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An Introduction to State and Local Public Finance

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Overview

Public finance is the field of economics that studies government activities and the various means of financing these activities. In general, public finance deals with any of the three levels of government: federal, state, and local. While the basic theories of public finance apply regardless of the level of government studied, state and local public finance has emerged as an important sub-field of public finance in recent years. An increased emphasis on state and local public finance is due to several factors. First, the past forty years have seen a dramatic rise in state and local government expenditures. State and local (city and county) government expenditures topped $1.1 trillion in 1996, a 500 percent increase in real dollars since 1960. In 1996, state and local government expenditures comprised over 16 percent of the Gross Domestic Product of the United States. Second, there are nearly 87,000 separate state and local governments in the United States, each having its own fiscal responsibilities and revenue sources. Unlike the federal government, changes in the taxing and expenditure behavior of one state or local government has impacts on surrounding localities as residents are mobile between state and local government jurisdictions. Third, the major services provided by state and local governments - education, public welfare, health care, and highway construction and maintenance - are those which most directly impact the daily lives of residents.

While the public sector is characterized by both revenues and the expenditure of these revenues on public goods and services, the focus of this chapter is on the revenue, or financing, side of government. The chapter is designed to provide the reader an understanding of the basic principles, theories and issues in state and local public finance. The chapter consists of two major parts each consisting of three sections. The first part includes three sections that provide an introduction to government growth, taxes, and tax theory, in addition to several important issues facing state and local governments. Selected applications in public finance are covered in sections four, five and six. While the chapter as a whole is written to provide a continuum between topic areas, each section may be read independently without a loss of understanding. The first two sections are written for the general reader and require only a minimal background in economics. Section three requires a background in undergraduate microeconomics, and a portion of the third section also requires a basic knowledge of differential calculus and econometric modeling. The fourth and sixth sections contain mathematical formulas and econometric models, but these formulas and econometric models can be skipped without loss of continuity. The fifth section is appropriate for the general reader and those having a background in basic microeconomics. For a further analysis of each section presented in this chapter, the reader is referred to several excellent texts on public finance. These include: *State and Local Public Finance* by Ronald C. Fisher, *Public Finance* by Harvey Rosen, and *Public Finance: A Contemporary Application of Theory to Policy* by David Hyman.

Section I provides numerical and graphical evidence on the growth of state and local governments in recent years. Several explanations for the dramatic increase in the size of state and local governments are also presented. The section then focuses on the major categories of state government expenditures and discusses the major historical trends for each expenditure category. Although this section contains a substantial amount of data for illustrative purposes, the reader should not focus on memorizing every bit of data, but rather concentrate on acquiring an overall understanding of the changes in state and local government over the past several decades.

Section II discusses the primary revenue sources for state and local governments. The section begins by providing background on the changing revenue sources for state and local government revenues. The revenue sources addressed include the sales tax, the property tax, the personal income tax, the corporate income tax and excise taxes. Attention is also given to the incidence of a tax in terms of the income distribution and revenue generation. States' historical reliance on each tax as a source of revenue is discussed, along with critical issues and ideas surrounding each tax. Important issues surrounding sales tax revenues, such as cross border shopping and taxing electronic commerce, are also discussed within the section.

Section III provides an overview of tax theory. The distributional impacts of taxation and the effects of taxation on the efficiency of markets are discussed. Both issues should be considered by public officials when evaluating taxes in their state or community. A short background on efficiency is presented along with an analysis of the impact taxes have on the efficiency of market operations. Graphical analyses and differential calculus are used to derive expressions used to compute the efficiency costs of taxation. The section ends by presenting two popular models of optimal taxation - the Ramsey Rule and the Laffer curve.

Section IV provides a general background on revenue forecasting for state and local governments. The section begins by discussing the forecasting process. Further portions introduce the reader to the various forecasting methods available, differentiating between qualitative forecasting methods and quantitative forecasting methods. The benefits and drawbacks of each method are also discussed. Attention is given to the Box-Jenkins ARIMA model and the causal forecasting model.

Section V presents an overview of cost-benefit analysis, paying specific attention to evaluating the costs and benefits of public projects. The important concepts of present value, discount rates, and how to value costs and benefits are also included. The section concludes by addressing several pitfalls common to cost-benefit analysis.

Fiscal impact analysis is discussed in section VI. This sub-area of cost-benefit analysis is concerned with only the tangible effects of a policy or event on public sector costs. Several different planning approaches are presented, including methods for projecting public revenues and costs. Several econometric models often used in fiscal impact analysis are also discussed.

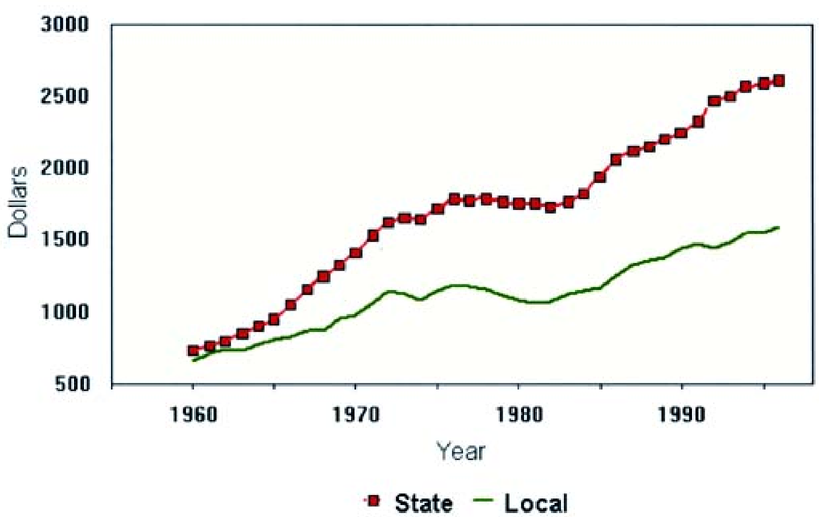
PART 1 - GOVERNMENT GROWTH, TAXES AND TAX THEORY

I. The Growth of State and Local Governments - Revenues and Expenditures

A. Evidence on the Growth of State and Local Governments

Historically, state governments have produced higher education, welfare, public health and state-wide highway maintenance and improvements, whereas local governments produced elementary and secondary education, local infrastructure, parks, and police and fire protection. While the roles of both levels of government have remained the same over time, the past forty years have seen a dramatic increase in state and local government expenditures. Per capita state and local expenditures from 1960 to 1996, in real 1993 dollars, are shown in Figure 1.

Figure 1: Real Per Capita State and Local Expenditures 1960 - 1996



In 1960 state governments were spending roughly $740 per person while local governments spent about $670 per person. As seen in Figure 1, both state and local expenditures per capita have increased dramatically. Per capita state expenditures topped $2,600 in 1996, nearly a 350 percent increase from 1960. Local expenditures per capita increased 250 percent between 1960 and 1996, with 1996 local expenditures per capita reaching $1,600.

The growth in state and local governments can also be shown by considering state and local government expenditures and revenues as a percent of Gross Domestic Product (GDP) of the United States. Expenditures and revenues as a percent of GDP highlights the growing role of state and local governments in producing a higher percentage of the country's total output. The measure also reveals the percentage of total income that is used by state and local governments. State and local government revenues and expenditures as a percent of GDP from 1960 to 1996 are provided in Table 1.

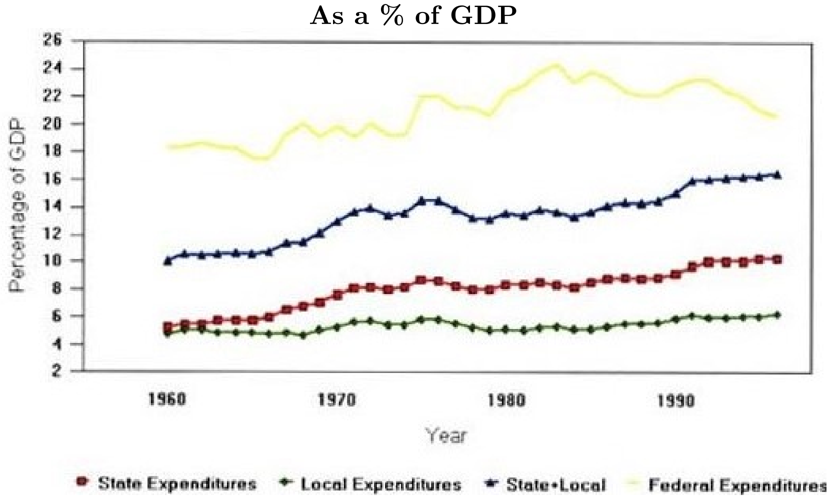
Local expenditures and revenues as a percent of GDP increased nearly 50 percent over the past forty years, while state expenditures and revenues as a percent of GDP nearly doubled between 1960 and 1996. It is interesting to compare this increase in state and local government expenditures with expenditures of the federal government. Local, state, and federal government expenditures as a percent of GDP are shown in Figure 2.

Table 1: State and Local Government Expenditures and Revenues - 1960 to 1996
As a Percent of Gross Domestic Product

	Expenditures			**Revenues**		
Year	State and Local	State	Local	State and Local	State	Local
1960	10.11	5.30	4.81	9.84	5.33	4.51
1965	10.63	5.76	4.87	10.53	5.82	4.71
1970	12.99	7.68	5.31	12.94	7.69	5.25
1971	13.73	8.12	5.61	13.21	7.76	5.45
1972	13.96	8.19	5.77	13.99	8.17	5.82
1973	13.44	8.01	5.43	14.09	8.38	5.71
1974	13.64	8.22	5.42	14.24	8.39	5.85
1975	14.55	8.72	5.83	14.39	8.49	5.90
1976	14.52	8.69	5.83	14.49	8.60	5.89
1977	13.89	8.33	5.56	14.44	8.57	5.87
1978	13.30	8.05	5.25	14.15	8.47	5.68
1979	13.16	8.06	5.10	13.79	8.36	5.43
1980	13.63	8.43	5.20	14.12	8.63	5.49
1981	13.44	8.37	5.07	13.97	8.52	5.45
1982	13.87	8.56	5.31	14.53	8.73	5.80
1983	13.71	8.37	5.34	14.30	8.53	5.77
1984	13.39	8.21	5.18	14.39	8.77	5.62
1985	13.71	8.55	5.16	14.81	9.05	5.76
1986	14.19	8.82	5.37	15.03	9.22	5.81
1987	14.47	8.90	5.57	15.13	9.23	5.90
1988	14.38	8.82	5.56	14.83	9.08	5.75
1989	14.54	8.95	5.59	14.99	9.21	5.78
1990	15.12	9.20	5.92	15.38	9.38	6.00
1991	15.99	9.77	6.22	15.89	9.72	6.17
1992	16.10	10.13	5.97	16.11	10.02	6.09
1993	16.18	10.14	6.04	16.31	10.25	6.06
1994	16.31	10.18	6.13	16.42	10.32	6.10
1995	16.39	10.28	6.11	16.51	10.38	6.13
1996	16.57	10.31	6.26	16.64	10.45	6.19

Source: Tax Foundation, *Facts and Figures on Government Finance*, various years, U.S. Census Bureau, *State Government Finances*, various years, and (Holcombe and Sobel, 1997,8-9).

Figure 2: Expenditures By Level of Government
As a % of GDP



Historically, federal expenditures as a percent of GDP have been higher than both state and local governments combined, but Figure 2 shows the gap between federal and state and local government expenditures has decreased in recent years. In 1960, state and local government expenditures totaled about 10 percent of GDP, whereas federal government expenditures reached 18 percent of GDP, nearly 80 percent greater than state and local governments. As of 1996, however, state and local government expenditures reached 17 percent of GDP, whereas federal government expenditures only increased to roughly 21 percent of GDP.

B. Explaining the Growth of State and Local Governments

There are several factors that explain the dramatic growth of state and local governments over the past four decades. Individual income rose significantly during this period. With higher incomes, individuals demand more goods and services, including those traditionally provided by state and local governments. An important point, however, is that while incomes and government expenditures experienced an overall increase during this period, the growth in state and local expenditures slowed and even decreased during the recessionary periods of the mid 1970s and early 1980s and 1990s. Growth in income slowed during these periods, and as a result state and local governments received relatively less revenues, thereby reducing expenditures. This marked decrease in the growth of state and local government expenditures during recessionary periods can be seen in Figure 1.

Another factor that explains the overall growth of state and local governments is that the population of the United States increased during this period, in part due to the baby-boom occurring after World War II. State and local expenditures rose during this period to meet the increasing demands for state and local government services created by the growing population. Life expectancies also increased during this period. As individuals continued to live longer, there was an increase in demand for government goods and services such as health care and public welfare.

The initial increase in state expenditures during the 1960s was in part due to states' rapid introduction of new taxes during the 1950s, 1960s, and early part of the 1970s. New taxes led to an increase in revenues to state governments and thus an increase in state government expenditures. Between 1951 and 1969, sixteen states adopted sales taxes. Since 1969, no state has adopted a sales tax. Ten states adopted personal income taxes between 1961 to 1976, and eleven adopted a corporate income tax between 1957 and 1971. Only two states adopted a personal income tax since 1971, and no state has adopted a corporate income tax since 1971 (ACIR, *Significant Features of Fiscal Federalism*, various years).

A final explanation for the growth of state and local governments is ***devolution*** - the transfer of responsibilities from higher levels of government to lower levels of government. Recently, state governments have taken a more active role in providing services such as education and public welfare, activities traditionally funded by the federal government. Although there has been much research and debate on devolution, one of the primary explanations for increased state and local responsibilities is the public's decreasing confidence in the federal government's ability to effectively provide goods and services, along with the growing desire for decentralization and competition that is part of the capitalistic mentality (Tannenwald, 1998). As long as state and local governments gain greater responsibility in providing goods and services, increases in state and local government expenditures can be expected.

C. The Changing Responsibilities of State Governments

While there has been an overall increase in state expenditures in recent history, this does not imply that expenditures on each function of state government have increased. To the contrary, state expenditures on certain functional areas have decreased over time, while others, as expected, have increased. State expenditures can be categorized into five functional areas: higher education, highways, public welfare, health care, and correctional facilities. Expenditures on each functional category as a percent of total state expenditures are shown in Table 2.

Table 2: State Expenditures By Category - Percent of Total						
Year	Education	Highway	Public Welfare	Health Care	Corrections	Other
1950	21.33	19.56	17.91	7.73	1.50	31.97
1960	31.79	26.87	13.62	7.66	1.56	18.50
1970	39.75	17.36	17.01	6.90	1.42	17.56
1980	38.53	10.98	19.38	8.04	1.95	21.12
1990	36.38	8.71	20.65	8.39	3.40	22.47
1996	35.33	7.82	26.44	8.43	4.16	17.82

Source: U.S. Census Bureau *State Government Finances*, various years, and (Holcombe and Sobel, 1997, 24-25)

i. *Education*

Education expenditures, specifically on higher education, comprise the greatest percentage of total state expenditures, although this percentage has decreased slightly in the past two decades. In the 1960s and early 1970s there was a significant increase in the public's demand for higher education over earlier years, increasing from 21 percent of state expenditures in 1950 to nearly 40 percent of state expenditures in the late 1960s and early 1970s. This increase in demand resulted from two factors: 1) society began to place a greater weight on the importance of higher education beginning in the 1960s, and 2) the baby-boomers reached college age. The combination of these two factors raised the demand for higher education, thus forcing states to spend an increasing percentage of their total budget on education during this time period. Although states are currently spending a smaller percentage of their total budget on higher education expenditures than in the past, higher education still remains the greatest priority of state governments as roughly 35 percent of state expenditures are currently allocated to higher education.

ii. *Highways*

Unlike education expenditures, states have spent a declining portion of their total budget on highways. From over 25 percent of total expenditures in 1960, expenditures on highways have decreased to only about eight percent of total expenditures in recent years. This decrease is due to several factors. First, the 1950s and 1960s saw a dramatic increase in the number of highways constructed, in part due to the creation of the Federal Interstate System. Although highways require periodic maintenance, highways are durable goods lasting for many years. Once the initial cost of new highway construction is met, states require relatively less funds to maintain roadways. Second, highway construction and maintenance are financed through motor fuels taxes which are usually levied as a certain number of cents per gallon. Motor fuel taxes are thus not indexed by inflation, meaning that as the price of fuel increases the tax collected does not increase because it is not linked to the price of fuel, just the quantity of fuel purchased. As the price level increases, states receive a higher percentage of their funds from inflation-linked taxes like the sales tax and income tax rather than gasoline taxes. As a result expenditures on non-inflation indexed items decrease relative to other expenditure categories. A continual increase in tax rates on non-indexed items would increase tax revenues, however this option is not frequently considered by officials given the probable public opposition.

iii. *Public Welfare*

Since the early 1960s, public welfare has been an increasing portion of total state expenditures. Totaling roughly 14 percent of state expenditures in 1970, welfare expenditures as a percent of total state expenditures reached over 26 percent in 1996. The Medicaid program, which began in 1965, has been the predominant cause of the increase in state welfare expenditures (Holcombe and Sobel, 1997, 29). Although Medicaid is typically viewed as health care rather than welfare, a state makes a payment to an individual for health care rather than directly spending the money on health care for the individual. Thus, Medicaid is considered a welfare expenditure in terms of state budgeting. In 1970, less than one-half of all welfare expenditures consisted of public medical payments. By the 1990s, however, nearly three-quarters of all public welfare expenditures could be attributed to the Medicaid program.

iv. *Health Care*

Health care expenditures include those expenditures on hospitals, contributions to local clinics and public health programs. Medicaid payments are not included in health care since they are considered a public welfare expenditure rather than a health care expenditure. Unlike other categories of state government expenditures, health care expenditures have remained a relatively constant percentage of total state expenditures. While health care costs have consistently increased over time, state health care expenditures have hovered between seven and eight percent of total state expenditures over the past several decades.

v. *Corrections*

Correctional expenditures predominately consist of expenditures on state prisons. Although current correctional expenditures consist of only four percent of total state expenditures, this amount has nearly tripled since the 1950s when correctional expenditures accounted for only 1.5 percent of total state expenditures. States' increased responsibility for correctional facilities can be attributed to: 1) the 'war on drugs' beginning in the early 1980s, which led to an increase in the number of convicted drug offenders, 2) an increase in the violent crime rate, which, according to the U.S. Bureau of the Census, has increased from 571 incidents per 100,000 population to over 750 incidents per 100,000 population in the mid 1990s, and 3) an increase in the overall state and federal prison population, increasing from 100 per 100,000 population in 1970 to over 400 per 100,000 population in 1997.

vi. *Other Expenditures*

Although higher education, welfare, health care, highways and correctional facilities are the five main expenditure categories, states do provide funding for other functional areas as well.

Some of the areas include library services, veteran's services, parks and recreation and public utilities. Expenditure on these categories has averaged about 20 percent of total state expenditures.

D. Conclusion

This section provided evidence on the rapid growth in state and local governments over the past forty years. Attention was given to explaining those factors responsible for the dramatic increase in state and local government size. These factors include increases in income, an increase in the overall population, an increase in life expectancies, the introduction of new taxes, and the transfer of fiscal responsibility from the federal government to state and local governments. The section then addressed the main categories of state government expenditures and discussed the major historical trends for each of these five expenditure categories.

Although the future cannot be predicted with certainty, a growing, older population along with the decentralization of government decision making all suggest that the current trends in the growth of state and local governments will continue. State and local governments will be asked to provide more goods and services for the populations they represent. Only in the unlikely event that populations decide the free-market can better provide the goods and services once provided by local governments, there is little doubt the 21st century will see an increase in the size of state and local governments.

II. Funding State and Local Government - State and Local Taxes

Each state and local government in the United States uses a variety of taxes to raise the revenues necessary to meet required expenditures. These taxes include the sales tax, personal income tax, property tax, excise taxes, and the corporate income tax. In addition to choosing between different taxes, the tax rates vary across state and local governments. The combination of taxes and tax rates used by each state or local government is termed the ***tax mix***. This section first presents an overview of the major sources of state and local government tax revenue. The reader will see that individual state or local governments differ greatly in their reliance on each tax as a source of revenue. This is primarily due to varying economies of scale in the provision of goods and services and differences in voters' tax preferences across localities and states. After providing an overview of the major tax sources for state and local governments, each of the five major taxes used by state and local governments is discussed as are other common sources of state and local government revenue.

A. State and Local Government Revenue

Traditionally, state and local governments use five types of taxes to raise revenues. These taxes include the general sales tax, the personal income tax, the corporate income tax, the property tax and excise taxes (taxes such as alcohol and tobacco taxes and the motor fuels tax). Although these five taxes are all used by both state and local governments, the importance of each tax in contributing to total tax revenues differs between both levels of government.

i. *State Government Revenue*

In 1998, state governments generated almost $475 billion in state tax revenues. Tax revenues by state are shown in Table 1. Considering total taxes, it is not surprising that high population states like California, New York, Texas and Florida generated the most tax revenues. However, on a per capita basis things appear much different. Connecticut, Delaware and Hawaii generated the most tax revenue per person, while tax revenues per capita in some higher population states are near the lowest in the nation.

Table 1: 1998 State Tax Revenues

State	Total Taxes ($ mill.)	Per Capita ($)	Per Capita Rank	State	Total Taxes ($ mill.)	Per Capita ($)	Per Capita Rank
Alabama	5,734	1,318	46	Montana	1,332	1,514	39
Alaska	1,186	1,932	12	Nebraska	2,633	1,583	33
Arizona	6,949	1,488	42	Nevada	3,228	1,848	15
Arkansas	4,057	1,598	31	New Hampshire	1,009	851	50
California	67,713	2,073	9	New Jersey	15,605	1,923	13
Colorado	5,898	1,485	43	New Mexico	3,575	2,058	10
Connecticut	9,394	2,869	1	New York	36,155	1,989	11
Delaware	1,981	2,663	2	North Carolina	13,869	1,838	16
Florida	22,513	1,509	41	North Dakota	1,078	1,690	23
Georgia	11,589	1,517	38	Ohio	17,643	1,574	35
Hawaii	3,176	2,662	3	Oklahoma	5,301	1,584	32
Idaho	2,057	1,674	25	Oregon	4,999	1,523	37
Illinois	19,771	1,641	29	Pennsylvania	20,629	1,719	22
Indiana	9,747	1,652	27	Rhode Island	1,784	1,806	18
Iowa	4,803	1,678	24	South Carolina	5,683	1,482	44
Kansas	4,648	1,768	21	South Dakota	834	1,130	49
Kentucky	7,115	1,808	17	Tennessee	6,996	1,288	47
Louisiana	6,082	1,392	45	Texas	24,629	1,246	48

Table 1: 1998 State Tax Revenues							
State	**Total Taxes ($ mill.)**	**Per Capita ($)**	**Per Capita Rank**	**State**	**Total Taxes ($ mill.)**	**Per Capita ($)**	**Per Capita Rank**
Maine	2,370	1,905	14	Utah	3,458	1,647	28
Maryland	9,190	1,790	19	Vermont	958	1,620	30
Massachusetts	14,488	2,357	5	Virginia	10,543	1,552	36
Michigan	21,693	2,210	6	Washington	11,806	2,075	8
Minnesota	11,504	2,435	4	West Virginia	3,012	1,663	26
Mississippi	4,343	1,578	34	Wisconsin	11,150	2,134	7
Missouri	8,222	1,512	40	Wyoming	856	1,779	20

Source: Federation of Tax Administrators

General sales taxes have historically been the greatest source of revenues for state governments. In 1996, over 37 percent of state revenues came from general sales taxes. Personal income taxes were second in importance to the general sales tax, followed by the corporate income tax and excise taxes on alcohol, tobacco and motor fuels. Individual source state tax revenues as a percent of total state tax revenues from 1950 to 1996 are shown in Table 2.

