Urban Policy Research, Piscataway, NJ, 1982.
2. J.W. Hartmann, F.E. Hopkins, and D.B. Cato. Short-Term Forecasting of Gasoline Demand. TRB, Transportation Research Record 801, 1981, pp. 22-28.
3. A. Zellner and F. Palm. Time Series Analysis and Simultaneous Equation Econometric Models. Journal of Econometrics, Vol. 2, 1974, pp. 17-54.
4. K.F. Wallis. Seasonal Adjustment and Multiple Time Series Analysis. In Seasonal Analysis of Economic Time Series (A. Zellner, ed.), U.S. Department of Commerce, 1978.
5. E.P. Howrey. The Role of Time Series Analysis in Econometric Model Evaluation. In Evaluation of Econometric Models (J. Kmenta and J.B. Ramsey, eds.), Academic Press, New York, 1980.
6. W.J. Dixon and others. BMDP Statistical Software 1981. Univ. of California Press, Los Angeles, 1981.
7. M.J. Wolfgram. Forecasting the Demand for Highway Use of Gasoline: Econometric, Univariate, and Multiple-Time-Series Models. School of Business, Univ. of Wisconsin-Madison, Ph.D. dissertation, 1982.
8. D.A. Pierce. Relationships--and the Lack Thereof--Between Economic Time Series, with Special Reference to Money and Interest Rates. Journal of the American Statistical Association, Vol. 72, 1977, pp. 11-22.
9. C.W.J. Granger and P. Newbold. Spurious Regressions in Econometrics. Journal of Econometrics, Vol. 2, 1974, pp. 111-120.
10. P. Zarembka. Transformation of Variables in Econometrics. In Frontiers in Econometrics (P. Zarembka, ed.), Academic Press, New York, 1974.
11. G.E.P. Box and G.C. Tiao. Intervention Analysis with Applications to Economic and Environmental Problems. Journal of the American Statistical Association, Vol. 70, 1975, pp. 70-79.
12. G.E.P. Box and G.M. Jenkins. Time Series Analysis: Forecasting and Control, rev. ed. Holden-Day, San Francisco, CA, 1976.
13. A.C. Harvey. The Econometric Analysis of Time Series. Wiley, New York, 1981.
14. W.P. Cleveland and G.C. Tiao. Modeling Seasonal Time Series. Economie Appliquée, Vol. 32, 1979, pp. 107-129.

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New Funding Sources for Public Transit: Who Pays?

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As financial crises have increasingly plagued transit systems, new and/or additional sources of funding have been sought. One issue that has not been well documented in this area is the question of who pays for each source. A number of potential household-based funding sources and their general impact on families at different income levels can be analyzed by using data published by the U.S. Bureau of Labor Statistics. Sixteen options including fares were examined and compared as to their relative regressivity (burdens). This was accomplished through a three-step process. First, relevant consumer expenditures by income levels were noted. Next, expenditures as a percentage of income were calculated. Finally, percentage expenditures by each income level relative to those of the highest income level were determined. The results can be used to compare the impact of one source versus another or to choose a source to minimize negative distributional impacts. Subject to certain qualifications, it was found that most household-based sources were regressive. The most regressive were household (head) tax, cigarette tax, and transit fares. Progressive alternatives include parking, income, and stock-transfer taxes. It is suggested that decreased federal funding will lead to the tapping of more regressive sources as well as to increasing reliance on business-based taxes, service cutbacks, and fare increases.

The financial problems of mass transit have become increasingly severe in recent years and are likely to get worse. Proposed budget cuts for the Urban Mass Transportation Administration (UMTA) could have significant consequences for transit systems. In particular, elimination of federal transit operating-assistance programs (Sections 5 and 18 of UMTA Act of 1964, as amended) has been anticipated. A recent survey by the American Public Transit Association (APTA) suggests that a majority of transit systems face reduced service, increased fares, and the need for new tax revenues and/or state and local assistance as a result (1).

Over the last dozen years, the financial condition of public transit has deteriorated markedly. In 1980, operating revenues of transit systems amounted to $2.6 billion versus operating expenses of $6.0-6.5 billion, a deficit of almost $4 billion. This compares with an operating deficit of less than $300 million in 1970 (operating revenue of $1.7 billion, operating expenses of only $2.0 billion) (2). In the past, this deficit has been largely closed by subsidies; the largest growth of these came from the federal government. With proposed reductions from this source, increased subsidies from other levels of government (state, regional, local), higher operating revenues (fares), or reduced operating costs (improved efficiency, reduced service) will be necessary.

