0.157	Sales tax	0.369
Property tax	0.174	Payroll tax	0.631
Income tax	0.179	Fare increase	0.786
Parking tax	0.261		

Studies of the transmission of operating subsidies suggest less than a full correspondence between changes in subsidies and changes in user benefits, however. In the leakage model *(4)*, the injection of a subsidy in a transit system will generate factor price inflation, productivity declines, and service utilization declines, all of which detract from the benefits users ultimately witness in the form of lower fares or new transit trips. Lee reports leakage estimates of 77 percent resulting from federal operating subsidies *(4)*.

The implications of the leakage hypothesis for the benchmark values presented in Table 4 are evident. These values represent thresholds assuming no leakage, and to the extent that leakages are present, the appropriate values would be greater. If a 75 percent leakage rate is applied, for example, the corresponding threshold values associated with the financing alternatives would be four times greater than those presented in Table 4. The relative positions of the financing alternatives would not be influenced by leakages. But it is likely that with increases in the leakage rate fewer financing options would tend to satisfy the optimality conditions discussed previously.

A primary objective of this paper has been to examine the disaggregate impacts of local alternatives for financing transit. Input-output analysis provides a means for achieving this end. But the framework has also precluded addressing some important questions associated with tax incidence, administration, and implementation. In particular, the distribution of the impacts on total household income will vary with the level of income. Rock, for example, has examined the relative incidence of several of the alternatives studied here and found (in descending order) the fare increase, gasoline, and sales taxes to be regressive, and the parking tax to be progressive *(8)*. In terms of factors associated with the administration of the tax, a survey of transit systems conducted by Walther revealed that the stability of the revenue stream provided by a financing program was a principal concern in terms of facilitating long-term planning *(25)*. Finally, with respect to the design and implementation of transit financing programs Jones notes that political expediency has often taken precedence over normative criteria, and he concludes that "many would question whether the political process is capable of the disciplined craftsmanship necessary to devise a program of appropriate design" *(2)*.

That these issues have not been addressed in this paper is not an indication of an assessment of their unimportance. Rather, in a limited way, the results are intended to contribute to the economic, social, and political craftsmanship needed in forging new transit financing programs.

ACKNOWLEDGMENTS

The authors gratefully acknowledge the comments of G. B. Arrington, William Beyers, Robert Cervero, Douglass B. Lee, and Anthony Rufolo. Research assistance was provided by Larry Conrad, Wei-Ching Chiang, and Rishi Rao. Financial support was provided by the Transportation Studies Center, Portland State University.

REFERENCES

1. D. H. Pickrell. *The Causes of Rising Transit Operating Deficits.* Final Report DOT-I-83-47. UMTA, U.S. Department of Transportation, July 1983.
2. D. W. Jones, Jr. *Urban Transit Policy: An Economic and Political History.* Prentice-Hall, Inc., Englewood Cliffs, N.J., 1985.

3. J. A. Gomez-Ibanez. Assessing the Arguments for Urban Transit Operating Subsidies. In *Transportation Research Record 573*, TRB, National Research Council, Washington, D.C., 1976, pp. 1–11.
4. D. B. Lee. Evaluation of Federal Operating Subsidies to Transit. TSC Staff Study, U.S. Department of Transportation, Cambridge, Mass., Aug. 1983.
5. J. Pucher. Effects of Subsidies on Transit Costs. *Transportation Quarterly*, Vol. 36, No. 4, Oct. 1982, pp. 549–562.
6. J. Pucher. Equity in Transit Finance. *APA Journal*, Vol. 47, No. 3, Oct. 1981, pp. 387–407.
7. J. Pucher. Who Benefits From Transit Subsidies? Recent Evidence From Six Metropolitan Areas. *Transportation Research-A*, Vol. 17A, No. 1, 1983, pp. 39–50.
8. S. N. Rock. New Funding Sources for Public Transit: Who Pays? In *Transportation Research Record 900*, TRB, National Research Council, Washington, D.C., 1983, pp. 35–38.
9. R. Cervero and M. Wachs. An Answer to the Transit Crisis: The Case for Distance-Based Fares. *Journal of Contemporary Studies*, Vol. 5, No. 2, spring 1982, pp. 59–70.
10. W. Vickrey. Optimal Transit Subsidy Policy. *Transportation*, Vol. 9, 1980, pp. 389–409.
11. R. Cervero. *Intergovernmental Responsibilities for Financing Public Transit Services*. Final Report DOT-I-83-30. UMTA, U.S. Department of Transportation, Aug. 1983.
12. L. A. Metzler. Taxes and Subsidies in Leontief's Input-Output Model. *Quarterly Journal of Economics*, Vol. 65, 1951, pp. 433–438.
13. J. H. Mutti and W. E. Morgan. Interstate Tax Exportation Within the United States: An Appraisal of the Literature. *International Regional Science Review*, Vol. 10, No. 2, 1986, pp. 89–112.
14. *Strengthening the Federal Revenue System: Implications for State and Local Taxing and Borrowing*. Advisory Commission on Intergovernmental Relations, Washington, D.C., Oct. 1984.
15. W. Leontief and D. Ford. Air Pollution and the Economic Structure: Empirical Results of Input-Output Computations. In *Input-Output Techniques* (A. Brody and A. P. Carter, eds.), North-Holland Publishing Co., Amsterdam, 1972, pp. 9–30.
16. C. A. Dahl. Do Gasoline Demand Elasticities Vary? *Land Economics*, Vol. 58, No. 3, Aug. 1982, pp. 373–382.
17. D. A. Pickrell and D. C. Shoup. Land Use Zoning as Transportation Regulation. In *Transportation Research Record 786*, TRB, National Research Council, Washington, D.C., 1980, pp. 12–17.
18. M. Kyte et al. *Development of Time Series Based Transit Patronage Models to Assist Decision Makers in the Evaluation of Alternative Service Level and Fare Strategies*. Draft Final Report 1. UMTA, U.S. Department of Transportation, Sept. 1984.
19. *Fiscal 1984–85 Proposed Budget*. Tri-County Metropolitan Transit District. Portland, Oreg., 1984.
20. J. V. Cartwright et al. *Rims II: Regional Input-Output Modelling System*. Bureau of Economic Analysis, U.S. Department of Commerce, April 1981.
21. *Cost of Owning and Operating Automobiles and Vans—1984*. FHWA, U.S. Department of Transportation.
22. *Significant Features of Fiscal Federation*. Advisory Commission on Intergovernmental Relations, 1981–1982 ed., Washington, D.C., April 1983.
23. *Industrial Energy Substitution: Econometric Analysis of U.S. Data, 1958–1974*. Electric Power Research Institute, Report EA-3462, Palo Alto, Calif., April 1984.
24. *Handbook of Labor Statistics*. Bureau of Labor Statistics, U.S. Department of Labor, Bulletin 2070, Dec. 1980.
25. E. S. Walther. *State and Local Financing of Public Transit Systems*. Final Report DOT-I-87-31. UMTA, U.S. Department of Transportation, June 1983.

Publication of this paper sponsored by Committee on Application of Economic Analysis to Transportation Problems.