Table 2: State Tax Revenues By Source - Percent of Total						
Year	General Sales	Personal Income	Corporate Income	Alcohol/Tobacco	Motor Fuels	Other
1950	21.06	9.13	7.39	11.49	19.47	31.46
1960	23.85	12.25	6.54	9.19	18.49	29.68
1970	29.56	19.15	7.79	8.12	13.10	22.28
1980	31.49	27.06	9.72	4.67	7.09	19.97
1990	33.18	31.97	7.24	2.99	6.45	18.17
1996	37.53	31.91	7.01	2.62	6.21	14.72

Source: U.S. Census Bureau *State Government Finances*, various years, and (Holcombe and Sobel, 1997, 36)

Although sales taxes have been the greatest revenue source for state governments, the personal income tax has increased in importance in recent years, now only contributing slightly less to total revenues than the sales tax. Corporate income tax revenues as a percentage of total tax revenues have remained relatively constant except for a slight increase in the 1980s. Alcohol, tobacco and motor fuel taxes have become a less significant portion of total state tax revenues over time. As previously mentioned, this is primarily a result of these taxes not being linked to inflation as are the other three taxes. Unlike local governments, the property tax currently contributes a very smaller percentage to overall state tax revenues, although historically this percentage has been higher. The property tax only accounted for about two percent of total state tax revenues in 1996. States' decreasing reliance on the property tax is reflected in the falling percentages of other tax sources shown in the last column of Table 2.

ii. *Local Government Revenue*

The major tax revenue sources for local governments are quite different than that of state governments. The predominant source of tax revenue for local governments has been the property tax. In 1996, the property tax accounted for 74 percent of local government tax revenues. Recall the property tax accounted for only two percent of state tax revenues. Local governments also rely on general sales taxes, but much less than state governments. Sales taxes currently account for about 15 percent of local tax revenues. The personal income tax is also a smaller percentage of local tax revenues than state tax revenue, with only about five percent of local tax revenues coming from personal income taxes. Local governments receive about five percent of total taxes from excise taxes, whereas state governments receive approximately 15 percent of tax revenues from excise taxes.

B. The Sales Tax

A ***general sales tax*** imposes the same tax rate on the purchase of all commodities. Another common name for a general sales tax is the retail sales tax, as the tax applies to most retail sales. The sales tax is considered an ***ad valorem*** tax because it is levied as a percentage of the sales price. Although this is the true definition of a general sales tax, it is important to realize that the sales tax really only applies to *most* commodities rather than all commodities. Many state and local governments exempt services, food, and prescription drugs from the sales tax. However, because the tax applies to most consumption goods, the term general sales tax is used.

i. *State Sales Taxes*

As of 1999, only five states did not have a general sales tax. These states were Alaska, Delaware, Montana, New Hampshire and Oregon. Sales tax rates in the other forty-five states and the District of Columbia range from three percent to seven percent. Colorado has the lowest sales tax rate at three percent, while Mississippi and Rhode Island both have sales tax rates of seven percent. State sales tax rates as of 1999 are shown in Figure 1.

Figure 1: State Sales Tax Rate - 1999

ii. *Local Sales Taxes*

Thirty-one states have a local-taxing option which allows local governments to levy a local sales tax in addition to the state sales tax. In this case, the total sales tax the consumer pays is the state sales tax rate plus the local sales tax rate. Local rates are usually less than the state rate. In Kansas, for example, local sales taxes range from 0.25 percent to 2.25 percent (city plus county), whereas the state sales tax rate is 4.9 percent. Local sales taxes are collected with state sales taxes at the time of purchase and are remitted to the state, usually on a monthly basis. The state then returns the local portion of the sales tax collected back to the originating local government. In essence, the state government acts as the tax collector for local governments.

iii. *Generating Sales Tax Revenues - Issues for State and Local Governments*

As shown previously in Table 2, sales tax revenues have been an increasing percentage of total state tax revenues. Not only have states placed an increasing reliance on sales tax revenues, sales tax revenues themselves have increased over the past several decades. In 1960, sales tax revenues were roughly one percent of GDP, whereas by 1996 sales tax revenue neared four percent of GDP. State and local governments can increase sales tax revenues two ways: 1) by expanding the ***tax base***, which is the activity being taxed (general consumption or retail sales in the case of the sales tax), or 2) increasing the tax rate. As most state and local sales taxes already apply to general consumption, expanding the tax base would not significantly increase revenues, although removing certain exemptions would increase sales tax revenues. Initial sales tax rates for many states ranged between two and three percent. However, the need for additional revenues forced states to double or triple their initial sales tax rates to the current levels shown above in Figure 1.

By law, a state is not allowed to collect sales tax revenue from an out-of-state seller. Sales taxation requires in-state 'nexus,' or physical presence of both buyer and seller in the state. So, for example, if a consumer in New York purchases a product in Oklahoma, the state of New York cannot by law require Oklahoma to collect New York sales tax on the purchase. The purchase is thus not subject to any sales tax. ***Compensating use taxes*** are used by states to collect tax revenues from out-of-state purchases. Use tax rates are the same as the sales tax rate. Use taxes are usually imposed on the consumption or storage of tangible personal property within the state, regardless of where the property was purchased. So, for example, if a consumer buys a vehicle from another state, the consumer does not have to pay the home state sales tax since the purchase was made out-of-state, but the buyer is legally required to pay the home state use tax on the purchase since the product will be used in the home state. Unfortunately, most consumers are not aware of the use tax and their responsibility in remitting it. Also, unlike businesses which are routinely audited, evading the compensating use tax is relatively easy because of the low probability of detection. Thus, compensating use taxes are usually only collected on large-ticket durable purchases such as cars, boats, etc. that can be easily documented and traced.

a. *Taxing Electronic Commerce*

As state and local government rely heavily on sales tax revenues, the explosion of electronic commerce, often called e-commerce, in recent years has created significant concerns for local retailers and state and local government officials. Only totaling several billion dollars in 1996, the National Governors Association (NGA) estimates that e-commerce will grow to over $300 billion by 2002. Local retailers and state and local governments tend to favor taxing electronic commerce. Local merchants fear the increased competition from Internet shopping, and state and local governments project large sales tax revenue losses (over $20 billion according to NGA) due to consumers purchasing products on-line rather than locally. Opponents of taxing the Internet argue that the Internet is the last remaining sector of the economy where free trade is present. They attribute the rapid growth in e-commerce and technology to the fact that there are no major taxes on e-commerce to hinder growth. They suggest that e-commerce is just another form of competition for local retailers, and as such local retailers should devise strategies to remain competitive in an electronic marketplace. Furthermore, opponents of taxing electronic commerce argue that state and local governments should become more fiscally responsible rather then relying on the Internet to provide extra tax revenues.

The biggest fear of state and local governments is the loss in sales tax revenue due to increases in e-commerce. Traditionally, the sales tax is collected at the point of purchase. A well-defined nexus, or physical presence, is required for a state or local government to collect sales taxes. To levy and collect sales taxes in any state requires that both the buyer and the seller be physically located in that state. According to the Interstate Commerce clause of the U.S. Constitution, if the seller is in a different state than the buyer, the buyer's state cannot by law attempt to collect sales tax from the out-of-state seller. Notice, however, that the nexus problem applies not only to Internet commerce, but mail order purchases as well.

To overcome the nexus problem many states impose a use tax that is equal in value to the state's sales tax rate. When a remote seller does not collect a state's sales tax, consumers who make remote purchases are required to pay a use tax on the value of their remote purchase. In Kansas, a use tax is imposed "for the privilege of using, storing, or consuming within this state any article of tangible personal property." (K.S.A. 79-3703). Unfortunately, collecting use tax revenue from consumers is a problem, regardless of whether consumption occurs locally or on-line. Because most businesses are aware of this use tax and are subject to audits, the reporting and collection of use tax from businesses is not a problem. What is a problem is that most consumers are not aware of the use tax so the tax revenue goes uncollected. Furthermore, there is little incentive for consumers to remit this tax, as enforcing this tax at the individual consumer level would be next to impossible. So although most states have a use tax to overcome the nexus problem arising from the sales tax, the ignorance of consumers regarding the existence of this tax, the high costs of enforcing this tax and the extremely low probability of detection from not remitting the tax all currently make the use tax an ineffective alternative to collect lost sales tax revenues.

One question is why state and local governments have become so concerned about revenue losses from e-commerce when they have been facing a similar problem with mail order purchases. State and local governments are concerned with tax losses due to e-commerce because, unlike mail order, e-commerce is projected to increase dramatically in the near future. While mail order sales reached $55 billion in 1998 (U.S. Census Bureau *Monthly Retail Sales)*, e-commerce is projected to reach over $300 billion by 2002. With $300 billion in untaxable electronic commerce, the $20 billion loss in sales tax revenue translates into about a ten percent loss in state and local government tax revenues.

Although the projections for e-commerce and sales tax revenue losses are quite large, retailers and state and local governments should be aware of several factors leading to a possible over-estimation of e-commerce and tax revenue losses (see Goolsbee and Zittrain, 1999, 413-428; McClure, 1997, 731-749; Hellerstein, 1997, 593-606). First, the National Governors Association's e-commerce projections include business-to-business sales. Whether or not businesses buy from each other on-line is irrelevant because any sales between businesses are tax exempt, regardless of the medium in which the purchase occurs. Second, just because a consumer purchases a product on-line does not automatically imply that the product substituted for a locally sold product. The Internet has made available to consumers a greater variety of products, many of which are not available locally. If a consumer purchases a product that he could not buy locally, then local retailers and local governments are not losing any revenues. Using data from the Forrester Research Company, (Goolsbee and Zittrain, 1999, 413-428) empirically tested whether Internet sales divert retail purchases away from local retailers. They found no significant evidence that on-line shopping substitutes for local retailing.

Another reason for the possible over-estimation of revenues losses is a failure to consider the type of product purchases. The Boston Consulting Group (BCG, 1998) reports that roughly 40 percent of business-to-consumer e-commerce involves purchases of food, apparel, travel and financial services. In the majority of state these purchases are exempt from the sales tax. So any substitution between local consumption and on-line consumption of these items will not result in a revenue loss for state and local governments. Of the remaining 60 percent of e-commerce, almost half is comprised of computer sales (BCG, 1998). Many on-line computer sellers already pay sales tax because they have in-state repair services, thus creating nexus. Also, not every on-line computer purchase came from a local retailer - some purchases were made through mail-order, in which case no tax collection was required anyway. However, while local governments may not lose sales tax revenues in the usual amounts projected, they may lose revenue from other sources, i.e. property taxes (loss of establishments) and income taxes (fewer employees or employees with lower incomes) if consumers substitute from local commerce to electronic commerce.

Despite the possible over-estimation of revenue losses, state and local governments are concerned that if e-commerce continues to grow and no tax plan is in place, it will be increasingly difficult if not impossible to levy taxes on the Internet. There are several additional problems state and local governments face in taxing the Internet. The Internet Tax Freedom Act (ITFA) enacted by congress in 1998 placed a three-year moratorium on levying new taxes on the Internet. The ITFA has recently been extended until 2006. The purpose of the ITFA was to allow the Internet and Internet technology to grow and remain unimpeded by taxation and regulation. An important point, however, is that the ITFA only prevents *new* taxes from being levied on e-commerce. Officials fear that new taxes would discriminate against certain parties involved in Internet commerce and technology, while leaving other areas of Internet technology untaxed. The ITFA does not apply to sales and use taxes because these are not new taxes for those state and local governments already having sales and use taxes. So, state and local governments could levy state and local sales and use taxes on e-commerce. The problem is the Interstate Commerce clause of the U.S. Constitution, which currently prohibits states from collecting revenues from out-of-state sellers (the nexus problem) and the inability of states to enforce and collect use tax on consumer purchases.

Technological constraints and the vast number of taxing jurisdictions are two other problems facing state and local governments. Even if taxation of out-of-state sellers was possible, how do state and local governments collect the tax revenue? Sellers would have to know the location of the buyer and the state and local tax rates in the buyer's state and community. Currently there are over 6,400 different tax rates in the United States. Determining the tax for every single buyer at the time of purchase would place a huge cost on sellers. Also, one basic principle of taxation is that taxation should only occur if compliance costs are low. If compliance costs are high, then there is a greater chance of tax avoidance. As of now there is no low-cost method for determining a buyer's tax rates at the time of an on-line purchase. This may not be a problem in the future, however, as plans for tax rate database software exist. With this software, sellers would be given all applicable tax rates after the buyer enters his or her delivery address. The software would automatically compute the tax based on the buyer's address.

E-commerce and Internet taxation will undoubtedly continue to be important issues for state and local governments as well as local retailers. Questions remain as to magnitude of tax revenue losses and the impact of e-commerce on local retailers. On a simpler level, the question of whether the Internet should be taxed at all is at the heart of many debates on taxing e-commerce. Officials will have to deal with the Interstate Commerce clause of the Constitution to gain the opportunity to tax out-of-state sellers. Even if state and local governments could legally tax out-of-state sellers, an efficient method of tax collection needs to be developed to prevent tax avoidance.

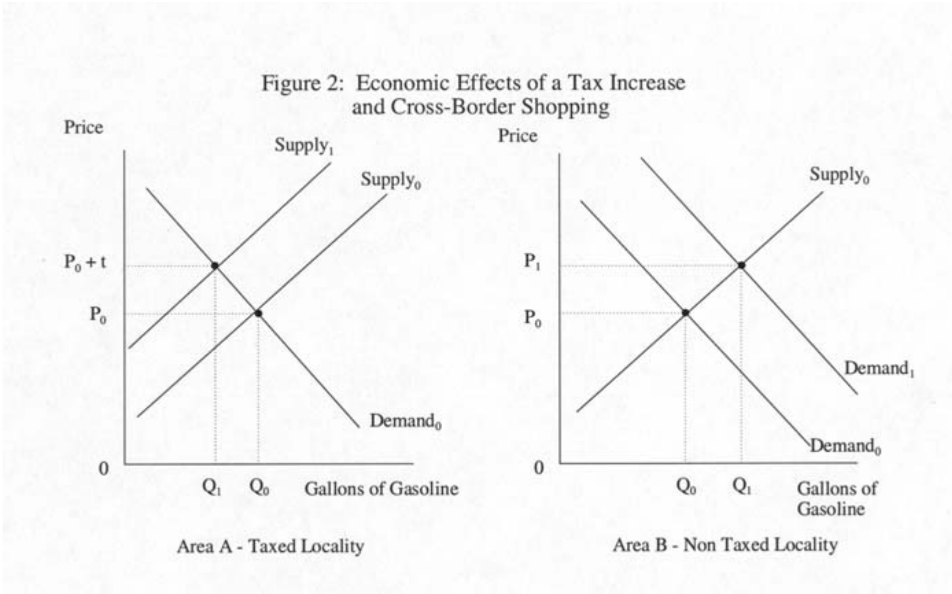
b. *Cross-Border Shopping*

There are nearly 87,000 state and local government taxing jurisdictions in the United States. Thirty-one states have a local sales tax option which gives counties and cities the authority to levy local sales taxes in addition to the state tax rate. Within a state and across cities and counties one will encounter different tax rates. The proximity of regions having different tax rates produces a situation where the economic activity in one region is dependent on the tax activity or tax policy change occurring in nearby regions. If a sales tax change occurs in one region, then all neighboring regions can be impacted by the change, even if these regions made no change in their own sales tax policies. This dependence is primarily due to cross-border shopping, which occurs because economic agents in one region adjust their behavior in response to a tax change and the impacts of this behavioral change spill over into neighboring regions.

Many studies have been conducted to examine the degree to which sales tax differentials between regions cause cross-border shopping and a resulting revenue gain or loss. Mikesell and Zorn (1986) examined the impact of a sales tax increase (0.5 percent) in a small city in Mississippi relative to surrounding areas in which the tax remained at 5 percent. They found that the tax rate differential caused a significant reduction in sales within the city, namely a one-half percentage rate differential caused a 1.1 percent decrease in city sales. Fisher (1980) examined the impact of tax rate differentials between Washington, D.C. (higher rate) and the surrounding Maryland and Virginia suburbs (lower rate). He found that the tax rate differential had no impact on overall sales between the regions, but did have a negative and significant impact on food sales. Every one percentage point increase in the rate differential between Washington. D.C. and the suburban area was predicted to cause a seven percent drop in food sales in Washington, D.C.

The general impact of cross-border shopping can be shown graphically. Consider the market for gasoline in two neighboring regions A and B, both selling gasoline in a competitive market. This scenario is depicted in Figure 2. Before the imposition of any tax (or tax change), the markets in both regions are in equilibrium at price P_0. Now, suppose area A decides to a levy a per unit tax on gasoline. The imposition of a tax by area A is shown by the ecrease in the supply curve (Supply_1) for gasoline in area A. Now, the price of gasoline in area A is higher ($P_0 + t$) than before the tax, and the quantity of gasoline sold is now lower. One of the basic principles of tax analysis is that individuals attempt to change their behavior to avoid a tax. Given the price increase in area A, some consumers will substitute gasoline in area A with the now lower-priced gasoline in area B. This substitution from A to B increases the demand for gasoline in area B shown by Demand_1. Substitution will continue from A to B until the tax inclusive price of gasoline in area A, $P_0 + t$, is equal to the price of gasoline in area B, P_1, assuming no transportation costs, product differentiation, or information costs between the two regions. When these prices are equal, there no longer remains an incentive for consumers to substitute between products.

What Figure 2 shows is that a tax increase in one area actually leads to a price increase in neighboring areas. Although taxes were not raised in area B, the imposition of a tax in area A caused a substitution from area A to B, thus increasing the demand and the price for gasoline in area B. This highlights an important aspect of local public finance - *prices and product availability in one region are dependent upon tax policy and price changes in neighboring regions.*



Not only are one region's prices impacted by neighboring tax changes, revenues to a local government can also be impacted. As shown in Figure 2, the tax increase in area A led to an increase in the price of gasoline and the quantity of gasoline sold in area B. With an increase in the quantity of gasoline sold, area B would experience an increase in gasoline tax collections if a tax is in place, as gasoline taxes are levied per gallon. Also, if gasoline was subject to the sales tax, sales tax revenues would increase in area B because the price of gasoline increased in area B. Although area B did not increase taxes on gasoline, the tax increase in area A resulted in a higher price and quantity of gasoline sold in area B, thereby increasing gasoline tax revenues and sales tax revenues, if both applicable. Thus, a locality's tax revenue, in addition to prices and quantity sold, are also dependent on any tax change occurring in a neighboring region.

C. The Personal Income Tax

States have increased their reliance on the personal income tax as a source of revenue more than any other tax. As shown above in Table 2, personal income tax revenues accounted for less than 10 percent of state tax revenues in 1960 and more than 30 percent of state tax revenues in 1996. As of 1999, seven states did not have a personal income tax on earnings. These states were Alaska, Florida, Nevada, South Dakota, Texas, Washington and Wyoming. Two states, New Hampshire and Tennessee, only tax dividend and interest income. Not only have states increased their reliance on the personal income tax, income tax revenues as a percentage of GDP increased from less than one percent of GDP in 1960 to more than three percent of GDP in 1996. Thus, the amount of personal income tax revenues received by states has also increased dramatically over the past several decades.

Personal income tax rates and income brackets for each rate vary greatly across states. Income brackets refer to a certain range of income that is taxed at a certain rate. As a simple example, a state may have two income brackets, one ranging from $0 to $25,000 and the other ranging from $25,001 and higher. The tax rate for the first bracket might be five percent and may be ten percent for the second bracket. Some states have a flat tax rate, meaning all income is taxed at the same rate.

i. *The Marginal Tax Rate*

The ***marginal tax rate (MTR)*** measures the additional tax liability for every additional dollar in income. Marginal tax rates are adjusted by state and local officials (as well as federal officials for the federal personal income tax) to influence personal income tax revenues. In fact, the dramatic increase in personal income tax revenues generated by states is a result of increases in marginal tax rates over time. Marginal tax rates are computed as:

$$MTR = \frac{\Delta Taxliability}{\Delta Taxableincome}$$

where Δ is the Greek letter Delta and means "change in." MTR is simply the change in tax liability due to a change in taxable income, or the additional tax owed for each additional dollar in taxable income. Marginal tax rates and tax brackets for a sample of state are shown in Table 3.

Table 3: Selected Marginal Personal Income Tax Rates - 1999

State	Tax Rate (%)			Income Brackets ($)	
	Lowest	Highest	# Brackets	Lowest	Highest
Georgia	1.0	6.0	6	750	7,500
Maine	2.0	8.5	4	4,150	16,500
New York	4.0	6.85	5	8,000	20,000
Utah	2.3	7.0	6	750	3,750
Wisconsin	4.77	6.77	3	7,500	15,001

Source: Federation of Tax Administrators. Income brackets in some states are different for single, married, and joint filers. The income bracket ranges presented above are for single filers.

To see how marginal tax rates and income brackets are used to compute an individual's overall tax liability, consider the following tax schedule for a hypothetical state.

Income Range	Marginal Tax Rate
$0 - $10,000	10 %
$10,001 - $50,000	15 %
$50,001 - $70,000	20 %
$70,001 +	25 %

According to the above tax schedule, the individual's first $10,000 is taxed at 10%, his next $40,000 is taxed at 15%, his next $20,000 is taxed at 20%, and any income over $70,000 is taxed at 25%. So, for his first $10,000 each additional dollar between $1 and $10,000 is taxed at 10%, each additional dollar between $10,001 and $50,000 is taxed at 15%, and so on.