There are a number of important issues that can be addressed in this area. For example, does transit offer benefit to nonusers to justify subsidies? Are the cities and suburbs being treated equally as far as transit benefits and costs are concerned? Are road versus transit funding being treated equitably? Should social considerations (e.g., taxes on cigarettes or alcohol) be involved? What funding sources are politically acceptable and substantial enough to offer short-term or long-term assistance? Should subsidies come from nontransportation users? Notably absent from most discussions of transit finance is the issue of how different income groups would be affected by the employment of different funding sources. While this may be due in part to the lower priority given this question, it may also be due to the lack of information available. It is the purpose of this paper to consider the general differences in who pays from various financing alternatives and to hold the profile of who benefits constant for simplicity.

In economic terms, the differential tax incidence of one source will be compared with that of another

source. Differential tax incidence examines distributional changes by holding total revenue and expenditures constant while substituting one tax for another. Musgrave and Musgrave (3) suggest that this concept offers the best approach for tax policy analysis, since actual tax policy decisions usually involve issues such as comparing alternative ways of raising revenue.

Incidence refers to who (ultimately) bears the burden of a tax; that is, who pays. The initial distribution of burdens can differ from the final distribution if adjustments by consumers or firms are made in response to tax changes. This is called tax shifting. Unfortunately, there is serious disagreement on the final incidence of taxes that might be subject to significant tax shifting (e.g., property tax, corporate income tax, payroll tax). The final incidence of such business-based sources depends on changes in wages, prices, and profits as a result of the tax. Data on the shifting of tax burdens are scarce and there is little consensus on the result.

As a result, the funding sources analyzed in this paper are taxes levied on households, where the conventional wisdom [although it is not unanimous (4)] suggests that the initial and final distribution of burdens would be the same. This burden can be estimated by noting the expenditures or tax payments made by particular households. Most previous studies have concluded that the general category of sales and excise taxes tends to be regressive, whereas income taxes range from proportional to progressive depending on their structures (3,5).

RELATIVE INCIDENCE OF ALTERNATIVE HOUSEHOLD-BASED FUNDING SOURCES

Detailed spending patterns by U.S. families in different income brackets are required to examine the incidence of taxes levied on households. The only readily available and suitable data are provided by the Consumer Expenditure Survey (CES) of the Bureau of Labor Statistics (6), which is taken every 10-12 years, most recently during 1972-1973. This will allow comparison of the following funding alternatives on households: sales tax, motor fuel tax, cigarette tax, alcohol tax, automobile excise tax (new and/or used vehicles), parking and towing tax, (vacation) tolls, utility tax (electricity and/or natural gas), vehicle registration fee, income tax, title transfer fee, tickets and admissions tax, mortgage tax, a household (head) tax, and transit fares.

Calculating the relative incidence (burden) of each tax or fee requires a three-step process. First, expenditures on each item subject to tax or each tax amount must be noted by income level. A convenient breakdown available from the CES data is to arrange families by income decile from the 10 percent of families with the lowest income (decile 1) to the 10 percent of families with the highest income (decile 10). For four selected deciles (1, 4, 7, 10), gross expenditures are noted in Table 1. Each figure represents the average expenditure (in dollars) on an item by a family in a particular decile. The table notes, for example, that a decile-1 family spends $98 per year on gasoline, and this expenditure increases with income up to $561 for a decile-10 family.

The second step in this process is to calculate the percentage of income represented by the expenditure data in Table 1. The CES reports that the mean incomes of families in deciles 1, 4, 7, and 10 are $1559, $7063, $13 466, and $31 974, respectively. Table 2 displays the results, which indicate, for example, that spending on gasoline ranges from 6.3 percent of income in decile 1 to 1.8 percent of income in decile 10.