Suppose an individual is earning $60,000 a year. What is his tax liability? Based on the above schedule, his first $10,000 is taxed at 10%, so his tax liability for his first $10,000 is $1,000 ($10,000 × 10%). His next $40,000 is taxed at 15%, so his tax liability for his next $40,000 in income ($50,000 - $10,000) is $6,000 ($40,000 × 15%). To this point the first $50,000 of the individual's $60,000 has been taxed. He has $10,000 remaining ($60,000 - $50,000) which is taxed at 20%. His tax liability for the remaining $10,000 would be $2,000 ($10,000 × 20%). His total tax liability is simply found by adding the tax liabilities for each income bracket: $1,000 + $6,000 + $2,000 = $9,000. So, an individual earning $60,000 a year and facing the above tax schedule would pay $9,000 in personal income taxes.

ii. *The Average Tax Rate*

The ***average tax rate (ATR)*** is simply a measure of an individual's tax liability as a percentage of his income. The ATR is computed as:

$$ATR = \frac{Taxliability}{Taxableincome} \times 100$$

For example, if an individual owes $5,000 in state personal income taxes and has a taxable income of $40,000, his ATR is 12.5% ($5,000 For example, if an individual owes $5,000 in state personal income taxes and has a taxable income of $40,000, his ATR is 12.5% ($5,000 ÷ $40,000) × 100. Having ATRs across individuals allows a comparison of which individuals are paying a higher or lower percent of their income in state personal income taxes.

iii. *Tax Incidence*

Tax incidence refers to which individuals bear the burden of a tax *after* the economy has adjusted to changes caused by the taxes. In general, incidence is concerned with the revenue burden of the tax, namely which groups of individuals are paying a larger percentage of tax revenue than other groups. An important point in tax incidence analysis is that taxes cause changes in individuals' behavior. Those individuals bearing the ultimate burden of the tax may be different than the individuals on whom the tax was initially levied. The more a group of individuals is willing to change their behavior to avoid the tax, the smaller the burden of taxation will be for those individuals. For example, if a tax is levied on a group of individuals, say buyers of gasoline, but a portion these individuals alter their behavior by consuming no gasoline (thus avoiding the tax), then the burden of taxation falls on those individuals still consuming gasoline.

Although incidence tells us which groups bear the burden of the tax, evaluating incidence in terms of good or bad or high or low is done by comparing the incidence of a tax relative to something else. The most common method of comparison is to compare the incidence of one tax to that of another tax that raises the same amount of revenues. This is called ***differential incidence***. Another method of comparison is that of ***budgetary incidence*,** which considers the incidence of a tax only after the revenue benefits of the tax (such as income transfers, educational benefits) have been considered.

a. *Regressive, Progressive and Proportional Taxes*

Once the economy has adjusted to changes in prices caused by the tax and the final tax burden is known, the burden of the tax is sometimes characterized by its impact on the income distribution. The terms regressive, progressive, and proportional are often used to define the burden of taxation on income distributions. A tax is considered ***regressive*** if the burden of taxation decreases with income, that is, higher income individuals spend a smaller percentage of their income on the tax than lower income individuals. For a ***progressive*** tax, the burden of taxation increases with income, meaning higher income individuals spend a greater percentage of their income on the tax than lower income individuals. Finally, a tax is considered ***proportional*** if the burden of taxation remains the same over all levels of income. Under a proportional tax, each income group spends an equal percentage of their income on the tax.

Although these definitions seem straightforward, there remains some uncertainty about the impact of a tax on the income distribution. The income distribution could refer to current income or to lifetime income. Depending on which definition of the income distribution one uses, the conclusions regarding regressivity, progressive, and proportionality may be different as incomes generally increase over one's lifetime. Studies by Pechman (1985) and Fullerton and Rogers (1993, chapter 1-7) compute the tax incidence in terms of the income distribution for the major taxes used in the United States. Pechman, using current income, finds that sales and excise taxes are regressive, the property tax and corporate income tax tend to be proportional or slightly progressive, and the personal income tax is progressive. The regressivity of sales and excise taxes is not surprising as lower income individuals tend to spend a higher portion of their income on consumption goods (which are the tax bases for sales and excise taxes) than wealthier individuals. The proportionality or progressivity of the other taxes are a result of political manipulation. In terms of lifetime income, the tax incidence of these taxes differs slightly. Fullerton and Rogers, using lifetime income rather than current income, find that, as does Pechman, sales and excise taxes are regressive. They also find the personal income tax to be moderately progressive. However, Fullerton and Rogers find that the corporate income tax is regressive for the lowest income individuals when considering lifetime income. They also find the property tax is regressive for the lowest income individuals, proportional for middle income individuals, and progressive for the wealthiest individuals. Clearly, although the methodologies used by both authors provide similar conclusions, determination of tax incidence does to some degree depend upon one's definition of income.

D. The Corporate Income Tax

Unlike other revenue sources, corporate income tax revenues have remained a relatively constant proportion of total state tax revenues. Only during the 1980s did corporate income tax revenue contribute to a significantly larger percentage of state tax revenues. In addition to being a relatively constant percent of total state tax revenues, corporate income tax revenues have remained a small percentage of GDP, comprising 0.4% of GDP in 1960 and 0.7% of GDP in 1996. As of 1999, six states did not have a corporate income tax. These states were Michigan, Nevada, South Dakota, Texas, Washington and Wyoming.

The corporate income tax is structured the same as the personal income tax, except the marginal tax rates are slightly higher and, of course, the income brackets are larger. Unlike the personal income tax, thirty-two states have a flat corporate income tax rate, meaning there is a single tax rate for all levels of corporate income. Although this flat rate may appear proportional, deductions and exemptions can create a progressive corporate income tax even with a constant marginal tax rate.

E. Excise Taxes

An ***excise tax*** is a tax that is levied on a specific commodity, such as alcohol, tobacco and gasoline. Excise taxes are also called selective sales taxes. Unlike general sales taxes, excise taxes on the above commodities can also be a fixed amount per unit sold rather than a percentage of the total sales price. For example, an excise tax on gasoline is, say, 30 cents a gallon, or the excise tax on cigarettes is 50 cents a pack. The vast majority of states and those local governments given a local tax option have excise taxes on alcohol, tobacco, and gasoline. In fact, most states have different tax rates for beer, liquor, and wine; cigarettes and other tobacco; and gasoline and diesel fuel. In addition, not only do a majority of states have excise taxes, many of the commodities taxed under an excise tax are also subject to the general sales tax. Excise taxes for selected states and commodities are shown in Table 4.

Table 4: Selected State Excise Tax Rates - 1999

	Beer (cents/gal.)	Wine (cents/gal.)	Liquor (cents/gal.)	Cigarettes (cents/gal.)	Gasoline (cents/gal.)	Diesel (cents/gal.)
Alabama	53	170	(a)	165	18	19
Illinois	7	23	200	58	19	22
Nebraska	23	75	300	34	25	25
Ohio	18	32	(a)	24	22	22
Washington	26	87	(a)	83	23	23

Source: Federation of Tax Administrators. Note: all values rounded to the nearest cent.
(a) Liquor sales are run through state-controlled stores. Revenues from liquor sales are obtained from stores' net profits.

Of all state tax revenues, excise tax revenues have been a decreasing percentage of total state tax revenues. Furthermore, the amount of excise tax revenues collected has fallen from 1.6% of GDP in 1960 to less than 1% of GDP in 1996. This decrease in state excise tax revenues is because excise taxes are not linked to inflation. One way to increase excise tax revenues is to increase the excise tax rate. However, as prices continually rise this would require an unending increase in excise tax rates or a broadening of the tax base. Clearly, constant increases in excise tax rates would be quite unpopular with the public, thus explaining why state and local officials do not continually increase excise tax rates. As a result, states have decreased their reliance on excise tax revenues and moved to other available revenue sources, such as the sales tax, personal income tax, and corporate income tax.

F. Property Taxes

The property tax is the predominant source of revenues for local governments. In 1996, nearly three-quarters of local government revenue came from property taxes, whereas the property tax only accounted for two percent of total state tax revenues. Property taxes are usually paid annually, although quarterly and monthly payments are also common. Local governments tax residential property, commercial property, and agricultural property. Not only are the property tax rates on these properties different, tax rates across cities and counties are different.

i. *Computing the Property Tax*

Unlike sales and income taxes, computation of the property tax liability is much more difficult. Although the computation of property taxes can differ across states, most states follow a common model. Property tax rates are based on the appraised market value of one's property, the assessment rate, and the mill levy. The first step in property tax collection requires an appraisal of one's property. This property appraisal is done by a city or county official and is an appraisal of the market value of one's property. Local governments then have an assessment rate which is used to determine what percentage of the property's appraised value is taxed. The percentage of the property's appraised value is termed the ***assessment value***, which is simply the appraised value times the assessment rate. Once the assessment value is determined, the final tax owed is determined by the mill levy. One ***mill*** is equal to 1/1000 of assessed value. The final property tax owed is computed by multiplying each $1,000 in assessed value by the mill levy. Mill levies vary by city and county, but a range of 90 to 150 mills ($90 to $150 in tax for every $1,000 in assessed value) is common. Officials can increase property tax revenues by increasing the assessment rate, the mill levy, or both.

To understand how property taxes are computed, consider the following example for a homeowner whose home is appraised at $150,000:

Appraised Value of Property:	$150,000
Assessment Rate (set by local government):	10%
Assessed Property Value:	$15,000 ($150,000 × 10%)
Mill Levy (set by local government):	120 mills
Property Tax Owed:	$1,800 ($15,000 ÷ $1,000) × 120

ii. *Advantages and Disadvantages of the Property Tax*

As all property owners are subject to the property tax and the tax is the predominant source of local government revenues, plans to change property tax rates are usually met with much public debate and local media attention. Although debate surrounding the property tax involves the mill levy and the assessment rate, the property tax has one main advantage and one main disadvantage that are frequently raised during property tax debates. The main advantage of the property tax is that it provides a much more stable source of revenue over other taxes. Revenue stability is important as state and local governments rely on tax revenues to fund goods and services. Revenues from personal income taxes, corporate income taxes, and sales taxes move with economic conditions. In recessionary periods, individuals consume less goods, thus reducing sales tax revenues. Also, because individuals are consuming less, corporate and personal incomes fall which reduces personal and corporate income tax revenues. In turn, tax revenues from these sources rise during an economic expansion. Unlike consumption and income, property tax revenues are immune to short-run changes in economic conditions because assessed values are not impacted by economic changes. As local governments rely on property tax revenues much more than state governments, local governments have a more stable revenue source than state governments.

The primary disadvantage of the property tax is the unequal treatment of individuals in terms of market value. All property is not appraised annually due to the massive administrative costs that would be involved. The problem of market value and unequal treatment comes into play when, for example, one individual's home is appraised at a higher value but another individual's home, while having the same true market value, is not appraised. Therefore, although the true market value of both homes may be the same, the individual whose home was appraised at a higher value will pay higher property taxes. This problem also occurs frequently during the selling of a home which requires a current property value appraisal. If two homes were both appraised at $100,000 three years ago, and one homeowner decides to sell his house which is now appraised at $115,000, the new homeowner will pay higher property taxes than the person whose home is still appraised at $100,000, even though the appraisal value for this home should now be $115,000.

G. Other Revenue Sources - Intergovernmental Revenues, User Fees and State Lotteries

Besides the five major tax sources discussed above, state and local governments receive revenues from other sources as well. One important source of total state and local revenues is the contribution of funds from the federal government. Funds exchanged between levels of government, usually from the federal government to state governments or from state governments to local government, are called ***intergovernmental revenues***. In 1996, nearly 20 percent of total state revenues consisted of intergovernmental revenues from the federal government.

User fees are another source of state and local government revenues. ***User fees*** are payments for the use of a publicly provided service, such as state parks, sewage and water services and toll roads. Tax dollars are used for the fixed start-up costs, such as road paving, building construction, etc. However, user fees are then used to cover the variable costs of operation once projects are completed. In some instances revenues from user fees may exceed the variable costs of operation and may serve as a source of general fund revenue for state governments.

An additional revenue source for state governments in recent years has been state lotteries (see Clotfelter and Cook, 1989; Borg, Mason and Shapiro, 1991). Since New Hampshire introduced the first state-operated lottery in 1964, thirty-seven states and the District of Columbia were operating a lottery as of 2000. In most states, lottery adoption occurs through a public referendum (see Hersch and McDougall, 1989; Garrett, 1999). In 1997, lottery sales in the United States topped $35 billion, or roughly $120 per capita. For each lottery ticket purchased, a portion of the purchase price (usually a one-dollar purchase price) is used to cover prize payouts, administrative costs, and retailer commissions. After covering all expenses, the portion remaining with the state is termed net lottery revenue. Net lottery revenues are roughly 30 percent of total lottery sales, totaling about $12 billion in 1997. Net lottery revenues are used to fund various social programs within a state. In Pennsylvania, net lottery revenues are allocated to senior citizen care, whereas West Virginia divides its net lottery revenues between tourism and education. Other states like Ohio, Illinois and Florida allocate 100 percent of their net lottery revenues to education. Historically, net lottery revenues account for only about three percent of total state revenues. However, increasing fiscal pressures and a growing public opposition to increasing tax rates have made lotteries a more popular avenue for generating revenues in recent years.

H. Conclusion

This section discussed trends in state and local government revenue and the various taxes used by state and local governments to raise revenues. The section began by providing evidence on state and local government revenue collections, sources of revenues from various taxes, and state and local governments' changing reliance on various taxes. Time was spent discussing revenue issues involving electronic commerce and cross-border shopping. The remainder of the section focused on the five main taxes used by state and local governments to raise revenues, as well as a discussion on tax incidence. The following section of the chapter deals with principles of tax analysis and discusses several important issues state and local officials should use when evaluating a tax. Two popular models for optimal taxation are also presented in the next section.

III. Principles of Tax Analysis

State and local governments use a variety of taxes to raise revenues. State governments favor sales taxes, excise taxes and personal income taxes, whereas local governments predominately rely on property taxes. On the surface it appears that raising revenues is a fairly benign process - state and local government officials simply adopt a tax or change an existing rate and the required revenues are obtained. What is missed in this simple process are the impacts tax adoption and changes have on individuals, markets and other government revenues. Effective tax policy requires understanding the basic economics of taxation. This chapter explores the basic principles of tax analysis.

The first section discusses the distributional effects of taxation, focusing primarily on evaluating the burden of taxation on selected groups of individuals. Efficiency concerns are presented next, with a look at the efficiency costs of taxation and the efficiency-equity trade-off. The final section introduces two models of taxation, the Ramsey Rule and the Laffer curve. While both models focus on revenue generation, each model makes different assumptions regarding the motives and goals of governments in raising revenues. Full understanding of this chapter requires some knowledge of microeconomics, calculus and econometrics. The calculus portions can be skipped, however, without a loss of understanding the basic theoretical ideas.

A. Distributional Effects of Taxation - Tax Incidence

Tax incidence is concerned with which groups of individuals are paying a larger percentage of tax revenue than other groups. An important point in tax incidence analysis is that taxes cause changes in individuals' behavior. Those individuals bearing the ultimate burden of the tax may be different than the individuals on whom the tax was initially levied. The more a group of individuals is willing to change their behavior to avoid the tax, the smaller the burden of taxation will be for those individuals.

i. *Single-Market Analysis of Tax Incidence*

Evaluating tax incidence is most commonly done using a competitive, single-market framework. Although the impacts of taxation on other markets is ignored here for simplicity, the reader should be aware that changes in one market always have impacts on other markets. Single-market analysis is termed ***partial equilibrium analysis***.

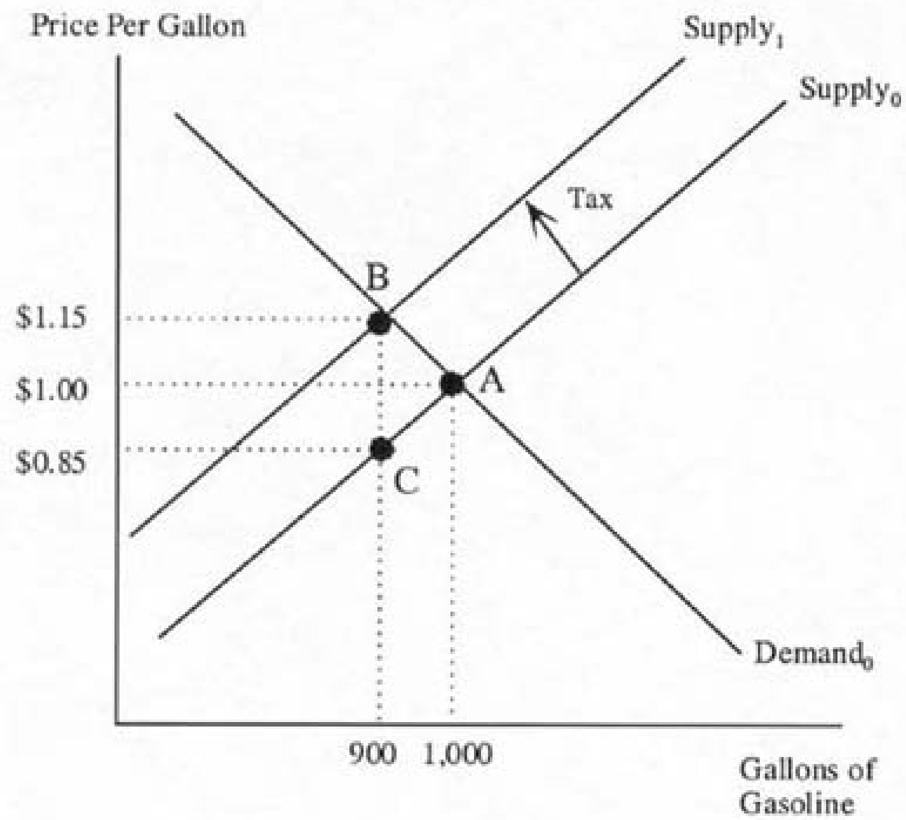
a. *A Unit Tax on Buyers and Sellers*

Suppose that before the imposition of a tax the gasoline market is in equilibrium and the equilibrium price per gallon is $1.00 and the equilibrium quantity is 1,000 gallons. As will be shown, the economic impact of a tax is the same regardless of whether the tax is levied on buyers or sellers. However, first consider the situation where a tax of $0.30 per gallon is levied on sellers of gasoline. This scenario is shown in Figure 1a.

Initial market equilibrium is shown by point A at the intersection of $Demand_0$ and $Supply_0$. Imposing a tax on sellers of gasoline causes the supply curve for gasoline to decrease by the amount of the tax. The new supply curve is $Supply_1$, with the distance between $Supply_0$ and $Supply_1$ equal to the amount of tax. With the tax in place, consumers are now paying $1.15 per gallon, an increase of $0.15 per gallon before the tax. Sellers now receive $1.15 per gallon, shown by the intersection of $Demand_0$ and $Supply_1$ at point B. However, sellers are responsible for paying the tax, so the $1.15 received by sellers is the tax *inclusive* price. As shown by point C, sellers receive only $0.85 per gallon of gasoline after paying the tax. Note that the imposition of the gasoline tax has reduced the quantity of gasoline bought and sold from 1,000 gallons to 900 gallons.

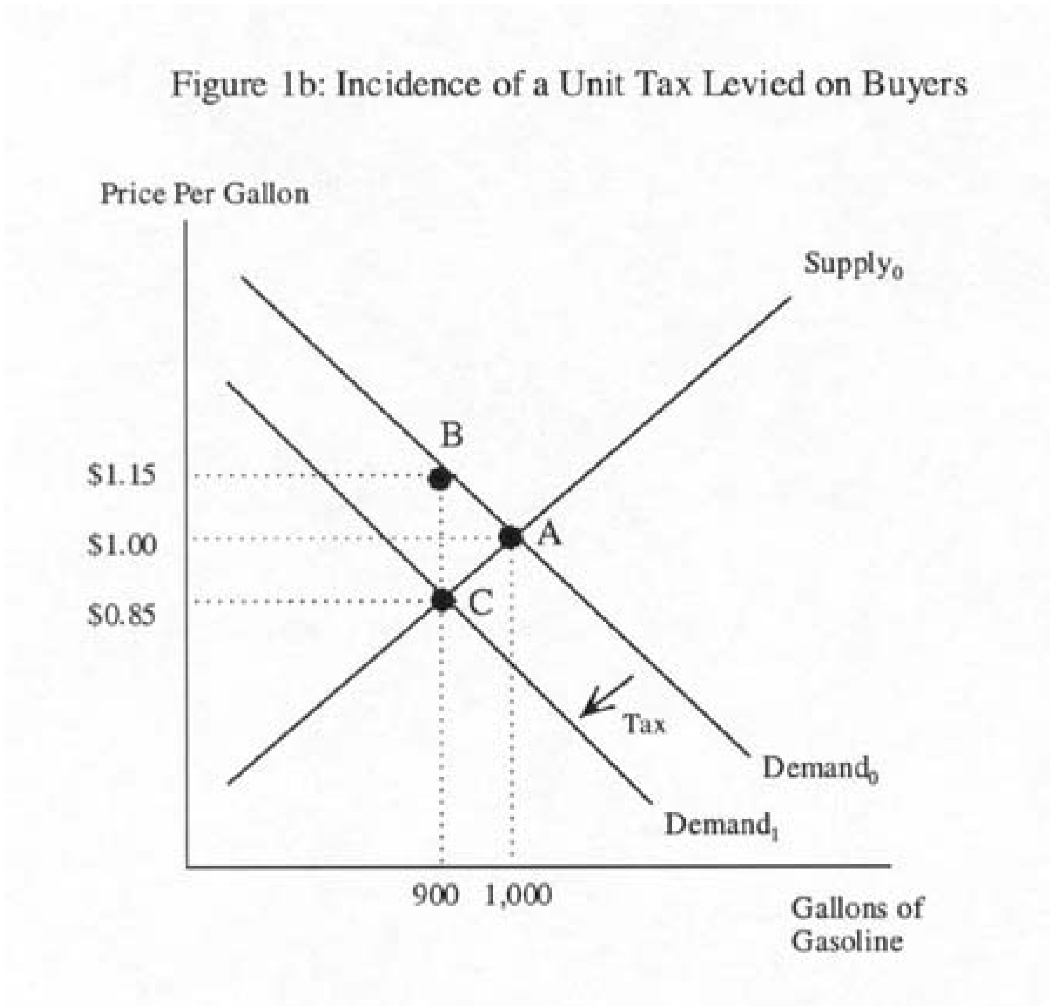
The revenue burden of consumers and sellers is determined by the rectangular areas shown in Figure 1a. Consumers' share of tax revenue is $135, computed from the area of the top rectangle. Similarly, sellers' share of tax revenue is also $135, computed from the area of the bottom rectangle. Total tax revenues collected equal $270, which is the sum of the consumers' share and sellers' share. In this example both consumers and sellers bear the same revenue burden.

Figure 1a: Incidence of a Unit Tax Levied on Sellers



Before proceeding, it is important to note that the above burden on sellers is really a burden on individuals rather than a physical business entity. A burden on sellers may result in lower profits, lower employee wages, etc. So although we say the burden of taxation falls on 'sellers,' the reader should realize that the burden really falls on all individuals associated with the taxed business.

The economic impact of the tax is the same regardless of which group is initially taxed. Consider Figure 1b which shows the economic impact of a $0.30 gasoline tax now levied on buyers rather than sellers. Again, the initial equilibrium price of $1.00 per gallon and equilibrium quantity of 1,000 gallons is shown by point A, the intersection of $Demand_0$ and $Supply_0$. Imposing a $0.30 tax on buyers of gasoline decreases the demand for gasoline by the amount of the tax, shown by the new demand curve $Demand_1$. As a result of the tax, sellers now receive $0.85 per gallon, shown by the intersection of $Demand_1$ and $Supply_0$ at point C. Consumers also pay $0.85 per gallon, but this is the tax exclusive price. With the $0.30 tax, consumers ultimately pay $1.15 per gallon ($0.85 plus $0.30 tax). In this case, sellers receive $0.85 per gallon, the same as they received net-of-tax when the tax was levied on sellers. Consumers also pay $0.85 per gallon, but this is net-of-tax. With the tax levied on consumers, consumers must pay $1.15 per gallon, the same price paid when the tax was levied on sellers.



The revenue burden for consumers and suppliers is the same as before. Both consumers and sellers each face a burden of $135, with the total burden again equal to $270. The results from both examples highlight an important aspect of tax incidence - in a competitive market, a unit tax levied on sellers has the same market effects as a unit tax levied on buyers. Thus, the revenue burdens of buyers and sellers will be the same regardless of whom the tax is initially levied upon.

b. *A General Rule of Tax Incidence*

An important point regarding tax incidence is that *those individuals less likely to change their behavior will ultimately bear a greater burden of the tax.* The price elasticity characterizes willingness to change behavior.

Figures 2a and 2b illustrate the importance of price elasticity and tax incidence. In Figures 2a, the price elasticity of supply is less than the price elasticity of demand. This is determined by examining the slope of the supply and demand curves - a change in price has a smaller impact on the quantity supplied than it does on the quantity demanded. Using the previous example of a $0.30 gasoline tax levied on suppliers, the imposition of a $0.30 tax per gallon on suppliers results in a final price to consumers of $1.05 and a net-of-tax price received by sellers of $0.75. The quantity of gasoline supplied again falls to 900 gallons. The revenue burden to consumers is now $45 (area of top rectangle), whereas the revenue burden on suppliers is $225 (area of bottom rectangle). Notice that the overall revenue burden is still $270. Because suppliers change their behavior less than consumers, suppliers bear a larger portion of the final tax burden.

Figure 2a: Incidence of a Unit Tax - Inelastic Supply

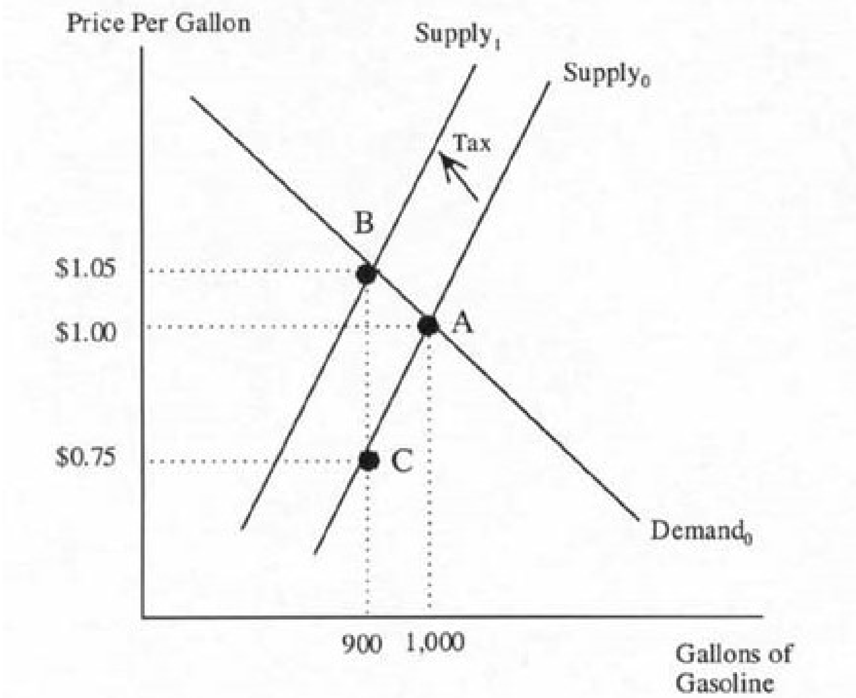


Figure 2b: Incidence of a Unit Tax - Inelastic Demand

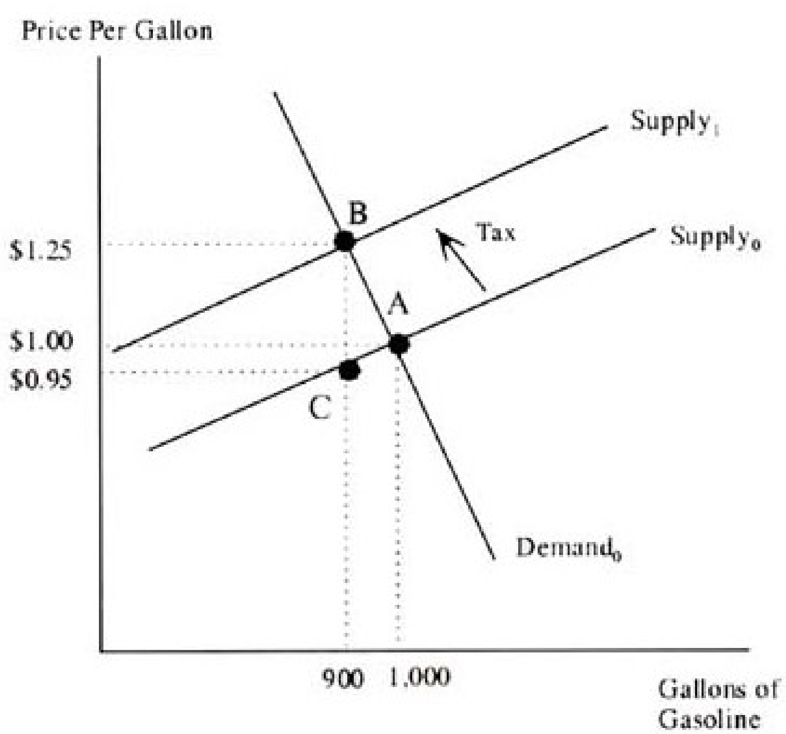


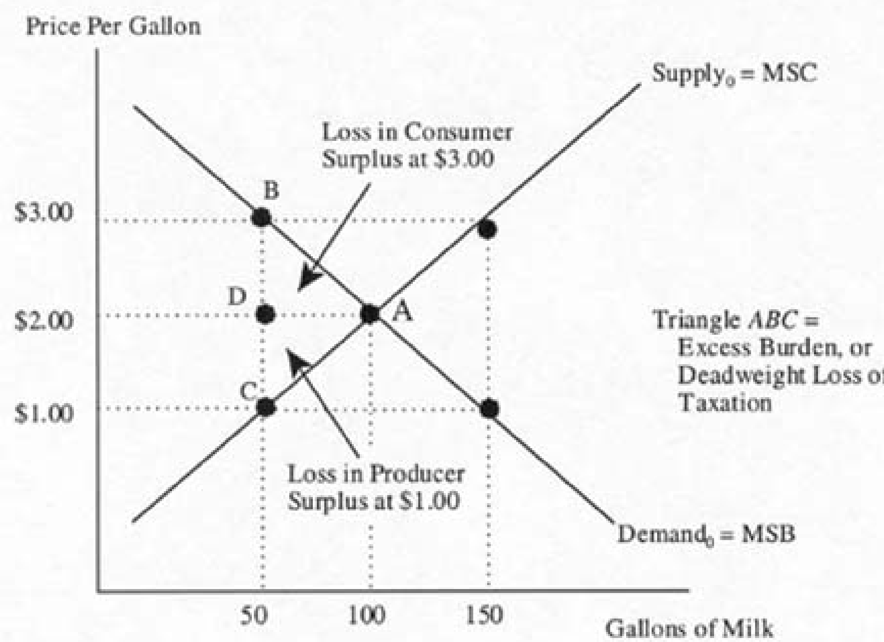
Figure 2b considers the case where demand is more inelastic than supply. That is, consumers are less responsive to changes in price than suppliers. The result of a $0.30 tax levied on suppliers reduces the initial supply, resulting in a price to consumers of $1.25. Sellers also receive $1.25, but this is the tax inclusive price. The net-of-tax price received by sellers is now $0.95. The revenue burden to consumers is now $225 and the burden on suppliers is only $45, with the overall revenue burden again remaining the same at $270. Because demand is less responsive to price changes than is supply, consumers will bear a greater portion of the overall tax burden.

The final revenue burden will primarily fall on those individuals less likely to change their behavior in the presence of a price increase. In other words, the group of individuals having a smaller price elasticity of demand or supply will bear the greater burden of taxation.

B. Efficiency

Recall from microeconomics that competitive markets result in an efficient allocation of resources. ***Efficiency*** is said to occur when 1) the marginal social benefits of consuming a good are equal to or are greater than the marginal social costs of producing that good, or similarly 2) any additional consumption or production of a good is not possible without making another party worse off. A graphical depiction of efficiency in the market for milk is shown in Figure 3.

Figure 3: Market Efficiency



The supply curve for a commodity can be equated to the marginal social costs (MSC) of production - it reveals the additional costs for producing additional gallons of milk. As we are considering a competitive market, the price a seller receives is equal to the marginal costs of production. As we are also assuming no spill-over costs to other parties, the marginal cost of production is equal to the marginal social costs of production. Similarly, the demand curve reveals the marginal social benefits of consumption (MSB), or the additional benefits received from consuming additional units of a commodity, with the price reflecting consumers' willingness to pay for additional units of the commodity. Marginal benefits of consumption decrease due to decreasing marginal utility of consumption.

The equilibrium price for a gallon of milk is $2.00 and the equilibrium quantity is 100 gallons. This is an efficient outcome because $MSB = MSC$. Any further production over 100 gallons would create a situation where $MSC > MSB$, suggesting that society should decrease milk production Similarly, any production less than 100 would create a situation where $MSB > MSC$, suggesting that milk production should be increased. Notice that any other price besides $2.00 is not sustainable in a competitive market. At $3.00 a gallon, quantity supplied (150) exceeds quantity demanded (50), and $MSB > MSC$. This excess supply puts downward pressure on prices. Likewise, at only $1.00 a gallon, quantity demanded (150) exceeds quantity supplied (50) and again $MSB > MSC$. Excess demand puts upward pressure on prices. Only at $2.00 is the market in equilibrium, and at this equilibrium the market produces an efficient outcome.

Tax policy often creates market inefficiencies because the tax inclusive price is fixed above the equilibrium price. For example, suppose that in Figure 3 a $1.00 a gallon tax is levied on milk, raising the total price to $3.00 and decreasing the quantity of milk to 50 gallons. With the tax, $MSB > MSC$. Although society would be better off with increased milk production, the tax prevents this increase in production from occurring. Both consumers and suppliers are harmed by the tax. The loss to consumers is represented by triangle ABD, which shows the loss in ***consumer surplus*** - the benefits to society from consumption. Without the tax, the consumer surplus would be the area under the demand curve above the price of $2.00. With the tax, however, consumers lose ABD in consumption. Similarly, the loss to producers is represented by a loss in ***producer surplus***, or the benefits to producers from increased production. Producer surplus in the absence of the tax would be the area below the price of $2.00 and above the supply curve. The loss in producer surplus resulting from the tax is area ACD. The total loss to society is the sum of consumer losses and producer losses and is termed the ***excess burden of taxation***, or ***deadweight loss of taxation***.

The reader should see the relationship between efficiency and tax incidence. If a tax does not force individuals to change their behavior, then no efficiency cost is created. The tax incidence simply falls on those individuals directly taxed. However, if the tax does force individuals to alter their behavior then an efficiency cost is created and determining tax incidence is more difficult as consumers and sellers change their behavior to avoid the tax.

Although the above analysis has demonstrated the inefficiencies caused by taxation, the imposition of a tax may actually restore market efficiency in some cases. This predominately occurs in the case of ***externalities***, which are negative (or sometimes positive) unintended spill-over effects to third parties. In essence, the producers of a negative externality, such as a steel producer emitting pollution from its factory, do not consider the external costs of steel production (the pollution) when determining its production decisions. As a result, the market provides an amount of steel production that is greater than the efficient amount because the external costs of steel production are not considered. A tax levied on steel producers that is equivalent to the external costs of steel production (pollution) will decrease the supply curve for steel producers and restore efficiency conditions at $MSB = MSC$. In the case of a market failure, such as a negative externality, governments can use taxes to restore market efficiency.

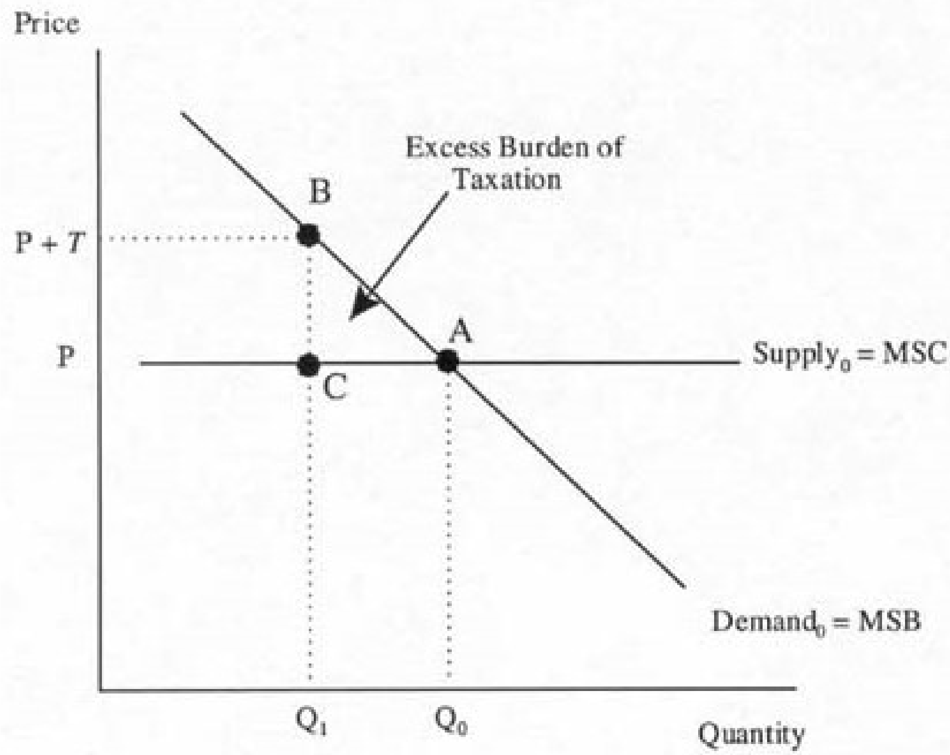
i. *Computing The Efficiency Loss From a Tax*

This section derives the expressions for computing the efficiency loss in a single-market due to the imposition of a unit tax and an ad valorem tax. Efficiency loss was shown graphically in Figure 3. The analysis here makes two assumptions. The first assumption is that of a linear demand curve. Second, a horizontal supply curve is assumed, meaning any amount of the product can be supplied at the market price, but that none will be supplied if the price falls below the equilibrium price (perfectly elastic supply). The analysis becomes more complicated with an upward sloping supply curve.

a. *Efficiency Loss From A Unit Tax*

First consider the imposition of a unit tax, T, such as an excise tax on gasoline, shown in Figure 4. At point A, $MSB = MSC$. With the tax, however, the new price is $P + T$ and now $MSB > MSC$. The deadweight loss of taxation is represented by area ABC. A general expression for the deadweight loss of taxation, or excess burden (EB), is outlined below.

Figure 4: Efficiency Loss From a Unit Tax



The excess burden is triangle ABC. The area of any triangle is found by finding $1/2 \cdot base \cdot height$. The base of the triangle is the change in quantity demanded, or dQ. Similarly, the height of the triangle is the change in price, or dP. Thus,

$$EB = 1/2 \cdot base \cdot height = 1/2 \cdot dQ \cdot dP$$

The change in price is simply the tax, T (from $P + T - P$). An expression for dQ can be obtained from the formula for the price elasticity of demand, $\in$:

$$\in = \frac{dQ}{dP} \cdot \frac{P}{Q}$$

Solving the price elasticity of demand expression for dQ gives:

$$dQ = \frac{\in \cdot dP \cdot Q}{P}$$

Plugging the expressions for dP and dQ into the formula for EB and rearranging terms yields the following expression for excess burden:

$$EB = \frac{1}{2} \cdot \frac{T^2 \cdot \in \cdot Q}{P}$$

The excess burden of taxation is dependent upon the price elasticity of demand and the tax rate. The reader should note, however, the expression above suggests that the excess burden of taxation is zero if the price elasticity of demand is zero. This is an artifact of the single-market analysis done here. In reality, even if the price elasticity of demand for the taxed commodity is zero, there will still be an impact on other markets as consumers change their consumption of other commodities.

b. ***Efficiency Loss From an Ad Valorem Tax***

Deriving the expression for the efficiency loss from an ad valorem tax, t, is almost identical to that of a unit tax. The only difference is in the expression for dP. Under an ad valorem tax, dP equals $P \bullet t$ rather than just T under a unit tax. With an ad valorem tax, the tax-inclusive price is $P(1+t)$, so $dP = P(1+t) - P = Pt$.

With a new expression for dP and the same expression for dQ as under a unit tax, the expression for the excess burden of an ad valorem tax is:

$$EB = \frac{1}{2} \bullet t^2 \bullet \in \bullet Q \bullet P$$

ii. ***The Efficiency/Equity Tradeoff***

The above sections have shown that the imposition of tax generally creates market inefficiencies. It is important to realize, however, that there exists an efficiency/equity tradeoff when evaluating taxes. Although most taxes create inefficiencies, tax revenues are used in the production of social goods, such as education and public welfare. The main idea behind these programs is to create a more 'equitable' society in terms of providing all individuals a subsistence level of education and income. It should be clear as to why the efficiency/equity tradeoff exists. Without taxes, markets would function more efficiently. Production levels would be higher, consumers would have more goods available to them, prices would be lower and mean incomes would be higher, although there would be a greater variance in incomes across individuals. With greater efficiency there will exist greater societal inequality because there are no revenues to be allocated from one portion of society to another. If we are concerned with equity, however, the distribution of tax revenue will result in a more equitable distribution of income (a lower variance) across individuals, but the inefficiencies created will cause relatively higher prices, lower mean incomes, and a lower availability of goods. Whether we should have a more equitable or more efficient society is a matter of opinion and is frequently a topic of political debate.

C. Two Models of Optimal Taxation

This portion of section III presents two famous models of optimal taxation. The first model considered is the Ramsey Rule. This model assumes that governments attempt to minimize the excess burden (efficiency loss) of taxation subject to given revenue requirements. The 'optimal' tax rate under the Ramsey rule is the rate that minimizes the excess burden of taxation while still generating the required revenues.

The Laffer curve is the second model of taxation presented. This model assumes that governments will attempt to generate as much revenue as possible without any regard to the efficiency losses caused by taxation. Only constitutional constraints and other legislation can limit the government's desire for increased revenue. This view of government has been coined the "Leviathan" model of government (see Brennan and Buchanan, 1977). The Laffer curve considers the inverse relationship between tax rates and tax bases and the impact of this relationship on tax revenues. The analysis reveals that a higher tax rate is not always the maximizing rate - a lower tax rate may actually raise more tax revenues than a higher tax rate.

i. ***The Ramsey Rule***

The previous sections have shown that while taxes do generate revenue benefits, taxes also create an excess burden on society. Obviously policy makers are confronted with an assumed trade-off - they need to generate a given amount of revenue, but generating this revenue will impose an additional cost on society. Within this framework, the problem for policy makers is to find tax rates that satisfy their revenue constraints but also minimize the deadweight loss to society. The following model of optimal taxation derives an expression for the 'optimal' commodity tax, optimal in terms of generating the required revenue while at the same time minimizing the deadweight loss to society. The model, termed the Ramsey Rule, produces the conditions set forth by (Ramsey, 1927), who argued that the excess burden of taxation will be minimized by setting the ratio of tax rates inversely proportional to price elasticities of demand for both products.

Suppose there are two goods X and Y. Assume that policy makers wish to levy ad valorem taxes on both goods and the supply curves for both goods are perfectly elastic (horizontal). While these taxes will generate revenues, they will also create a loss to society. The problem for the policy maker then becomes selecting tax rates that minimize the excess burden given certain revenue constraints. This problem can be expressed as:

$$\min\{EB_X + EB_Y\} \text{ subject to } R = t_X \bullet P_X \bullet X + t_Y \bullet P_Y \bullet Y$$

where EB_X and EB_Y are the excess burdens from taxing good X and from taxing good Y, each equal to the expression of the excess burden under an ad valorem tax shown in the previous section. R is the revenue raised from goods X and Y, $t_X \bullet P_X \bullet X$ is the revenue raised from good X (where X is the quantity of good X), and $t_Y \bullet P_Y \bullet Y$ is the revenue raised from good Y (where Y is the quantity of good Y). The Lagrangian for the above problem is:

$$\min_{t_X t_Y} L = \frac{1}{2} \bullet t_Y^2 \bullet \in_Y \bullet Y \bullet P_Y + \lambda \Big[R - t_X \bullet P_X \bullet X - t_Y \bullet P_Y \bullet Y \Big]$$

Taking first-order conditions yields:

$$\frac{\delta L}{\delta t_X} = t_X \bullet \in_X \bullet X \bullet P_X - \lambda \bullet P_X \bullet X = 0 \tag{1}$$

$$\frac{\delta L}{\delta t_Y} = t_Y \bullet \in_Y \bullet Y \bullet P_Y - \lambda \bullet P_Y \bullet Y = 0 \tag{2}$$

From (1), $\lambda = \in_X \bullet t_X$. From (2), $\lambda = \in_Y \bullet t_Y$

Equating λ's provides $\in \bullet t_X = \in_Y \bullet t_Y$

Rearranging terms yields the conditions for optimal commodity taxation:

$$\frac{t_X}{t_Y} = \frac{\in_Y}{\in_X}$$

Taxes on goods X and Y should be levied so that the ratio of tax rates is equal to the inverse ratio of the price elasticities of demand for both goods. If the above conditions are satisfied, the excess burden of taxation will be minimized and the revenue constraints will be met.

Although insightful, the Ramsey Rule has some limitations. The above model assumes there are only two commodities in the economy, a rather unrealistic assumption. The analysis also becomes more complicated if the assumption of a perfectly elastic supply curve is dropped. In this case, the expressions for the excess burden will include a term for the price elasticity of supply. Furthermore, satisfying the above rule assumes knowledge of the price elasticities of demand for both commodities. Finally, the above model assumes that policy makers actually care about minimizing the deadweight loss to society when levying taxes. Much of the literature in the field of public choice casts doubt on this assumption, arguing that government officials attempt to generate as much revenue as possible to further their political agendas without any regard for the efficiency costs created by taxation.