The final step is to look at the relative expenditure patterns by assigning an index number of 1 to the percentage spent on an item by the decile-10 family and scaling the spending by the other deciles accordingly. Since tax on the expenditure items would be proportional to spending, the relative incidence for either expenditures or taxes on expenditures by item will be the same. That is, comparing total expenditures on an item as a percentage of income for each population decile relative to that of decile 10 will yield the same relative pattern as the distribution of tax burdens applied to the item. The calculations are displayed in Table 3. This suggests, for example, that a decile-1 family pays a 3.5 times greater percentage of their income for gasoline (and thus gasoline taxes) compared with a decile-10 family.

DISCUSSION OF RESULTS

The funding sources considered in Table 3 can be categorized as progressive (taking an increasing percentage of income as income rises), regressive (taking a decreasing percentage of income as income rises), or proportional. Progressive sources have rising relative-incidence numbers as income increases. Parking and towing fees and state and local income taxes fit this description. Most of the other sources are regressive; they have relative-incidence values that fall as incomes rise. The degree of regressiveness differs significantly; a head (household) tax or a cigarette tax is seen to be extremely regressive; a new car excise or admissions tax is seen to be less regressive. Similar results occur if an S-index of progressivity is calculated (8).

Regressive taxes often carry a negative connotation. This notion stems from the ability-to-pay principle of taxation: those with greater ability should bear a proportionately larger share of the financing burden. This principle suggests that knowledge of the redistributive impacts of a tax could be used to select a particular funding source a priori or to mitigate any adverse consequences for the distribution of income a posteriori through ongoing governmental tax or transfer programs. A regressive tax would tend to place a heavier (percentage of income) burden on the poor and make the distribution of income less equal. In this sense, such a tax would violate the ability-to-pay principle. However, an alternative principle of taxation is to tax in proportion to benefits received. This principle excludes distributional considerations. Recently, there seems to be an implicit swing toward the benefit principle relative to federal transit funding.

In fact, "progressive" and "regressive" are technical terms with no value judgment attached. This classification, however, depends centrally on the initial distribution of income. For example, there is nothing inherently regressive about a sales tax. It is regressive because income is distributed unequally; the more unequal the distribution, the more regressive it becomes. Comparison of different taxes reflects the nature of these taxes in terms of the distribution of income of the society within which they are applied.

QUALIFICATIONS

Some qualifications need to be made to the above analysis. The data reflect actual spending patterns and thus incidence based on taxes and charges as they existed in 1972-1973. If the distribution of

Table 1. Yearly expenditures on taxable goods and services and other sources.

Item	Expenditure ($) by Decile			
	1	4	7	10
Taxable goods[a]	1407	3262	5139	8676
Taxable goods[b]	823	2201	3723	6847
Gasoline	98	270	449	561
Parking and towing	1	5	9	32
Tolls	0	2	4	8
Alcoholic beverages	33	79	127	252
Cigarettes	57	107	146	142
Gas and electric	135	222	320	432
Vehicle registration[c]	10	28	40	53
State and local income taxes	7	84	263	906
Title transfer fee[d]	1	3	4	5
New car purchases[e]	100	281	514	1005
Used car purchases[e]	73	191	338	407
Admissions and fees	11	26	54	116
New mortgage debt	180	410	1206	1462
Household tax[f]	18	18	18	18
Public transportation fares	33	56	42	88

Note: Data from Consumer Expenditure Survey (6).

[a] Goods subject to general sales tax, assuming that food purchased for home consumption and medicine and drugs are subject to sales tax. See paper by Rock (7) for more details.
[b] Assuming the items in footnote a are not subject to sales tax.
[c] Assuming a $25/vehicle fee.
[d] Based on the percentage of families purchasing a car and a fee of $10.
[e] Net outlay (excluding trade-in values).
[f] Assuming $18/family.

Table 2. Yearly expenditures as percentage of income.

Item	Expenditure (%) by Decile			
	1	4	7	10
Taxable goods[a]	90.3	46.2	38.2	27.1
Taxable goods[b]	52.8	31.2	27.6	21.4
Gasoline	6.3	3.8	3.3	1.8
Parking and towing	0.04	0.07	0.07	0.10
Tolls	0.02	0.03	0.03	0.03
Alcoholic beverages	2.1	1.1	0.9	0.8
Cigarettes	3.7	1.5	1.1	0.4
Gas and electric	8.7	3.1	2.4	1.4
Vehicle registration	0.6	0.4	0.3	0.2
State and local income taxes	0.5	1.2	2.0	2.9
Title transfer fee	0.07	0.04	0.03	0.02
New car purchases	6.4	4.0	3.8	3.1
Used car purchases	4.7	2.7	2.5	1.3
Admissions and fees	0.7	0.4	0.4	0.4
New mortgage debt	11.5	5.8	9.0	4.6
Household tax	1.2	0.3	0.1	0.1
Public transportation fares	2.1	0.8	0.3	0.3

Note: Data rounded off.