Despite several drawbacks, the model presented above illustrates the problem of optimal commodity taxation. It nicely incorporates the concepts of efficiency and highlights the efficiency/equity tradeoff discussed in the previous section. As an exercise, the reader may wish to perform the above analysis for a per unit tax rather than an ad valorem tax. This requires the assumption that both a unit tax and an ad valorem tax will generate the same amount of revenues, or $T = t \bullet P$, where T is the per unit tax rate and t is the ad valorem tax rate. Working through the above problem using per unit taxes should provide the reader the same final expression for the optimal tax rates.

ii. *Tax Rates, Tax Bases and Tax Revenues - The Laffer Curve*

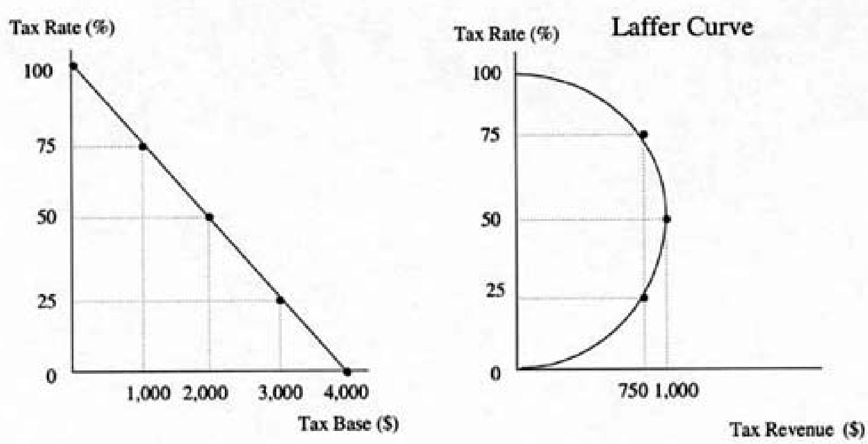
Basic microeconomic theory suggests that an increase in price reduces the quantity of the product consumed because consumers substitute from the higher priced good to a lower priced good. Imposing a tax or increasing a tax rate leads to a reduction in consumption as consumers substitute away from the now higher price good. A detailed analysis of this behavior change was presented earlier in this section. The important issue addressed here, however, is the impact this substitution away from the taxed product has on tax revenues.

Recall that the ***tax base*** is the activity being taxed - retail sales is the tax base for the sales tax, income is the tax base for the personal income tax, etc. There is a negative relationship between tax rates and tax bases. For example, consider yourself and the personal income tax. If the personal income tax rate was zero, you would work a given number of hours a week, say 45 hours. As the tax rate increases (approaching 100 percent) you will slowly work fewer hours, substituting leisure for work. This substitution will continue as tax rates are continually increased until some point where you would choose not to work at all. At this point you will have completely substituted leisure for work. In this extreme case there is no longer a wage income tax base.

This substitution away from the taxed activity directly impacts tax revenues. Tax revenues are equal to the tax rate multiplied by the tax base, or $R = t \cdot B$, where R = revenues, t = the tax rate, and B = the tax base. So, if the personal income tax rate is 10 percent and personal income is \$100,000, personal income tax revenues are \$10,000. Recalling the inverse relationship between tax rates and tax bases and using the above revenue formula, the reader should see that the revenue impact of a tax change depends upon the magnitude of the change in t or B. Suppose tax rates are increased. Holding the tax base constant, the rate increase should increase revenues. But the tax base is not constant, and will in fact become smaller under the tax rate increase. Thus, t rises but B falls. The final impact on revenues is not clear. If t rises more than B falls revenues will increase, whereas if t rises less than B falls revenues will fall. An equal change in t and B will keep revenues constant.

What the above example shows is that tax revenues are impacted by changes in the tax rate and the tax base. The economist Arthur Laffer suggested that beyond some tax rate, higher tax rates will shrink the tax base so much that revenues will actually decline. The Laffer curve shows the relationship between tax rates and tax bases and their impact on revenues. The derivation of a hypothetical Laffer curve is shown in Figure 5.

Figure 5: Derivation of the Laffer Curve



The left-hand side figure shows the inverse relationship between tax rates and tax bases. A Laffer curve is constructed using the relationship between tax rates and tax bases and the above revenue formula. At a tax rate of zero revenues will be zero. As the tax rate initially increases, revenues increase because the initial increase in the tax rate does not cause a greater substitution away from the taxed activity. However, as the tax rate continues to increase, more individuals will substitute away from the taxed activity until at some point, represented by point B in Figure 5, tax revenues actually begin to fall. The process also works in reverse. At very high tax rates, revenues will be relatively low. As the tax rate falls, more people substitute into the taxed activity, increasing the tax base. Beyond a certain point, however, the decrease in the tax rate will be greater than the increasing tax base and revenues will fall.

The Laffer curve relationship gained much popularity in the 1980s under Ronald Reagan. His reduction in marginal federal income tax rates from 70 percent to 33 percent was criticized as being a gift to the rich at the expense of the poor. However, according to data from the IRS, tax revenues from the top 1 percent of income earners actually increased by over 50 percent between 1980 and 1990. Although tax rates were reduced, the rich as a group actually paid *more* in taxes under the 33 percent rate than under the 70 percent rate because the tax reduction caused a massive increase in work and investment.

What Figure 5 and the above discussion suggest is that there is a revenue maximizing tax rate, and because of the inverse relationship between tax rates and tax bases, generating additional revenues may not always be obtained by simply increasing tax rates. A continual increase in tax rates by state and local officials may not guarantee an increase in tax revenues - beyond some point tax rate revenues will actually begin to fall. Thus, within the context of the Leviathan view of government, although governments will attempt to generate as much revenue as possible, additional revenue is not always had by a simple increase in the tax rate.

a. *Empirical Estimation of the Optimal Tax Rate Using the Laffer Curve*

State and local officials should understand the relationship between tax rates, tax bases and tax revenues when conducting tax policy. However, just an understanding of the Laffer curve may not be adequate for tax policy. Ghaus (1995) finds that a well-defined sales tax Laffer curve does exist at the local level, and that the optimal sales tax rate is dependent upon the property tax rate, housing preferences, the wage rate, and income. Actually estimating a Laffer curve and finding the optimal tax rate (optimal in terms of revenue maximization) will provide state and local officials evidence about whether an increase or decrease in rates will cause revenue to rise or fall.

As a foundation for empirically estimating a Laffer curve, consider the following mathematical derivation for a Laffer curve:

Tax revenues, R, are equal to the tax rate, t, times the base, B, or

$$R = t \bullet B \tag{1}$$

The inverse relationship (assumed linear) between tax rates and tax bases can be expressed as:

$$B = \alpha - \gamma t \tag{2}$$

Substituting (2) into (1) provides:

$$R = t \bullet (\alpha - \gamma t) = \alpha \bullet t - \gamma t^2 \tag{3}$$

As the assumed goal of governments is to maximize revenues, differentiating (3) with respect to t gives the following first-order condition:

$$\frac{\delta R}{\delta t} = \alpha - 2 \bullet \gamma t = 0 \tag{4}$$

Note that the second derivative of (4), $-2 \bullet \gamma$, is < 0, confirming that the optimal is indeed a maximum. Solving (4) for the optimal tax rate, t^*, results in the following expression:

$$t^* = \frac{\alpha}{2 \bullet \gamma} \tag{5}$$

Empirical estimation of a Laffer curve is based on the revenue equation (3). Specified as a linear regression model, equation (3) for a single tax becomes:

$$Revenue_i = \delta + \alpha \ taxrate_i + \gamma taxrate_i^2$$

The subscript i denotes the units of observation, such as individual counties or states. A regression of tax revenues on the tax rate and the tax rate squared will provide estimates for the coefficients α and γ (an overall constant term, δ, should also be included in the model). Using these estimates, the optimal tax rate can be computed by using (5).

There are some assumptions inherent in the above methodology, however. First, equation (3) assumes only tax rates impact tax revenues - no other explanatory variables are included in the model (see Ghaus, 1995). Omitting relevant variables can result in biased and inconsistent estimates for and . Second, the regression results from (3) assume that the optimal tax rate is the same over all units of observation. So for an analysis of say, 50 counties, only one optimal tax rate for all counties can be computed. To allow optimal tax rates to differ across units of observation, additional independent variables such as socioeconomic or government characteristics need to be interacted with the tax rate and included in equation (3). This will provide a more complicated expression for t^*, but t^* will now vary across units of observation. Third, the above regression model assumes a cross-sectional analysis, that is, data across units of observation for a single time period. It is also possible to have time series data on tax revenues and tax rates for a single city, county or state. Empirical estimation is the same, except now the appropriate subscript would be a t, denoting each time period. The optimal tax computed from a time series model would provide a single optimal rate for all time periods included in the analysis.

The Laffer curve framework for finding the optimal tax assumes that the goal of governments is to maximize revenues with no concern about the societal costs of taxation. Under the Ramsey Rule, the optimal tax was found under the assumption that governments try to minimize the deadweight loss of taxation subject to a revenue constraint. Clearly, the optimal tax for both models may not be the same given the underlying assumptions of each model.

D. Conclusion

This section provided an introduction to the principles of tax analysis. Tax incidence was first addressed, with an emphasis on determining the revenue burden of taxation. The key point regarding tax incidence is that individuals who are less likely to alter their behavior to avoid the tax will bear a higher burden of the tax. So although a tax may be initially levied on one group, if members of this group change their behavior to avoid the tax, the final incidence of the tax will fall on other groups. After discussing tax incidence, the inefficiencies created by taxation were discussed. This portion of the section began by first providing an overview of efficiency and then provided graphical and mathematical derivations for the excess burden, or deadweight loss, of taxation. The next issue addressed was the efficiency/equity tradeoff of taxation. Here, time was spent addressing the tradeoff between efficient markets and a more equitable society. The final sections presented the Ramsey Rule and the Laffer curve, two models of optimal taxation. Given the revenue needs of governments and the inefficiencies of taxation, each model was used to derive an expression for the optimal tax rate, optimal in terms of 1) minimizing the efficiency costs of taxation while subject to a revenue constraint in the case of the Ramsey Rule, or 2) revenue maximization in terms of the Laffer curve.

PART 2 - SELECTED APPLICATIONS IN PUBLIC FINANCE

IV. Revenue Forecasting

A. Introduction

Revenue forecasting involves the use of analytical techniques to project the amount of financial resources available in the future. In the public sector, revenues come from taxes, fees, license sales or intergovernmental transfers. Forecasting attempts to identify the relationship between the factors that drive revenues (tax rates, building permits issued, retail sales) and the revenues government collects (property taxes, user fees, sales taxes). The ability to accurately project future resources is critical to avoiding budgetary shortfalls or collecting excess taxes or fees. For the federal government, even small errors in projecting revenue can result in serious budget problems such as large surpluses or deficits. Thus, revenue forecasting is fundamental to both state and federal governments, as well as many larger municipalities. As local governments continue to shift reliance from the property tax to user fee-based revenues, forecasting will be increasingly important to smaller units of government and department administrators.

Revenue forecasts can apply to aggregate total revenue or to single revenue sources such as sales tax revenues or property tax revenues. There is no single method for projecting revenues. Rather, different methods tend to work better depending on the type of revenue. Similarly, there is no standard time-frame over which to attempt a forecast. State government might look ahead to the next year's budget, while managers of a city water system may be concerned about a twenty year time horizon. Finally, revenue forecasting is intimately tied to the public policy process and is thus subject to considerable scrutiny and even political pressure.

B. The Forecasting Process

Government fiscal policy is affected by the context in which it is formed. It deals with not only economic but also political concerns. It is essential to establish assumptions and procedures that concerned parties agree upon, as well as a mechanism for evaluating the validity of revenue forecasts. Thus, a disciplined process is needed. Guajardo and Miranda (2000) suggest a seven step process. The following steps are applied to each type of revenue to be forecast.

- The first step involves selecting a time period over which revenue data is examined. The length of time depends on the availability and quality of data, the type of revenue to be forecasted, and the degree of accuracy sought.
- In the second step, the data is examined to determine any patterns, rates of change, or trends that may be evident. Patterns may suggest that the rates of change are relatively stable or changing exponentially. Once the trend is identified, the forecaster needs to decide to what degree the revenue is predictable. This is done by examining the underlying characteristics of the revenue, such as the rate structures used to collect the revenue, changes in demand, or seasonal or cyclical variation.
- Forecasters next need to understand the underlying assumptions associated with the revenue source. They need to consider to what degree the revenue is affected by economic conditions, changing citizen demand, and changes in government policies. These assumptions help determine which forecasting method is most appropriate.
- The next step is to actually project revenue collections in future years. The method selected to perform the projection depends on the nature and type of revenue. Revenue sources with a high degree of uncertainty, such as new revenues and grants or asset sales, may employ a qualitative forecasting method, such as consensus or expert forecasting. Revenues that are generally predictable will typically be forecast using a quantitative method, such as a trend analysis or regression analysis.
- After the projections have been made, the estimates need to be evaluated for their reliability and validity. To evaluate the validity of the estimates, the assumptions associated with the revenue source are re-examined. If the assumptions associated with existing economic, administrative, and political environment are sound, the projections are assumed valid. Reliability is assessed by conducting a

sensitivity analysis. This involves varying key parameters used to create the estimates. If large changes in the estimates result, the projection is assumed to have a low degree of reliability.

- In the sixth step, actual revenue collections are monitored and compared against the estimates. Monitoring serves both to assess the accuracy of the projections and to determine whether there is likely to be any budget shortfall or surplus.
- Finally, as conditions affecting revenue generation change, the forecast will need updating. Fluctuations in collections may be caused by unexpected changes in economic conditions, policy and administrative adjustments, or in patterns of consumer demand.

C. Forecasting Methods

There are a wide range of forecasting techniques available (Frank, 1993; Makridakis and Wheelwright, 1987, 1989; Guajardo and Miranda, 2000). They range from relatively informal qualitative techniques to highly sophisticated quantitative techniques. In revenue forecasting, more sophisticated does not necessarily mean more accurate. In fact, an experienced finance officer can often "guess" what is likely to happen with a great deal of accuracy. In general, forecasters use a variety of techniques, recognizing that some perform better than others depending on the nature of the revenue source.

i. *Qualitative Forecasting Methods*

Qualitative forecasting methods rely on judgements about future revenue collection. These techniques are often referred to as judgmental or nonextrapolative approaches. In addition to their relatively small dependence on numbers, these techniques frequently do not provide a rigorous specification of underlying assumptions.

a. *Judgmental Forecasting*

Among the most commonly used methods of forecasting is ***judgmental forecasting***. This technique involves having an individual or small group of people make assessments of likely future conditions. While sounding ad hoc, the technique can produce very good estimates, especially when experienced persons are involved. The forecaster will utilize experience in conjunction with consideration of historical trends, current economic conditions, and other factors relevant to the revenue source.

Judgmental approaches tend to work best when background conditions are changing rapidly. When economic, political or administrative conditions are in flux, quantitative methods may not capture important information about factors that are likely to alter historical patterns.

A variation of the judgmental approach is ***consensus forecasting***. Here, experts familiar with factors affecting a particular type of revenue meet to discuss near-term conditions in order to reach agreement about what is likely to happen to revenue collections. For example, municipal public administrators might meet with persons familiar with the local real estate market, economists monitoring local, state and national conditions, and representatives of local financial institutions to come up with a consensus forecast of future building permit applications. Consensus forecasting tends to work best when there is little historical information to draw upon that might be used with a quantitative forecasting method.

Judgmental forecasting approaches certainly have their place among forecasting methods. To some extent, a judgmental perspective needs to supplement any forecasting technique, even the most quantitatively rigorous methods. As might be suspected, however, judgmental approaches can be subject to bias and other sources of error. Guajardo and Miranda (2000) provide the following list of the major weaknesses of qualitative forecasting methods:

- anchoring events – allowing recent events to influence perceptions about future events, e.g. the city hosting a recent major convention influencing perceptions about future room taxes
- information availability – over-weighting the use of readily available information

- false correlation – forecasters incorporating information about factors that are assumed to influence revenues, but do not
- inconsistency in methods and judgements – forecasters using different strategies over time to make their judgements, making them less reliable
- selective perceptions – ignoring important information that conflicts with the forecaster's view about causal relationships
- wishful thinking – giving undue weight to what forecasters and government officials would like to see happen
- group think – when the dynamics of forming a consensus tends to lead individuals to reinforce each other's views rather than maintaining independent judgements
- political pressure – where forecasters adjust estimates to meet the imperatives of budgetary constraints or balanced budgets.

ii. *Quantitative Forecasting Methods*

Quantitative methods relay on numerical data relevant to the revenue source. Quantitative methods also make explicit the assumptions and procedures used to generate forecasts. Finally, quantitative methods will also generally assign a margin of error to forecasts, providing a indication of the degree of uncertainty associated with the estimates.

There are two general types of quantitative forecasting methods. The first is a time series approach that consists of a large number of techniques that generally use past trends to project future revenues. The second general approach, while still incorporating time series data, constructs causal models that use the variables assumed to influence the level of a particular revenue.

In general, quantitative methods do a better job of predicting future revenues than do qualitative methods (Cirincione, et al., 1999; Makridakis and Wheelwright, 1989). Simpler quantitative methods also generally perform as well as more complex methods (Makridakis, et al., 1984). Finally, the time series approach typically outperforms the causal modeling approaches, at least in the near-term, given the uncertainty associated with capturing all the relevant economic factors that influence revenue generation (Frank, 1993).

a. *Time Series Approaches*

Time series approaches are the "bread and butter" of forecasting. They have been used extensively in the private sector and have been subject to substantial evaluation. Today, computer software exists that automatically applies the appropriate technique given the characteristics of the data entered. The underlying assumption of time series techniques is that patterns associated with past values in a data series can be used to project future values.

In using time series techniques, Frank (1993) identifies several essential concepts that need consideration prior to the selection of technique. The first is what constitutes a ***trend***. This fundamentally questions how long a data series is required for the technique to be able to identify any underlying pattern in the data. There are no definitive guidelines as to the number of data points required in constructing a data set. Generally, the data should cover a period of at least several years and, depending on the technique used, should include a minimum of 24 observations and perhaps as many as 50 or more observations.

Cyclicality in time series refers to the extent to which the revenue source is influenced by general business cycles. Again, with local governments moving away from the relatively stable and predictable property tax to sales taxes and user fees, the need to take into consideration the effects of business cycles becomes relatively more important.

Similarly, ***seasonality*** is another cyclic phenomenon that needs consideration. This is typically the case when the observations are monthly or quarterly. The mathematical formulas employed can be adjusted to determine both the degree of seasonality that may exist as well as whether seasonality is increasing or decreasing over time.

Randomness is another factor that affects time series data. Randomness refers to unexpected events that may distort trends that otherwise exist over the long-term. Events such as natural disasters, political crisis, and the outbreak of war can result in temporary distortions in trends. Randomness can also result from natural variations around average or typical behavior. When the data series have a constant mean and variance over time, this is known a ***stationarity***. Stationarity exists if the data series were divided into several parts and the independent averages of the means and variances of each part were about equal. If the average of each mean or variance were substantially different, nonstationarity would be suggested. When randomness tends to characterize a data series time series techniques do not perform very well, as performing econometric analyses on nonstationary data can often result in biased estimates.

b. ***Descriptions of Time Series Forecasting Models***

There are a large number of time series approaches that are used in forecasting. Cirincione, et al., (1999) discuss a number of issues in their use and provide a nice summary of a variety of techniques in an appendix to their article. This presentation builds on the technical description found there.

1. Naive Forecasting

A naive forecasting model simply assumes the revenue available at time t is the same amount available at time $t-1$. This is also known as the ***random walk approach***.

$$F_t = A_{t-1}$$

where F_t is the forecast at time t, and A_{t-1} is the actual value at time $t-1$.

A variation of this involves averaging the two prior periods to generate the estimate. Yet another variation involves adjusting for any seasonality that may be present. Naive forecasting is often used when the data series is unpredictable. It is also used in expert forecasting as the starting point for estimates that are then adjusted mentally.

2. Moving Average Models Moving average models are probably the most commonly used time series approach among local governments. As implied by the name, the future value to be forecast is based on the average of N previous periods. It is a moving average because the oldest data points are dropped off as new ones are added.

$$F_t = \frac{\sum_{i=1}^{N} A_{t-i}}{N}$$

where F_t is the forecast at time t, A_{t-i} is the actual value at time $t-i$, and N is the number of time periods averaged.

The length of time to include in the average depends on the degree of variation present in the data series. To the extent there appears a high degree of randomness in the data, a longer period is used. Similarly, to the extent cyclicality or seasonality is present in the data, longer time periods are required. An amount of trial and error will be needed to find the best fitting model, although new software can very rapidly identify the time period producing the minimum forecast error. While more complex time series techniques can perform better than the moving average, it does a reasonably good job and is often used as the benchmark against which other methods are compared.

3. Exponential Smoothing Models The single exponential smoothing model is one of the common forecasting techniques used in the private sector. The model is a moving average of forecasts that have been corrected for the error observed in preceding forecasts. In the first smoothing model, there is assumed no trend or seasonal pattern.

$$F_t = F_{t-1} + \alpha(A_{t-i} - F_{t-1})$$

where F_t is the forecast at time t, A_{t-i} is the actual value at time $t-i$.

The parameter α is the smoothing coefficient and has an estimated value between zero and one. It is referred to as an exponential smoothing model because the value of tends to affect past values exponentially. As

α approaches one, the forecast resembles a short-term moving average, while an α closer to zero tends to resemble long-term moving averages. Regardless of the value of α, however, exponential smoothing tends to give more recent values higher implicit weights. Again, α is typically estimated using trial and error to secure the best fitting model, but software today can rapidly find the model that minimizes forecast error.

4. The Holt Model The single parameter smoothing model presented above can be adapted to take into account trends that may be present in the data. The form presented here is called the Holt Model. In addition to the smoothing parameter estimated in the exponential smoothing model, a parameter representing the trend is also estimated.

Following the exposition found in Cirincione, et al. (1999), the forecast at time t for k periods into the future equals the level of the series at t plus the product of k and the trend at time t. The level of series is estimated as a function of the actual value of the series at time t, the level of the series at a previous time, and the estimated trend at a previous time. The parameter is a smoothing coefficient. The trend at time t is estimated to be a function of the smoothed value of the change in level between the two time periods and the estimated trend for the previous time period. The values for the smoothing parameters, α and β, are between zero and one.

$$
\begin{aligned}
F_{t+k} &= S_t + kT \\
S_t &= \alpha A_t + (1-\alpha)(S_{t-1} + T_{t-1}) \\
T_t &= \beta(S_t - S_{t-1}) + (1-\beta)T_{t-1}
\end{aligned}
$$

where F_{t+k} is the forecast at time k periods in the future, A_t is the actual value at time t, S_t is the level of the series at time t, T_t is the trend at time t, and α and β are smoothing parameters.