[a] See footnote a, Table 1. [b] See footnote b, Table 1.

these spending patterns has changed (and it certainly has), tax incidence could change. In a related manner, if the structure of taxes or charges changes, the results could be affected. For example, different fare structures (flat, zone, off-peak, weekend) would alter the transit expenditures of different income groups. Unfortunately, no updated CES has been scheduled. The implicit assumption was made that in response to tax changes, households would continue to buy taxable items or pay taxes in the same relative pattern as that which applied before. Any other assumption would vastly complicate empirical calculations. It is noted that if a tax used for transit funding is incremental to an existing source, the incidence would be essentially the same as the source to which it is attached.

Table 3. Relative incidence.

Item	Incidence (%) by Decile			
	1	4	7	10
Sales tax[a]	3.3	1.7	1.4	1.0
Sales tax[b]	2.5	1.5	1.3	1.0
Gasoline tax	3.5	2.1	1.8	1.0
Parking and towing fee	0.4	0.7	0.7	1.0
Tolls	1.0	1.2	1.1	1.0
Alcohol tax	2.7	1.4	1.2	1.0
Cigarette tax	8.3	3.4	2.5	1.0
Utility tax	6.4	2.3	1.8	1.0
Vehicle registration fee	4.0	2.4	1.9	1.0
State and local income tax	0.2	0.4	0.7	1.0
Title transfer fee	4.9	2.7	2.1	1.0
New car excise tax	2.0	1.3	1.2	1.0
Used car excise tax	3.7	2.1	2.0	1.0
Admissions tax	1.9	1.0	1.1	1.0
New mortgage tax	2.5	1.3	2.0	1.0
Household tax	20.5	4.5	2.4	1.0
Public transportation fares	8.2	3.0	1.2	1.0

Note: Based on unrounded data from Table 2.

[a] See footnote a, Table 1. [b] See footnote b, Table 1.

The use of a single year's income can be criticized as being unrepresentative of a longer-run view of income (9). Unfortunately, no data are readily available to correct this. Since national data were used, regional incidence could differ significantly from the reported figures due to local variations in tax rates, exceptions, expenditures, etc. The results should thus be viewed as a national aggregate. Some CES data are broken down by standard metropolitan statistical area and could give a limited picture of local incidence. In addition, data on alcohol expenditures, public transportation expenditures, and cigarette purchases suffered from serious underreporting (10). If the degree of underreporting was related to income, the reported figures could be biased. Due to the qualifications, it is difficult to ascertain the statistical significance of the results in Table 3. The results should be viewed as indications of regressivity or progressivity or the degree thereof rather than as statistically significant numbers.

Finally, a complete examination of equity would involve analysis of both who pays as well as who benefits. That is, the overall redistributive impact (or net fiscal incidence) of public transportation would consider the beneficiaries of the program as well as funding. The regressive nature of most funding sources could be countered by greater program expenditures (and benefits) that would accrue to lower-income families as major users. Social, legal, geographic, and fare-structure considerations similarly play an important role. The discussion above attempts to shed light on the who-pays groups by concentrating on differential tax incidence; it is recognized that this is only a portion of the total equity issue.

CONCLUSIONS AND IMPLICATIONS

The burden of increasing transit funding through a variety of sources has been examined by employing data provided by the U.S. Bureau of Labor Statistics. A number of potential subsidy sources as well as fares have been compared as to the income profiles of who pays from each potential source. The analysis suggests that choosing a new funding source or replacing one source with another has implications for the distribution of burdens. In addition, most sources are regressive; particular regressive

sources include a household tax and the cigarette tax. Progressive alternatives include parking and income taxes. Of the sources studied, virtually all of them are less regressive than increasing fares. This is one factor to be aware of in the consideration of across-the-board fare changes.