5. Damped Trend Exponential Smoothing While the Holt Model takes into consideration the trend that may be inherent in the data series, it somewhat unrealistically assumes the trend continues in perpetuity. This means it can overshoot estimates several time periods in the future. A variation known as damped trend exponential smoothing has the effect of dampening the trend as time continues into subsequent periods. It includes a third parameter, Φ, with a value between zero and one that specifies a rate of decay in the trend.

$$
\begin{aligned}
F_{t+k} &= S_t + \sum_{i=1}^{k} \phi T_t \\
S_t &= \alpha A_t + (1-\alpha)(S_{t-1} + \phi T_{t-1}) \\
T_t &= \beta(S_t - S_{t-1}) + (1-\beta)\phi T_{t-1}
\end{aligned}
$$

where F_{t+k} is the forecast at time k periods in the future, A_t is the actual value at time t, S_t is the level of the series at time t, T_t is the trend at time t, and ,α, β, ϕ are smoothing parameters.

6. Holt-Winter's Linear Seasonal Smoothing This model adapts Holt's method to include a seasonal component in addition to a smoothing coefficient and a trend parameter. The first variant of the model is additive. This assumes the seasonality is constant over the series being forecast.

$$
\begin{aligned}
F_{t+k} &= S_t + kT_t + I_{t-p+k} \\
S_t &= S_{t-1} + T_{t-1} + \alpha(A_t - S_{t-1} - T_{t-1} - I_{t-s}) \\
T_t &= T_{t-1} + \alpha\beta(A_t - S_{t-1} - T_{t-1} - I_{t-s}) \\
I_t &= I_{t-s} + \delta(1-\alpha)(A_t - S_{t-1} - T_{t-1} - I_{t-s})
\end{aligned}
$$

where F_{t+k} is the forecast at time k periods in the future, A_t is the actual value at time t, S_t is the level of the series at time t, T_t is the trend at time t, I_t is the seasonal index at time t, s is the seasonal index counter, and α, β, δ and are smoothing parameters.

$$\begin{aligned}
F_{t+k} &= (S_t + kT_t)I_{t-p+k} \\
S_t &= S_{t-1} + T_{t-1} + \frac{\alpha}{I_{t-s}}(A_t - I_{T-S}(S_{t-1} + T_{t-1})) \\
T_t &= T_{t-1} + \frac{\alpha\beta}{I_{t-s}}(A_t - I_{t-s}(S_{t-1} + T_{t-1})) \\
I_t &= I_{t-s} + \frac{S(1-\alpha)}{S_t}(A_t - I_{t-s}(S_{t-1} + T_{t-1}))
\end{aligned}$$

The multiplicative variant of this model assumes that the seasonality is changing over the length of the series.

Incorporating seasonality, of course, increases the data requirements – typically three to four years of monthly data. The model is also quite complex, estimating smoothing, trend and seasonal parameters simultaneously. Because of these difficulties, many communities use simpler methods such as single or double exponential smoothing methods.

7. Box-Jenkins ARIMA Models ARIMA is an acronym for autoregressive integrated moving average. Autoregressive and moving average refer to two of the components of the model, while integrated refers to the process of translating the calculations into a metric that can be interpreted.

ARIMA modeling has three components (Frank, 1993). In the *model identification stage*, the forecaster must decide whether the time series is autoregressive, moving average, or both. This is usually done by visually inspecting diagrams of the data or employing various statistical techniques. In the second stage, *model estimation and diagnostic checks*, the forecaster verifies the original model identification is correct. This requires subjecting the model to a variety of diagnostics. If the model checks out, the forecaster then proceeds to the third stage, *forecasting.*

The principle advantage of using the ARIMA approach is that the method can generate confidence intervals around the forecasts. This actually serves as another check of the validity of the model. If it predicts a high degree of confidence about a dubious forecast, the modeler may have to respecify the form of the model.

In order to achieve best results using the Box-Jenkins ARIMA approach, three assumptions need be met. The first is the generally accepted threshold of 50 data points. This tends to be a significant obstacle for many local governments who may collect data only annually for some types of revenue.

The second assumption is that the data series is stationary, i.e. that the data series varies around a constant mean and variance. Running a regression on two non-stationary variables can result in spurious results. If the data is non-stationary, the data series needs differencing and/or the addition of a time trend. If the data is trend non-stationary only, then adding a linear time trend to the model will render the series stationary. Trend non-stationary data have a mean and variance that change over time by a constant amount. If the data is first-difference non-stationary, then first differencing of the data will render the series stationary. Differencing involves subtracting the observation in time *t* by the observation in time *t-1* for all observations. Whether the data requires these types of treatment should become apparent at the identification stage, and is generally easily accomplished with econometric software programs.

The third assumption of ARIMA models is that the series be ***homoscedastic***, i.e. has a constant variance. If the amplitude of the variance around the mean is great even after differencing, the series is considered heteroscedastic. The remedy for this problem may be simple or complex and involves measures such as using the natural logarithm of the data, using square or cubed roots, or truncating the data series (cutting out certain values).

The first component of the ARIMA process is the autoregressive component. The autoregressive component predicts future values based on a linear combination of prior values. An autoregressive process of order p can be shown as:

$$F_t = \alpha_1 A_{t-1} + \alpha_2 A_{t-2} + \ldots + \alpha_p A_{t-p}$$

where F_t is the predicted value at time t, A_{t-p} is the actual value at time t, and α_p's are the estimated parameters.

The moving average component provides forecasts based on prior forecasting errors. The moving average component of a model for a q-order process can be shown as:

$$F_t = \beta_1 \varepsilon_t + \beta_2 \varepsilon_{t-1} + \ldots + \beta_p \varepsilon_{t-q}$$

where F_t is the predicted value at time t, ε_{t-q} is the forecast error at time t, and the β_p's are the estimated parameters.

These two components together form autoregressive moving average (ARMA) models. ARMA models assume a stationary data series before first differencing or the inclusion of a time trend. If a series has been rendered trend or difference stationary, the above models form the Box-Jenkins ARIMA model (Box and Jenkins, 1976). The number of autoregressive and moving average lags in an ARIMA model is represented as ARIMA(p, d, q), where d is the degree of difference, i.e. d=1 if the data is first differenced, d=2 if the data is second differenced, etc. If d=0, the ARIMA model is an ARMA(p, q). Further derivations can also take into account seasonality by considering autoregressive or moving average trends that occur at certain points in time. In the case of seasonality the ARIMA model is expressed as ARIMA$(p, d, q)(P, Q)$ where P is the number of seasonal autoregressive lags and Q is the number of seasonal moving average lags. Seasonality is a consideration with relatively frequent data, such as weekly, monthly, or possibly quarterly data.

8. Causal Models Causal forecasting models generally tend to be among the more complex techniques, having large data requirements and requiring a high degree of statistical skill. These approaches tend to work best for revenues that are heavily influenced by economic factors, such as business license fees, income taxes, and retail sales taxes. Thus, external data representing relevant economic performance indicators are used to predict the level of revenue expected. Some of the common economic information incorporated into these models include local population, income, and price information (Wong ,1995).

The complexity of causal models varies. The simplest type would be a simple linear regression model that might attempt to project revenue as a function of time, for example. Multiple regression models incorporate any number of relevant explanatory variables, including important policy variables as binary dummy variables. Binary variables take the value of one if a specific time period is represented and a value of zero otherwise. To illustrate, following Cirincione et al. (1999), four common regression models employing ordinary least squares can be show as:

$$\begin{aligned}
F_t &= \alpha + \beta_1 T_1 \\
F_t &= \alpha + \beta_1 T_1 + \beta_2 T_t^2 \\
F_t &= \alpha + \beta_1 T_1 + \gamma_1 D_1 + \gamma_2 D_2 + \ldots + \gamma_s D_s \\
F_t &= \alpha + \beta_1 T_1 + \beta_2 T_t^2 + \gamma_1 D_1 + \gamma_2 D_2 + \ldots + \gamma_s D_s
\end{aligned}$$

where F_t is the predicted value at time t, T_t is the value of the time at time t, T_t^2 is the squared value of time at time t, β_1 is the linear trend parameter associated with time, β_2 is the quadratic trend parameter associated with time squared, D_s is a binary dummy variable for each of the s seasons, and γ is the parameter value associated with each season. The estimated values on the dummy variables reveal the average level of the dependent variable during the designated time period. Testing the equality of the dummy coefficients can reveal whether there are significant differences in the average level of the dependent variable across seasonal periods.

Econometric forecasts are structured similar to regression equations, but can include estimates of change across multiple dimensions. Thus, complex events and relationships can be modeled where the output from one equation is fed into another equation as they are solved simultaneously. The types of revenue for which econometric forecasts are most useful include corporate tax, personal income tax, real estate tax, sales tax, and user charges and fees, such as building and construction permits.

D. Conclusion

This brief overview of revenue forecasting belies the fact that forecasting is a major field of economics. The intricacies and variations can not be represented thoroughly in a brief section. Yet, for those concerned with public finance, the topic is one of growing importance, especially at the municipal level. While some of these techniques are likely beyond the capability of local government managers, improvements in computer software and assistance available from universities and outreach providers increases the plausibility of using these tools even in smaller units of government.

V. Cost-Benefit Analysis

When choosing any course of action, a person inherently performs cost-benefit analysis. The notion is one of assessing alternative available courses, anticipating the positive (benefit) and negative (cost) impacts associated with the alternatives, and selecting the course that provides the greatest net benefit. In making decisions related to public spending, the process is much the same. More formally, it is a process intended to enhance social decision-making related to the efficient allocation of scarce public resources. Typically, cost-benefit analyses (CBA) are used in the selection of alternative policies related to programs, projects or regulations.

A. Steps in Performing Cost-Benefit Analysis

Conceptually, the steps in performing a CBA are simple. Boardman, et al. (1996) list them as shown in Table 1. As might be expected,however, actually doing each step can be very difficult. Each of these steps and a few of the issues associated with completing a CBA will be discussed in greater detail in this section.

i. *Identifying Stakeholders to the Analysis*

The analyst begins by deciding whose costs and benefits will be counted, i.e. who has "standing." In reality, this is often determined by the project sponsor, and can be a contentious issue. The project sponsor typically is concerned about how a project will affect the sponsoring jurisdiction. Project impacts, however, often spill over space and time, causing what are often called externalities. Acid rain caused by coal-fired generators, for example, can cause problems across state and national borders. Similarly, use of fossil fuels today may preclude options for energy generation in the future.

Table 1. Basic Steps of a Cost-Benefit Analysis

1. Determine which stakeholders will be included in the analysis
2. Identify the alternative policies to be considered
3. Identify the likely physical impacts and select the appropriate measurement indicators
4. Predict the impacts over the life of the project
5. Attach a dollar amount to all of the impacts
6. Find the present value of the dollar amounts over time
7. Add up the costs and benefits
8. Perform a sensitivity analysis of the results
9. Select the alternative with the largest net social benefits

Source: Boardman, Greenberg, Vining and Weimer, 1996, page 7.

ii. *Identify Alternative Policies to be Included*

The alternative policies need to be evaluated relative to the status quo. Generally, a project sponsor will have well-defined alternatives in mind. But, depending how the problem is stated, the alternatives can be almost infinite. If the question is "should we build a highway?" the analysis is fairly straightforward. If the question is "how do we solve our transportation needs?" the task becomes much more complex. Generally, the project sponsors will have used other means of decision-making to narrow the choices to one or a few.

iii. *Identify Likely Physical Impacts and Indicators*

All of the anticipated impacts (positive and negative) need to be identified and quantified in some form. In CBA, the perspective is homocentric, i.e. from the perspective of human values. Generally, we need to know something about cause-effect relationships. In many cases, the relationships and impacts are fairly straightforward, e.g. if we build the highway, we reduce the numbers of miles traveled, we increase the time saved, reduce the lives lost, and spend so much money.

In other cases, neither the nature of the relationship nor the type of impact is readily known. Whether a given program will reduce crime, for example, is difficult to anticipate because the causal factors underpinning crime are varied and not well understood. Sometimes, we need proxy indicators for the impacts of interest, e.g. reductions in the number of convictions as opposed to reduced crime. Similarly, if an animal species is generally considered an indicator of the health of an ecosystem, valuing a reduction of ecosystem viability is a difficult task. There are times people will look at the same information and interpret it in exactly opposite ways.

iv. *Predict the Impacts over the Life of the Project*

Most public projects will extend over a period of time. The next task is to quantify the impacts over the life of the project and beyond if residual effects are expected. Here again, our ability to predict the future is at question. Most of the texts on CBA discuss relationships in theoretical or hypothetical terms, but very few studies of how well a CBA actually anticipates the future impacts have been performed. Some of the common errors in performing CBA's are identified later in this section.

v. *Monetize All of the Impacts*

A dollar amount needs to be assigned to all of the anticipated impacts. The challenge is valuing impacts that are intuitively important but for which there are no markets or only poorly functioning markets to observe. Environmental impacts and impacts to human health and well-being are two cases in point.

vi. *Find the Present Value of Dollar Amounts*

For any project that extends over a period of years, all dollar amounts assigned need to be converted into a common metric. Future costs and benefits need to be discounted to obtain a present value . This is done to compare our choice of consuming resources now versus deferring that consumption to some future time. Given our assumption the CBA applies to public decision-making, we need to establish a social discount rate . Here again, determining the aggregate value all of a jurisdiction's affected citizens place on current versus future consumption is very difficult. While there are a number of theoretical considerations that can be brought to bear on the question, there is no agreement on what social discount rate should be applied for a given type of project. For this reason, we generally present results subject to a sensitivity analysis to demonstrate how alternative discount rates affect valuation.

vii. *Add up the Costs and Benefits*

The basic decision rule for CBA is simple. In the case of a single project, add up the net present value of the costs and benefits and, if the benefits minus the costs are greater than zero, go ahead with the project. If two or more project alternatives are being considered, select the one with the higher positive net present value.

Some advocate using alternative criterion for the decision rule. Sometimes results are reported as an internal rate of return or a benefit-cost ratio. Both the internal rate of return and the benefit-cost ratio can lead to erroneous conclusions, however, while use of the net present value of social benefits always yields a correct answer. Where disagreements typically arise is whether all the social costs and benefits have been monetized and summed. In cases where it is not possible to reach agreements about the value of a benefit or cost, it may be appropriate to use an alternative analysis method such as a cost-effectiveness analysis.

viii. *Perform a Sensitivity Analysis*

The use of sensitivity analysis in the context of CBA is to deal with uncertainties. A sensitivity analysis simply means inserting alternatives from a range of values related to unknown or uncertain parameters. For example, if it is uncertain how many lives an intervention will save, a range of numbers can be entered and compared to the cost. Any number of CBA components can be subject to sensitivity analysis, including who has standing and with what weight, the social discount rate used, or any of the parameters where there is uncertainty or disagreement.

ix. *Select the Preferred Alternative*

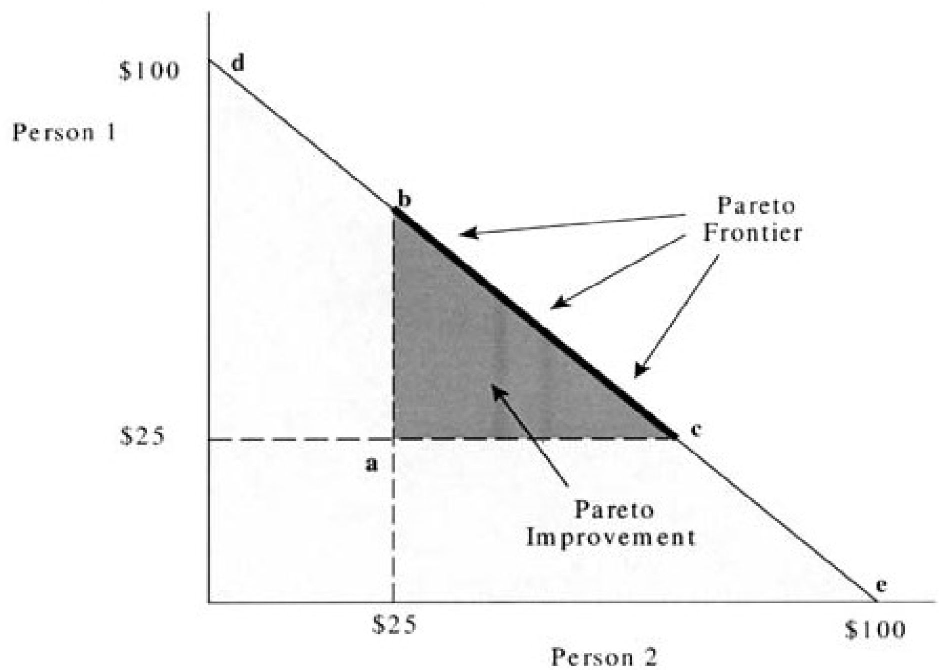
Finally, the analyst recommends the alternative with the highest positive net present value of social benefits. It should be kept in mind this is a normative judgement based on an efficiency consideration. Thus, in the political process of policy choices, decision-makers may choose other alternatives. Here, the analyst is best advised to present a recommendation rather than a decision.

B. Theoretical Foundations in Cost-Benefit Analysis

There are a number of concepts that help guide the analyst in performing CBA. In this section, we explore some of the basic assumptions inherent in this type of analysis, including allocative efficiency, willingness-to-pay, and opportunity costs. Thus far, we have referred to CBA as a means to identify the most efficient alternative policy or project. Here, we discuss what we mean by efficiency in the allocation of resources with a few basic concepts from welfare economics.

A simple and compelling concept in welfare economics is the notion of Pareto efficiency. An allocation of goods is said to be ***efficient*** if no alternative allocation scheme will make at least one person better off without making anyone else worse off. Intuitively, this would be the best alternative in social decision-making, even if in practice this would be extremely difficult to know. Thus, we equate the notion of the highest net present value with Pareto efficiency by use of two related concepts: willingness-to-pay and opportunity costs.

Figure 1: Pareto Efficiency



Willingness-to-pay is the amount of money a person would be willing to pay to get or avoid something other than the status quo. The aggregation of all stakeholder's willingness-to-pay is what is sought in identifying the net benefits of the policy. If someone were made worse off as the result of the change, we can introduce the notion of ***compensation*** to bring them back to at least the same level of well-being even if others' well-being was improved as a result of the policy. If, after performing the analysis, there are any estimated net benefits, this would imply that the proposed change would be a Pareto improvement over the status quo.

In valuing costs and benefits, the notion of opportunity costs is critical. The ***opportunity cost*** of using a resource is the cost of not using a resource in its next best alternative use. This is functionally what has to be given up to pursue the policy of interest. If the aggregate opportunity costs exceed the aggregate willingness-to-pay of stakeholders, the net benefits would be less than zero and the policy would not be a Pareto improvement.

Using these concepts, we would suggest that if all impacts were measured as an aggregate willingness-to-pay, and all resources used as inputs into the policy were valued as opportunity costs, an analysis showing a net present value would imply that it was at least theoretically possible to compensate those who had to give something up with policy implementation and still make someone better off. Thus, the policy change would be Pareto efficient. In practice, we apply this rule by suggesting we adopt only policies that have positive net present benefits. When one policy affects another, we would seek the combination of policies with highest net benefits. When policies are mutually exclusive, we choose the one with the highest net benefits.

C. Net Present Value

Many public programs are implemented over the course of years. Taking time into account when we estimate the value of costs and benefits associated with a project is essential. Not only are we concerned about the effects of inflation, time also influences how we perceive the value of money. Discounting is fundamental to CBA, and calculating the correct discount rate can make all the difference in the outcome of an analysis. We discount future values to determine a net present value .

The net present value criterion suggests proceeding with the project if the net present value is positive if the alternative is the status quo, or to proceed with the project alternative with the largest net present value.

Thus far, we have been ignoring the effects of inflation; we have only considered the time value of money. Of course, the purchasing power of money declines over time with price inflation. The question arises as to whether it is best to express the financial information presented in nominal dollars or in inflation-adjusted real dollars.

While some analysts use nominal dollars in CBA, in public sector financial analysis it is probably best to express the information in real dollars. The financial information to be dealt with is usually more intuitively clear when expressed in real terms. When working with real dollars, however, it the becomes necessary to apply a real discount rate rather than a nominal discount rate.

Because of uncertainties related to what discount rate to apply, and because the discount rate chosen can have a substantial affect on the outcome of a CBA, it is generally appropriate to subject the discount rate to a sensitivity analysis by varying it within a range of values.

D. Estimating Values

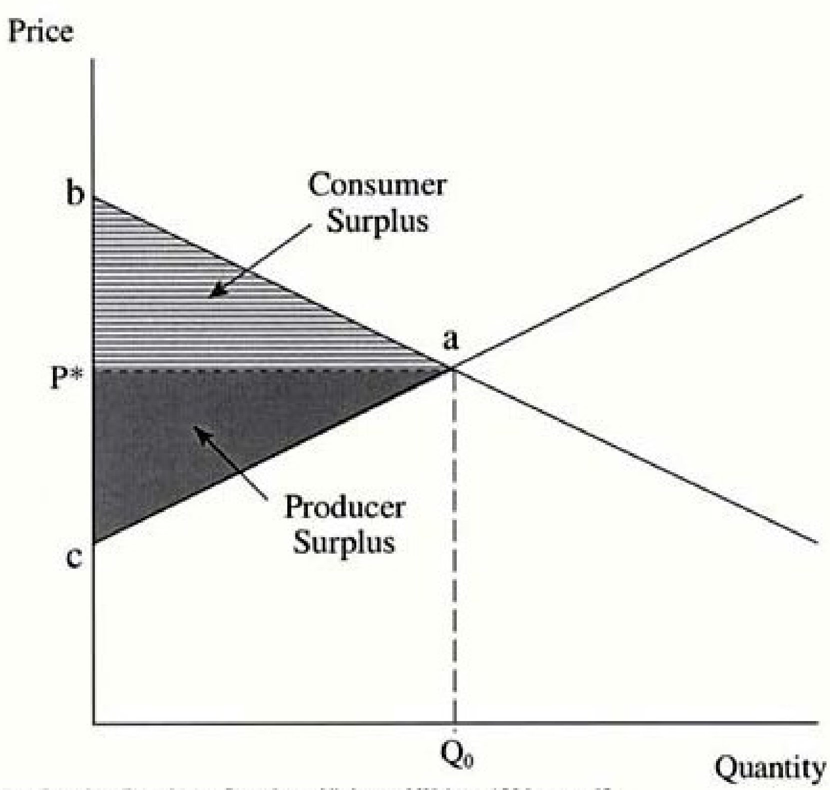
In many cases, estimating the values of costs or benefits is fairly straight-forward. Project expediters can estimate construction costs with a great deal of accuracy, notable exceptions on some public projects notwithstanding. Similarly, we can infer a great deal where we can make direct observations of behavior in undistorted private markets. Many times, however, directly observable behavior is not readily available. Further, there are no markets for many goods, such as pollution, or the markets are imperfect. This section provides an introductory discussion of some concepts, methods, and issues associated with establishing values for costs and benefits.

i. *Social Surplus*

In the private sector, a reasonable measure of benefit to a producer is simply net profit. The producer deducts from gross sales the cost of goods sold plus taxes. The money remaining after paying these bills would be considered the “surplus” to the producer. This surplus has a value – the profit. It is measurable, meaningful, and can be aggregated across many producers. Thus, we equate the notion of a cost or benefit in terms of changes in surplus, all of which can be conceptually linked to the notion of willingness-to-pay. In this case, for the opportunity to change the producer's "surplus," his willingness to pay would be exactly equal to the amount of the profit.

For public projects, valuing costs and benefits is not so simple. To the extent a project affects private producers, the analyst would be interested in measuring changes in producer surplus. But, public projects are often intended to benefit consumers (citizens), as well. To the extent a project benefits non-producers, we are also interested in measuring consumer surplus. The CBA attempts to capture changes for both groups. Together, the sum of producer and consumer surplus is social surplus, and this concept is what the analyst is trying to measure.

Figure 2: Social Surplus in a Competitive Market



Source: Based on Boardman, Greenberg, Vining and Weimer 1996, page 60

If there existed perfect markets for all goods and services, and supply and demand curves were known, measuring social surplus would be easy. Unfortunately, markets do not always work perfectly, for many types of goods markets do not exist, and we seldom have sufficient information to accurately depict supply and demand curves. Thus, we use a variety of methods to approximate markets to estimate supply and demand.

ii. *Estimating Values in Cost-Benefit Analysis*

There are a variety of methods to estimate the values of costs and benefits associated with public projects. Sometimes, a demonstration project or social experiment is conducted, studied and extrapolated to a larger initiative. In other cases, costs are estimated based on observations, or inferred from survey information or secondary data sources. This section will explore several of the basic methods used for estimating values in CBA.

a. *Values from Observed Behavior*

There are a number of practical methods available to estimate values based on observable behavior. These methods focus principally on changes in consumer surplus. Several are briefly outlined in this section.

1. Project Revenues as Benefits

In the private sector, counting revenues generated by a project as benefits makes sense. Project revenues may undercount the value of the benefits of public projects, however, because they do not consider changes in social surplus. In the example of introducing electricity to a remote area, we would grossly undervalue benefits if we only counted government-subsidized rates. Clearly, residents of the area would experience benefits beyond the fees generated if the alternative was no electricity. Project revenues, therefore, are not always a good indicator of benefit.

2. Estimating Demand Curves

If we have information about the quantity of a good demanded at different prices, it may be possible to make a direct estimation of the consumer demand curve (Barnett, 1988). For example, if we have data related to changes in bus ridership at various fare rates, we have all the information needed to estimate the consumer demand curve using econometrics – price of the service, quantity of rides demanded, the elasticity of demand at various prices. We can extrapolate from the available data the marginal benefit to the consumer of the service at a given price with a reasonable degree of confidence.

3. Market Analogy

For many public goods and services, there is no well-functioning market. Public education, recreational facilities, and many types of health services are cases in point. We can look for a private sector equivalent to extrapolate to the public sector, such as observing the prices paid at private universities, private camp sites, or private health care providers. Sometimes, it may even be possible to use information gathered from informal (illegal) markets when no legal private market exists.

4. Intermediate Goods

Governments sometimes produce goods that are used as inputs into production. An agricultural irrigation project is a good example. In a reasonably well-functioning agricultural commodities market, we can observe the incomes of dry-land versus irrigated farming producers. After taking into account the relative differences in input costs, we can reasonably estimate the "value added" to agricultural production associated with the government irrigation project.

5. Asset Values

Government projects can sometimes affect the price of assets such as land and capital. Once again, agriculture is a good case to illustrate this point. Land values will be quite different between land having access to irrigation water and land without. Similarly, differences in the market value of comparable homes near an airport versus those more distant can provide an indication of the value of a negative externality such as noise.

6. Hedonic Pricing

Building on the methods previously outlined, hedonic price functions use a regression method to value attributes that affect asset values, such as the value of a scenic vista in a housing market (Rosen, 1974). The method would first estimate the additional value of a house with a marginally better view, holding other factors that affect values constant. Secondly, willingness-to-pay is estimated, controlling for income and other socioeconomic factors. Using this method, consumer surplus can be estimated for projects that might improve or worsen a scenic vista.

7. Travel Cost Method

The travel cost method recognizes that the fees generated by an event or facility are only a small part of a consumers' willingness-to-pay. To enjoy the experience of a visit to a national park, for example, people will forego the opportunity to work, travel great distances, and incur significant food and lodging expenses. Thus, the value of the experience will exceed the gate admission many times over. The travel cost method uses the total cost of the trip, instead of the admission price, as an explanatory variable in estimating demand. As might be expected, this method is most often used in recreation-related studies.

8. Defensive Expenditures

Many people are willing to take defensive action in response to a situation (Bartik, 1988). For example, people will install home water purification systems or purchase bottled water in response to concerns related to water quality. If government takes action to maintain or improve water quality, some people will forego the expense they previously incurred. We can value water quality by observing the full costs incurred to take defensive action, and the value of government intervention by observing the changes in defensive behavior.

b. *Contingent Valuation*

Sometimes, there are no markets or proxies available with which to infer a value. In such instances it may be necessary to elicit people's perceptions of value using survey methods. The survey methods used in CBA are referred to as ***contingent valuation***.

There are a number of survey techniques available to elicit people's estimates of value (Bishop and Heberline, 1990; Cummings, et al., 1986). ***Open-ended questionnaires*** will simply ask how much a person would be willing to pay for a good. ***Closed-ended iterative bidding*** surveys specify a specific but variable amount and inquire whether a person would be willing to pay it. A third type of survey will ask people to ***rank order*** specific combinations of quantities of a good and associated payments. The ***dichotomous-choice method*** randomly assigns a price to a given quantity of a good, and people are asked whether they would be willing to pay the amount. Finally, there are several variations of the ***payment card method*** where people indicate a willingness to pay based on comparable goods or based on the hypothetical maximum amount they would pay. All of these approaches have been used with in-person interviews, telephone surveys and mail surveys (Mitchell and Carson, 1989).

As with all survey techniques, contingent valuation methods are subject to a number of potential problems (Hausman, 1993; Arrow, et al., 1993), including sample bias, non-response bias, and interviewer bias. In addition, contingent valuation methods have been criticized as being inaccurate in establishing a true willingness-to-pay. One of the principal criticisms is that a person's response to a hypothetical situation may be quite different than their response if faced with the reality of actually having to pay. Similarly, it can be very difficult to establish a meaningful context for the provision of a public good. A person would be willing to pay very different amounts to cross a bridge to go to a movie versus getting to a hospital emergency room.

Contingent valuation methods are frequently used in valuing environmental resources (Bateman and Willis, 1999). In this application, it has proven difficult to establish a context for questioning that people with differing views agree is neutral.

Given the hypothetical nature of the situations described in contingent valuation surveys, there have also been concerns related to respondents' inability to adjust their views by learning. We may think we value a good accurately, but may change that view after having had experience in its actual consumption. In marketing, it is well known that people tend to overvalue items with which they have had no prior experience.

There are a number of other criticisms related to contingent valuation methods. Each of the survey techniques has inherent strengths and weaknesses. In general, there is less criticism of contingent valuation methods when the survey is conducted while the respondent is actually engaged in the behavior of interest, as when recreating. Conversely, there is a great deal of controversy associated with studies that employ "non-use" or hypothetical situations. Clearly, a great deal of care is needed to conduct valid contingent valuation studies.

c. *Shadow Prices*

As the previous sections imply, conducting a CBA can be complex, costly, and time consuming. Whatever can be done to simplify and speed up completion of the study is generally accepted. Thus, many analysts adapt the results of previous research for use in CBA. Using values associated with preexisting studies is referred to as using ***shadow prices*** . A considerable amount of work has been conducted in three areas where it would otherwise be very difficult to estimate a value: the value of life, the value of time , and the negative values associated with particular crimes.

The *table* from Boardman et al. 1996, summarizes the results of major work in establishing various shadow prices frequently used in CBA. The wide variance of the values reported in the studies represented suggest the difficulty and imprecision with which we are currently able to establish such values.

E. Common Errors in Cost-Benefit Analyses

Invariably, errors occur when the task is to predict the future. Yet, there is considerable benefit in trying to anticipate the likely consequences of alternative courses of action in a rigorous fashion. It is legitimate to question how good our CBA methods actually perform. Few have taken the effort to compare CBA predictions with the actual outcomes. Despite the paucity of evidence, we can identify some of the common errors that have been observed in CBA (Boardman, et al.,1996; Rosen, 1985).

i. *Errors of Omission*

Errors of omission can arise from several sources. The first may be with whose interests we are concerned. Without adequate consideration or concern about who is affected by externalities, both costs and benefits may be undercounted. Similarly, some potential impacts may be considered either so remote or uncertain they are not counted at all. Such may be the case with industry air quality regulations and global warming.

ii. *Forecasting Errors*

There are a host of difficulties in forecasting future events. Generally, as the complexity of the project and the time horizon of the forecast increases, errors are more likely. Anticipating the rate of technical change or comprehending cause-effect relationships make forecasting difficult. Similarly, when the project is large, it is not uncommon for specifications to evolve over time.

iii. *Measurement Errors*

Even measuring events in the present is subject to the limitations of our measuring devices, the accuracy with which they are used, and our capacity to statistically analyze and interpret results. It is easy to forget the limitations of our primary data-gathering techniques and secondary data sources, and then further compound errors though data analysis.

iv. *Valuation Errors*

As indicated in earlier sections, the capacity to generate values associated with impacts is difficult and imprecise. Many of our measurement techniques are problematic, and their use is sometimes flawed. Similarly, the stock of available information related to shadow prices is relatively scarce. The range of values calculated across studies and methods attests to the imprecision of our current knowledge.

v. *Indirect Impacts*

In some cases, indirect economic impacts are counted as additional benefits, while indirect costs are ignored. If there is an effort to trace secondary and other tertiary impacts on the positive side to enhance the benefits, a similar effort is needed to trace the costs. In most cases, the effects are offsetting without a significant change in the net result (Rosen, 1985).

vi. *Double-Counting*

Double-counting is the opposite of the error by omission. Here, too many impacts are counted. In the case where a project both increases the value of land and the income generated by farming it, both should not be counted. In a competitive market, the value of the land is equal to the present value of the income generated by farming it. Counting increased land value and increased farm income represents double-counting.

vii. ***The Value of Labor***

The value of labor associated with a government-funded project, such as road building, is sometimes counted as a benefit. The labor purchased with public funding should be considered a cost to the project, unless the new labor was formerly from the ranks of the long-term unemployed.

F. Conclusion

The utility of cost-benefit analysis is that it introduces the notion of comprehensively accounting for the positive and negative impacts associated with public projects. It introduces a methodology that fosters rigor in thinking. Clearly, this represents an improvement over much state and local policy-making that is based on supposition and ideology.

The techniques associated with CBA are far from perfect, but there continue to be advances in technique and application. Still, it remains the responsibility of the analyst to employ the theory and techniques in a conscientious manner and help policy-makers understand the full impact of the decisions made. Even if applied in only a partial fashion, cost-benefit analysis can help state and local government officials improve the quality of decision-making.

VI. Fiscal Impact Analysis

Fiscal impact analysis is concerned with the tangible effects of a policy or event on public sector costs and revenues. Fiscal impact analysis is frequently used in the context of local decision-making related to land use changes, such as new housing or business development. It can help local policy-makers determine whether the public benefits of a development proposal or land use policy outweigh the public costs, thereby enhancing local fiscal conditions. Alternatively, it can help establish fair and equitable impact fees for developments that demonstrate a fiscal deficit.

In this section, we discuss common fiscal impact analysis techniques. The three types of analyses included are planning approaches, case studies, and econometric approaches. We provide a brief overview of each approach and discuss some of the considerations in their use. While we focus on public sector finance, each of the approaches can be adapted for use with other types of local impacts associated with economic events and policies, including social and demographic impacts.

A. Planning Approaches

Robert Burchell, David Listokin and their colleagues are probably the best known for their periodic summaries of the evolving state-of-the-art techniques in applied fiscal impact analysis (1978, 1980, 1994). They provide a practical guide to a series of approaches used by planners and other practitioners who deal with development proposals. Their focus is at the municipal and school district levels, attempting to estimate how population and employment changes are likely to affect demand for public services and generate local government revenues. Thus, the task is to estimate how a particular type of development is likely to affect local population (number of residents, employment and school-aged children) and to translate those changes into public service costs and public sector revenues. Here, we focus on the use of various multiplier approaches they outline.

i. *Projecting Population*

There are several ways to project population increases associated with development based on the use of demographic multipliers. In the case of a residential development proposal, we are interested in estimating the number of new residents and public school-aged children. For non-residential development proposals, we are interested in the number of new employees to be hired. The demographic multipliers are obtained from either national standards for population and school-aged children by housing type, or from local surveys. In the case of non-residential development, national standards are also available for employment by type of establishment, typically expressed as employees per thousand square feet. Changes in employment, then, would be used to project changes in population and school-aged children, based on assumptions of new worker in-migration and commuting patterns. While locally-derived multipliers are clearly preferable, gathering the necessary data can be a formidable challenge.

ii. *Projecting Costs*

The next task is to translate the estimated population, school children and employment changes into public service costs. Burchell and Listokin (1978, 1980) identify several methods that may be appropriate, depending on the type of community, the type of proposed development, and the existing service capacity in the municipality and school district. In general, in moderate-sized cities (10,000 to 50,000) with relatively stable growth patterns and some excess service capacity, average service cost methods do a reasonably good job of projecting expenditures associated with "typical" business development/housing projects. In larger, older cities or rapidly growing suburban/urban communities that have either significant excess or deficient capacity, a marginal service cost method is more appropriate. Marginal cost methods would also be appropriate where the project would be considered atypical in employment or household patterns.

The average cost method simply calculates the average cost per unit of service and multiplies this cost by the number of new units (housing, pupils, workers) generated by the project. This assumes the project does not generate demands that cross a threshold requiring major capital investments for such things as upgrading the sewer system or building new schools. Average cost methods include per capita multipliers, service standards, and proportional valuation.

The ***per capita multiplier*** is the most common average cost approach. Simply, it is the current per capita or per unit cost of providing services multiplied by the projected new population or housing unit increment. For the school district, total annual school costs or the total local tax levy would be divided by the district enrollment to obtain an average cost/tax levy per pupil.

Residential and nonresidential service costs are obtained by first apportioning a share of total municipal service costs to residential development versus business development. This is done by averaging two proportional values. The first is the ratio of residential to total parcels in the community. The second is the proportion of residential to total assessed valuation in the community. The average of these two ratios creates a factor to divide service costs between residential and nonresidential development. A cost per person for new residents and a cost per worker can then be applied to the projected increases.

Other less frequently used average cost approaches include the service standard and proportional valuation methods. The ***service standard method*** applies information from the *U.S. Census of Governments* to derive ratios of staffing and capital expenditures per person for several municipal functions. There are several sources for data related to service standards by municipal population size (Burchell, et al., 1994).

The ***proportional valuation method*** is applied to "typical" nonresidential development. It simply apportions a share of municipal service costs based on the proportion of new property valuation to total municipal valuation. This method does not work well with either very large or small development projects, or those that otherwise have an unusual employment pattern.

A marginal cost approach is more suitable in cases where there is either substantial deficient or excess service capacity, rapidly changing population, or the project is somehow atypical. It is also appropriate whenever there is need for a more intimate understanding of how the project is likely to affect municipal finance. Marginal cost approaches include the case study approach, the comparable city method, and the employment anticipation method.

As the name implies, the ***case study approach*** requires carefully investigating the impacts of the development and the current municipal service capacity. Interviews would be conducted with municipal service managers and school district officials to get a better estimate of costs than can be derived using an average cost. In older, stable cities with established infrastructure, the additional increment of service may have a marginal cost near zero. In rapidly growing fringe communities, the thresholds tipping new infrastructure investments may be readily crossed. Additional comments on case study approaches are offered later in this section.

The ***comparable city method*** is used in cases similar to where the case study approach is appropriate, but is simpler to employ. It involves using city and school district expenditure ratios derived from *U.S. Census of Governments* data categorized by cities of comparable population and growth rates. Where a pending economic change is going to alter the municipal size category and historic growth rate, the ratio of the new city class/growth multiplier to the old multiplier is multiplied by existing per capita expenditures to estimate new expenditures.

Finally, the ***employment anticipation method*** is a regression technique that predicts changes in employment and is appropriate for nonresidential development projects, particularly those with unusual employment patterns. Preexisting per capita public service multipliers by type of business are available (Burchell, et al., 1994). The analyst might simply apply one of these preexisting multipliers or create a regression model to use with a particular community. More will be said about utilizing econometric methods later in this section.

iii. *Projecting Revenues*

Economic policies and events also affect municipal and school district revenues. Burchell, et al (1994) identify the following own-source and intergovernmental revenues that may be affected:

Table 1 - Common Municipal Tax Revenues

Own Source Revenues	Own Source Revenues
Taxes	*Charges, Fees and Miscellaneous*
real property	interest, rents, royalties
personal property	licences and permits
utility	charges for services
income	fines
other	sales of fixed assets
	other
Intergovernmental Revenues	
State Aid	
Federal Aid	

Source: Burchell, Listokin, Dolphin, Newton and Foxley, 1994, page 131.

The analyst needs to consider the basis for each type of revenue. Many revenues are formula-driven, and the projection requires applying the appropriate rate to the expected change. For example, total assessed valuation changes are multiplied by the current real property tax rate. Similarly, many state and federal aids are distributed on a per capita basis and expected population changes would be inserted into the aid distribution formula. Of course, many aid formulas, such as those applied to school district funding, may be quite complex and change over time.

Other types of revenues are generated by changes in the population. Historical trends in taxable retail sales, user fees, or fines can be charted, converted to a per capita or per unit basis, and applied to the projected population or unit change. The final step is simply to compare the costs to the benefits to determine whether there is likely to be a net fiscal surplus or deficit.

iv. *Considerations in the Use of Planning Methods*

The methods discussed in this section provide a reasonably efficient way to project municipal fiscal impacts associated with economic policies and events. Care should be taken, however, to check that the underlying assumptions inherent in their application are reasonable in light of a given situation. Three cautions deserve specific mention.

There needs to be a reasonably good estimate of the likely direct changes associated with the economic policy or event. The change "scenario" needs to be carefully constructed and checked. In almost any type of policy analysis, the accuracy of assumptions associated with the direct impacts determine whether the analysis output is valid.

Similarly, consideration is needed to determine whether the development or other change is "typical," and whether it is reasonable to use multipliers or other parameters based on averages or national norms. It may be appropriate for the analyst to adjust the parameters if the standard approach is likely to result in under- or over-estimates. Similarly, there may be instances where it is appropriate to subject certain parameters to a sensitivity analysis.

Finally, there also needs to be an accurate understanding of the existing capacity within the municipality. If the change of interest trips the threshold where new municipal investment in staff, facilities or infrastructure are required, the costs to the municipality will change dramatically. In such a case, it is essential to use a marginal-cost, rather than an average-cost approach.

B. Case Study Approach

The case study is also categorized as a planning approach by Burchell and Listoken (1978, 1980). Here, it is highlighted to emphasize the importance of understanding the municipality's existing situation prior to performing the analysis. Too often there is an assumption that existing municipal staff and facilities have sufficient capacity to absorb changes. The fallacy of this assumption, however, is where many impact analyses fall short. It is essential to consider the irregular, but often substantial staff and capital costs that accompany growth. It is for this purpose that many growing communities have instituted growth impact fee policies.

As indicated earlier, the case study approach is a marginal-cost impact analysis method, best suited for use when there is significant over- or under-capacity in local public services. This will typically be the case in older central cities with stable or declining populations, and in newer urban communities with rapidly growing population. It can also be useful in established cities where the addition of a major new employer is likely to lead to rapid in-migration of new workers and their families.

As might be expected, the procedure is time and resource intensive. Scheduling and interviewing public service managers, documenting capacity, and confirming the results makes this among the least efficient impact analysis procedures. It has also been criticized as ad hoc, with analysts making up procedures as they go along. Some question whether service managers actually know the capacity of the systems they manage.

Here it is assumed a hybrid case study approach needs to be incorporated into an analysis using a combination of techniques. Over time, an experienced city planner will have a generally good idea where the municipality stands with regard to service capacity and will recognize when additional investigation is warranted. External consultants, however, will not have that benefit and may need additional time to understand the local situation. In either case, it is incumbent of the analyst to explicitly address the question of existing capacity related to key municipal and school district services.

i. *Summary of Procedures*

The case study approach can be summarized in Table 2, where the assumption is one of identifying impacts associated with new growth.

The process outlined here is intuitively straightforward. Care needs to be exercised when gathering the information to ensure service managers provide accurate assessments. In some cases, service managers may act in a self-serving manner in an effort to look good or maintain and/or enhance budgets. The important point here is to make a conscious and systematic effort to identify potential "hidden" future service costs associated with new development.

Table 2 - Steps in the Case Study Approach and Notes in the Execution of Procedures

Analysis	Notes
Contact key local public service administrators and school district officials	The analyst needs the endorsement of chief policy-makers and administrators to ensure timely response from department heads and line workers who have needed information.
Create a classification system of service functions	Sufficient detail is needed for understanding, e.g. public works might be broken into sanitary sewer, water, storm water, and roads.
Determine excess or deficient service capacity	Determine *desired* service level, not the *current* service level. Convert the information into the units of analysis needed, e.g. staff per 1,000 population, student teacher ratio, etc.
Project population increases and level of service demand	These projections are made using the planning techniques identified earlier, e.g. demographic multipliers, service standards, etc.
Determine anticipated service response	Given the projected increases, service administrators indicate what, if any, actions will be needed to accommodate new service demands.
Project total annual public service costs	Convert the administrator's estimates into a schedule of public service costs over the relevant time horizon.

Source: Based on Burchell and Listokin, 1978, page 48 and accompanying discussion.

C. Econometric Approaches

Econometric approaches go beyond per capita and case study methods insofar as they attempt to capture the interaction between components of the economy that determine levels of supply and demand of public goods. The approach uses statistical techniques that relate public expenditures to the factors that drive demand in a dynamic context. A series of equations are specified to predict functional expenditures and own-source and intergovernmental revenues. Such a system of fiscal equations can be used in isolation or can be linked to other components of the economy known to interact with the public sector, such as changes in private sector employment and the labor market, through so-called **conjoined models**.

i. ***Econometric Specification of Public Sector Supply and Demand***

Demand for public sector goods is typically modeled using local government (city, county or school district) expenditures, while supply uses local tax revenues (Deller, 1996). These are the dependent variables of interest to policy-makers in a series of econometric equations representing local government behavior. The challenge is to identify the independent variables that determine expenditure and revenue levels given an existing set of conditions and available data.