In addition, choice of particular funding sources also affects the sectors of society who pay. A number of household-based alternatives (e.g., levies on motor vehicles and their operations) keep redistribution within the transportation sector, since automobile users are paying. Other sources involve nontransportation sectors of society; e.g., the general sales tax concerns all consumers. Higher fares and/or service cutbacks affect the user sector to the greatest extent.

Political realities play a large role in funding changes. Sources are typically sought that will maximize revenue and the likelihood of adoption and minimize controversy. Tax incidence frequently plays a minor role. The financial crises facing transit systems have led to consideration of a variety of funding options. For example, in the Chicago area, recent proposals included increased sales, liquor, tobacco, stock-transfer, property, income, and/or motor fuel taxes; a gross receipts tax on oil companies; a tax on professional services; and fare increases and service cutbacks. The size of the projected deficits has severely limited the number of options available. Many of the excise taxes on consumption would hit on such a small relative market that their total yield would be too small or the tax rate on these items would have to be prohibitively large. As can be deduced from Table 1, few consumer expenditures are large enough to raise reasonable sums through household-based taxes. The general sales tax; a specific excise tax on gasoline, utilities, motor vehicles, or new mortgages; and income taxes appear to be the only sources with adequate potential as revenue raisers. To avoid controversy, many of the politically favored sources are not household-levied taxes. For example, New York State recently approved a tax package that was heavily weighted in this direction. Included was a gross receipts tax on oil companies, a commercial transportation services tax, a capital-gains tax on business real property, and a change in the way oil company profits are computed for tax purposes. The avoidance of household-oriented taxes is probably due to a number of factors, which include the connotation surrounding the regressivity inherent in many of these taxes, the relatively small yield of most excise taxes, and the preferences for taxes that could be sold to the public as business taxes. Taxes levied initially on business have burdens that are well hidden from individuals. The incidence of such levies is also among the most unsettled and controversial aspects of public finance. Nevertheless, the burden of such taxes will be passed on to some group of individuals, either as consumers (through higher prices), firm owners or stockholders (through lower profits), or workers (through lower wages).

Recent trends in federal financing suggest that more of the burden of transit financing will be shifted to state and local responsibility, who find themselves fiscally weak. This will likely result in a larger burden on the transit user, through increased fares and decreased service levels, as well as nonusers through higher subsidies. Federal general appropriation funding tends to be progressive; it relies principally on the income tax. State and local funding, on the other hand, tends to be regressive; it relies more on sales and property taxes. User charges (fares, services), as concluded above, are extremely regressive. This suggests that increased state and local and user burdens would increase the inequality in the distribution of income.

The results presented above provide information relative to the burden of a number of household-based taxes that are frequently mentioned as subsidy sources. Further research into the incidence of business-based taxes would complement this analysis and improve the information relative to the who-pays question, which should play an important role in the decisionmaking concerning transit finance. An updating of expenditure patterns, when such data become available, would also be in order.

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REFERENCES

1. Passenger Transport, Vol. 39, No. 51, Dec. 18, 1981.
2. Transit Fact Book 1981. APTA, Washington, DC, 1981.
3. R.A. Musgrave and P.B. Musgrave. Public Finance in Theory and Practice. McGraw-Hill, New York, 1980.
4. E.K. Browning and W.R. Johnson. The Distribution of the Tax Burden. American Enterprise Institute, Washington, DC, 1979.
5. J.A. Pechman and B.A. Okner. Who Bears the Tax Burden? Brookings Institution, Washington, DC, 1974.
6. Consumer Expenditure Survey, 1972-1973. Bureau of Labor Statistics, U.S. Department of Labor, Bull. 1992 and 1997, 1978.
7. S.M. Rock. Income Equity of Two Transit Funding Sources. TRB, Transportation Research Record 791, 1981, pp. 10-14.
8. S.M. Rock. Applying the S-Index to Transportation Financing Alternatives. TRB, Transportation Research Record 858, 1982, pp. 36-39.
9. D.G. Davies. Measurement of Tax Progressivity: Comment. American Economic Review, Vol. 70, No. 1, March 1980.
10. Reevaluation of the 1972-73 U.S. Consumer Expenditure Survey. Bureau of the Census, U.S. Department of Commerce, Tech. Paper 46, July 1979.

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