Typically, expenditures are modeled as a function of population, income, and a vector of other relevant variables that are thought to affect local decision-making, such as housing ownership, population dependency rates, poverty, unemployment, population density, etc. Following Deller (1996), the reduced form of the demand equation is:

$$\ln E = \alpha_E + \alpha_E \ln n + \lambda_E \ln Y + \sum \beta_{Ei} X_i + \psi_E \ln y + \sum \omega_{Ei} w_i$$

where

where E is the level of local expenditures for a particular expenditure category, n is local population, Y is median income, X is the vector of other relevant variables, y represents a given output level of the public good, and w represents the prices of inputs into the production of the public good.

Alternatively, the reduced form demand equation can be expressed as:

Expenditures $= f($quality, quantity, input conditions, demand conditions$)$

where quality and quantity are represented by the level of output y, input conditions are the prices of factor inputs w, and demand conditions are captured by the n population, Y median income, and the X vector of other relevant variables.

On the revenue side, the reduced form equation is:

$$\ln \tau = \alpha_\tau + \gamma_\tau \ln n + \lambda \ln Y + \sum \beta_{\tau i} X_i + \psi_\tau \ln \gamma + \sum \omega_{\tau i} w_i$$

where τ is the tax price, and other variables are defined as above. Theoretically, the revenue equation is more difficult to model because revenues are typically determined by accounting formulas, e.g. state aid formulas and set tax rates. Johnson, et al. (1997) have had considerable applied experience estimating these equations, and indicate that certain local characteristics can be used to estimate local revenues across most places. They illustrate the alternative reduced form equations for individual revenue sources as:

Non-local Aids $= f($expenditures, income, personal property, real property$)$

Sales Tax Revenues $= f($income, employment, in-commuters$)$

Other Tax Revenues $= f($sales tax revenues, income$)$

Real Property Tax $= f($income, employment, out-commuters$)$

Personal Property Tax $= f($income, out-commuters$)$

The specific form of these equations can vary considerably across states depending on the legal and institutional rules in place. The specification is offered only to provide a sense of the types of explanatory variables used. Analysts will need to experiment to obtain the best fitting model for any given state.

In estimation these models, cross sectional data for a state are used to create a pool of data for estimating the equations. Most of the data related to revenues, expenditures, income, etc. are used in a per capita form. To introduce a dynamic to the model, the output from one year is used to ‘boot-strap’ the input into the next year. This recursive procedure is repeated for several years thought to coincide with the time where the impacts of interest are assumed to occur. Typically, a base line scenario would be run assuming no change in the current economic conditions. Then, a change scenario would be run assuming the employment or population change associated with a policy of economic event, and would be compared to the base line to estimate impacts to public finances.

ii. *Conjoined Modeling Approaches*

Local government fiscal models can be specified and used as a "stand-alone" impact analysis tool. Recently, however, a number of researchers have been working to develop systems that link local government fiscal models to other economic models to increase their accuracy given known economic relationships. As implied by the equations presented, local governments respond to a series of signals related to supply and demand. Thus, there have been important recent advances in modeling systems that *conjoin* an input-output model with separate econometric models that deal with various spheres of community economic activity (e.g. labor market, housing, retail sales, etc.). Input-output models trace the economic linkages between sectors. For a complete discussion of input-output modeling, see Schaffer (1999). A principal benefit of this approach is combining the dynamics of econometrics with the industrial disaggregation available from input-output tables (Rey, 1999). Such an approach is thought to be more "holistic" in capturing the interrelationships between local economic entities (Deller, 1996).

The premise of these models is that employment is a fundamental driver behind local levels of population and, thus, public service supply and demand. Policies or economic events that affect employment will influence the level of local population and the demand for, and the capacity to support, public services. Thus, in a basic form of this modeling system, employment changes derived from an input-output model are fed into an econometric model representing the local labor market and public-sector finance to estimate fiscal impacts.

Given the open nature of the economy, labor market behavior is an important determinant of local fiscal conditions. People readily commute across municipal boundaries between work and home. To ignore this fact introduces potentially significant error into impact estimates. Thus, it becomes appropriate to consider use of an integrated modeling approach to estimate fiscal impacts.

Johnson, et al. (1997; see also Swenson and Eathington, 1998) have spearheaded an initiative to create a standard procedure for conjoining input-output models with fiscal and labor market models. Employment changes are estimated using standard input-output procedures. These employment changes are introduced into an econometric model that simultaneously solves labor market and fiscal impacts. The labor market module uses the following identity:

Unemployed = Labor Force + In-commuters - Employment - Out-commuters

In the basic model, the equations used to derive the components of this identity are:

Labor Force = f(employment, housing conditions, cost of living, public services, taxes, industry mix, area)

Out-commuting = f(employment, external employment, external labor force, housing conditions, cost of living, public services, taxes, industry mix, area, distance to jobs)

In-commuting = f(employment, external employment, external labor force, housing conditions, cost of living, public services, taxes, industry mix, area, distance to residence)

By extending these models, researchers have endeavored to conjoin a number of modules that affect local conditions, including housing demand, retail sales, and demographic composition (an ambitious example is found in Shields, 1998). In this way, policy-makers are presented with a wider range of impacts known to be associated with economic policy and change.

D. Conclusion

Local officials have long been concerned with the impact of growth and change on local public finances. Often, there has been a presumption that economic growth of any sort would have a beneficial impact on local fiscal conditions. Experience has shown, however, that this is not always true. Over time, planners and other analysts have developed a variety of methods to better anticipate the effects of change on public sector finances.

Planning approaches, such as per capita multipliers, have long been used as a relatively quick way to project public fiscal impacts, and are probably still the most common analysis technique used by practitioners. Recently, there have been important advances in econometric techniques that provide a fuller understanding of multiple impacts in both the public and private sectors while also capturing the interaction between economic sectors. These systems hold promise to make fiscal impact analysis a more useful tool insofar as they encourage a deeper discussion of how policy and economic change are likely to affect local well-being.

Regardless of the method, however, it is necessary to incorporate the spirit of the case study approach into the analysis to gain a deeper understanding of conditions in the community. This emphasis on knowledge of local capacity is vital to generating better projections and avoiding potentially significant hidden costs associated with development.

VII. Chapter Conclusion

This chapter provided an introduction to state and local public financing. The chapter began by providing an overview of the growth of state and local governments over the past forty years. The important sources of revenue - sales taxes, income taxes, corporate income taxes, excise tax, and property taxes - were all discussed in the second section of the chapter. With an understanding of the basic trends in state and local governments and the principle means of financing, the third section introduced the reader to the basic economic tools of tax analysis. Important concepts such as efficiency and the deadweight loss of taxation were presented. Tax incidence and the efficiency/equity tradeoff were also discussed. The third section concluded by presenting two models of optimal taxation. The second part of the chapter presented several applications in public finance. These included revenue forecasting, cost-benefit analysis, and fiscal impact analysis.

While this chapter covered the basic trends and issues surrounding state and local public finance, there are many other aspects of state and local public finance that were discussed here. One important issue facing all state and local governments is revenue stability. The stability of revenues is crucial in order to ensure a constant revenue stream during changing economic conditions. Each local or state government needs to decide on the appropriate mix of taxes that will ensure a stable revenue stream. Another area of state and local public finance is debt financing. Like the federal government, state and local governments often issue bonds in order to generate monies to fund public projects such as parking lots, libraries, parks, etc. Understanding the tolerable level of debt in terms of future tax revenues is an issue faced by all localities.

The number of public finance issues impacting state and local governments is almost limitless. While we cannot do justice to all issues here, we refer the reader to the public finance textbooks presented in the section of the chapter. These texts not only contain chapters on various issues of state and local public finance, they also contain many references to scholarly articles covering a myriad of public finance issues.

As the demand for local government goods and services continues to increase, public finance issues will have a growing impact on all of our lives. Local officials will discuss issues such as tax changes, tax implementation, debt financing, finance reform, etc. While public finance decisions are often made by these few individuals in power, their decisions will have a direct impact on the lives of all residents residing in the affected locality. We hope this chapter has provided the reader with the basic tools necessary to make educated, critical evaluations of public finance issues that may arise in their community.

References

Arrow, K., Solow, R., Portney, P.R., Leamer, E.E., Radner, R., and H. Schuman. 1993. "Report of the NOAA Panel on Contingent Valuation." *Federal Register*, 58: 4601-4614.

Barnett, W.F. 1988. "Four Steps to Forecast Total Market Demand." *Harvard Business Review*, 88(4): 28-38.

Bateman, I.J. and K.G. Willis. (eds.) 1999. *Valuing Environmental Preferences: Theory and Practice of the Contingent Valuation Method in the U.S., E.U. and Developing Countries.* New York: Oxford University Press.

Bartik, T.J. 1988. "Evaluating the Benefits of Non-marginal Reductions in Pollution Using Information on Defensive Expenditures." *Journal of Environmental Economics and Management*, 15(1): 111-127.

Bishop, R.C. and T.A. Heberlein. 1990. "The Contingent Valuation Method." Pp. 81-104 in R.L. Johnson and G.V. Johnson (eds.). *Economic Valuation of Natural Resources: Issues, Theory and Applications.* Boulder, CO: Westview Press.

Boardman, A.E., D.H. Greenberg, A.R. Vining and D.L. Weimer. 1996. *Cost-Benefit Analysis: Concepts and Practice.* Upper Saddle River, NJ: Prentice Hall.

Borg, M.O., P. Mason, and S. Shapiro. 1991. *The Economic Consequence of State Lotteries.* Praeger, Westport, Connecticut.

Boston Consulting Group. 1998. "The State of On-line Retailing." Boston Consulting Group and Shop.org

Box, G.E.P. and G.M. Jenkins. 1976. *Time Series Analysis: Forecasting and Control.* Revised Edition. San Francisco: Holden-Day.

Brennan, G. and J. Buchanan. 1977. "Towards a Tax Constitution for Leviathan." *Journal of Public Economics* 8: 255-274.

Burchell, R.W. and D. Listokin. 1978. *The Fiscal Impact Handbook: Estimating Local Costs and Revenues of Land Development.* Center for Urban Policy Research. New Brunswick, NJ: Rutgers, The State University of New Jersey.

Burchell, R.W. and D. Listokin. 1980. *Practitioner's Guide to Fiscal Impact Analysis.* Center for Urban Policy Research. New Brunswick, NJ: Rutgers, The State University of New Jersey.

Burchell, R.W., Listokin, D., Dolphin, W.R., Newton, L.Q., and S.J. Foxley. 1994. *Development Impact Assessment Handbook.* Washington, D.C.: ULI - the Urban Land Institute.

Cirincione, C., Gurrieri, G.A., and B. van de Sande. 1999. "Municipal Government Revenue Forecasting: Issues of Method and Data." *Public Budgeting & Finance*, 19(1): 26-46.

Clotfelter, C.T. and P.J. Cook. 1989. *Selling Hope: State Lotteries in America.* Cambridge: Harvard University Press.

Cummings, R.G., Brookshire, D.S., and W.D. Shulze. 1986. *Valuing Environmental Goods: An Assessment of the Contingent Valuation Method.* Totowa, NJ: Rowman & Allanheld.

Deller, S.C. 1996. "Theoretical Foundations of CE Models." Unpublished paper presented at the Community Economic Modeling Conference. Madison, WI. June 9-10, 1996.

Fisher, R.C. 1980. "Local Sales Taxes: Tax Rate Differentials, Sales Loss, and Revenue Estimation." *Public Finance Quarterly* 8: 171-188.

Fisher. R.C. 1995. *State and Local Public Finance: Institutions, Theory, Policy*, Homewood, Illinois: Richard D. Irwin, Inc.

Frank, H.A. 1993. *Budgetary Forecasting in Local Government: New Tools and Techniques.* Westport, CT: Quorum Books.

Fullerton, D. and D.L. Rogers. 1993. "Who Bears the Lifetime Tax Burden?" Washington D.C.: The Brookings Institution.

Garrett, T.A. 1999. "A Test of Shirking Under Legislative and Citizen Vote: The Case of State Lottery Adoption." *Journal of Law and Economics* 62: 189-208.

Ghaus, A.F. Aisha. 1995. "Optimal Local Sales Tax." *Urban Studies* 32*: 1369-1381.*

Goolsbee, A. and J. Zittrain. 1999. "Evaluating the Costs and Benefits of Taxing Internet Commerce." *National Tax Journal* 52: 413-428.

Gramlich, E.M. 1981. *Benefit-Cost Analysis of Government Programs.* Englewood Cliffs, NJ: Prentice-Hall, Inc.

Green, D.L., D.W. Jones, and M.A. Delucchi (eds.) 1997. *The Full Costs and Benefits of Transportation: Contributions to Theory, Method and Measurement.* New York: Springer.

Guajardo, S.A. and R. Miranda. 2000. *An Elected Official's Guide to Revenue Forecasting.* Chicago: Government Finance Officers Association.

Hausman, J.A. (ed.). 1993. *Contingent Valuation: A Critical Assessment.* New York: North-Holland.

Hellerstein, W. 1997. "Transaction Taxes and Electronic Commerce: Designing State Taxes That Work in an Interstate Environment." *National Tax Journal* 50: 593-606.

Hersch, P.L. and G.S. McDougall. 1989. "Do People Put Their Money Where Their Votes Are? The Case of State Lottery Adoption." *Southern Economic Journal* 56: 32-38.

Holcombe, R.G. and R.S. Sobel. 1997. *Growth and Variability in State Tax Revenue - An Anatomy of State Fiscal Crises.* Westport, Connecticut: Greenwood Press.

Hyman, D.N. 1999. *Public Finance: A Contemporary Application of Theory to Policy.* New York, New York: The Dryden Press, Harcourt Brace and Company.

Johnson, T.G., Scott, J.K., and J. Ma. 1997. "The Community Policy Analysis System (COMPAS)." Unpublished manuscript. Community Policy Analysis Center, University of Missouri - Columbia.

Long, D.A., C.D. Mallar, and C.V. Thornton. 1981. "Evaluating the Benefits and Costs of the Job Corps." *Journal of Policy Analysis and Management*, 1(1): 55-76.

Makridakis, S., Andersen, A., Carbone, R., Fildes, R., Hibon, M., Lewandowski, R., Newton, J., Parzen, E., and R. Winkler. 1984. *The Forecasting Accuracy of Major Time Series Methods.* New York: John Wiley & Sons.

Makridakis, S. and S.C. Wheelwright. 1987. *The Handbook of Forecasting: A Manager's Guide.* (2^{nd} ed.). New York: John Wiley & Sons.

Makridakis, S. and S.C. Wheelwright. 1989. *Forecasting Methods for Management.* (5^{th} ed.). New York: John Wiley & Sons.

Max, W. and D.P. Rice. "Shooting in the Dark: Estimating the Costs of Firearms Injuries."*Health Affairs*, 12(4): 171-185.

McClure, C.E. 1997. "Electronic Commerce, State Sales Taxation, and Intergovernmental Fiscal Relations." *National Tax Journal* 50: 731-749.

Mikesell, J.L. and C.K. Zorn. 1986. "Impact of the Sales Tax Rate on Its Base: Evidence From a Small Town." *Public Finance Quarterly* 14: 329-338.

Miller, T.R. 1993. "Costs and Functional Consequences of U.S. Roadway Crashes." *Accident Analysis and Prevention*, 25(5): 593-607.

Miller, T.R., M.A. Cohen and S. Rossman. 1993. "Victim Costs of Violent Crimes and Resulting Injuries." *Health Affairs*, 12(4): 171-185.

Mitchell, R.C. and R.T. Carson. 1989. *Using Surveys to Value Public Goods: The Contingent Valuation Method.* Washington, D.C.: Resources for the Future.

Moore, M.J. and W.K. Viscusi. 1990. "Models for Estimating Discount Ratesfor Long-term Health Risks Using Labor Market Data." *Journal of Risk and Uncertainty*, 3(4): 381-401.

Nelson, A.C. (ed.).1988. *Development Impact Fees*. Chicago: Planners Press.

Pechman, J.A. 1985. "Who Paid the Taxes: 1966-1985?" Washington D.C.: The Brookings Institution.

Ramsey, F.P. 1927. "A Contribution to the Theory of Taxation." *Economic Journal*, 37: 47-61.

Rey, S.J. 1999. "Integrated Regional Econometric and Input-Output Modeling," Unpublished paper. Department of Geography, San Diego State University. Available on the Internet at http://www2.econ.iastate.edu/classes/crp274/swenson/URP290/Readings/rey99-1.pdf.

Rice, D.P., MacKenzie, E.J. and Associates. 1989. *Cost of Injury in the United States: A Report to Congress*. San Francisco, CA: Institute for Health and Aging, University of California and Injury Prevention Center, The Johns Hopkins University.

Rosen, H.S. 1985. *Public Finance*. Homewood, Illinois: Richard D. Irwin, Inc.

Rosen, S. 1974. "Hedonic Prices and Implicit Markets: Product Differentiation in Pure Competition." *Journal of Political Economy*, 82(1): 34-55.

Schaffer, W.A. 1999. "Regional Impact Models." In S. Loveridge (ed.). *The Web Book of Regional Science*. Regional Research Institute, West Virginia University. Available on the Web: https://researchrepository.wvu.edu/rri-web-book/7/.

Shields, M.L. 1998. "An Integrated Economic Impact and Simulation Model for Wisconsin Counties." Unpublished dissertation. Department of Agricultural and Applied Economics, University of Wisconsin-Madison.

Swenson, D. and L. Eathington. 1998. "A Manual for Community and Fiscal Impact Modeling Systems: Practical Techniques for Building and Applying Community Level Models." Unpublished paper. Department of Economics, Iowa State University.

Tannenwald, R. 1998. "Devolution: The New Federalism - An Overview." In Devolution: The New Federalism, *New England Economic Review*, (May/June): 1-12.

Vuscusi, 1993. "The Value of Risks to Life and Health." *Journal of Economic Literature*, 31(4): 1912-1946.

Wong, J.D. 1995. "Local Government Revenue Forecasting: Using Regression and Econometric Revenue Forecasting in a Medium-Sized City." *Public Budgeting & Financial Management*, 7(3): 315-335.

Glossary

Cost-Effectiveness Analysis – Cost-Effectiveness Analysis (CEA) and Cost Utility Analysis (CUA) are sometimes used as an alternative to CBA. Generally, these alternatives are selected when it is preferable, or the analyst is unable or unwilling, to monetize all of the relevant impacts. This is sometimes the case when we might prefer to compare programs as to their cost per life saved. CEA utilizes a single quantified, but not monetized, metric such as *per life*. CUA does the same, but the measure is a construct consisting of two (usually) or more benefit categories, such as quality-adjusted life. Here, we might talk about cost *per year of quality life*.

Crime – Many public programs are initiated with the intent of reducing crime and criminal behavior. To estimate the benefits of such programs it is necessary to estimate the number and value of crimes the program will reduce. Several major studies have been completed that estimate the costs of medical care associated with various crime-related injuries, the opportunity costs of foregone productivity, and the value of pain and suffering (Miller, et al., 1993). Other relevant costs include criminal proceedings and incarceration.

Discounted/Present Value –Most are familiar with the idea of compound interest, or calculating the future value of money. If we save \$100 in a bank account at five percent simple annual interest ($i = .05$), after one year we have $(1 + .05) \cdot \$100 = \$105$. If we continue to save for the second year, we accrue $(1+.05) \cdot \$105 = \$110.25$. This can also be expressed as $(1+.05) \cdot (1+.05) \cdot \$100 = (1+.05)^2 \cdot \$100 = \$110.25$. If the money were left in the bank for five years, we can calculate the future value as $(1 + .05)^5 \cdot \$100$. More generally, if $\$X$ were invested for T years at interest rate i, we would calculate the future value as $\$X \cdot (1+i)^T$.

With discounting, we do exactly the opposite; we take some future value and calculate what it is worth to us today. If we agreed to purchase a guarantee of a \$100 payment one year from now, how much should we pay? We might be inclined to pay \$100, but that functionally provides the seller an interest-free \$100 loan. In exchange for the promise to receive \$100, we would discount that value by an amount representing our perception of deferring access to our \$100 for a year. We would want to calculate the present value of \$100 received a year from now.

To find the present value of \$100 received a year from now, we find the amount, which when multiplied by $(1 + .05)$, equals \$100. The calculation is simply $\$100/(1 + .05) = \$95.24$. If the promise is to pay \$100 two years from now, the calculation is $\$100/(1 + .05)^2 = \$90.70$. In general, when the interest rate is i, the present value of the promise to pay $\$X$ in T years is $\$X/(1+i)^T$. The interest rate i that we apply is called the **discount rate** and the term $(1+i)^T$ is the **discount factor**.

Typically, projects will have a stream of benefits that accrue at different times through the course of the project and beyond. We can calculate the present value of each year by applying the appropriate discount factor as illustrated in the table below.

Calculating Present Value

Dollars Payable	Years into the Future	Discount Factor	Present Value
X_0	0	1	X_0
X_1	1	$(1+i)$	$X_1/(1+i)$
X_2	2	$(1+i)^2$	$X_2/(1+i)^2$
X_T	T	$(1+i)^T$	$X_T/(1+i)^T$

Source: Adapted from Rosen 1985, page 177.

To get the present value of the stream of payments, we simply add the values in the last column:

$$PV = X_0 + \frac{X_1}{(1+i)} + \frac{X_2}{(1+i)^2} + \ldots + \frac{X_T}{(1+i)^T}$$

After calculating the present value of both the benefits and costs over the time period all impacts are assumed to accrue, the **net present value** is generated by simply subtracting the costs from the benefits:

$$NPV = \sum \frac{B_T}{(1+i)^T} - \sum \frac{C_T}{(1+i)^T}$$

Impact fees – Impact fee programs are intended to make additional new growth pay the full cost of additional public services (Nelson, 1988). While a housing development, for example, may be required to pay the costs of new streets and storm water drainage, the increase in municipal population also brings new demands for recreational facilities, traffic improvements, and other services. Failure to apply these costs to the new development is to provide an implicit subsidy to new residents by existing residents who must help pay the cost of new facilities. To the extent there is a clear connection between new growth and the need for new facilities and services, municipalities can implement a fee structure that requires new growth to pay its fair share of new municipal costs.

Internal Rate of Return – The internal rate of return is the discount rate at which the present value of a project's benefits is exactly equal to zero. This will yield some discount rate that can be equated with a "return on investment." The decision rule for policy makers would be to select the project if the social discount rate is less than the internal rate of return.

The **benefit-cost ratio** is simply the net present value of the benefits divided by the net present value of the costs. The decision rule would be that if the ratio value is greater than 1.0, go ahead with the project.

There are potentially problems in using either the internal rate of return or the benefit-cost ratio to guide the policy choice. There may be more than one internal rate of return that equals zero. This arises when the annual net benefits change from positive to negative more once through the discount period. Similarly, internal rates of return and benefit-cost ratios are percentages and can not be added across projects as is possible when the metric is dollars. Finally, the highest benefit-cost ratio is not necessarily the project that will maximize net benefits. For these reasons, net present value is a better choice to aid decision-making.

Nominal dollars – Nominal dollars reflect the purchasing power of a dollar at the current time of expenditure. Thus, what a dollar would purchase in 1980 would be very different than what a dollar would purchase in 2005. Real dollars remove the effects if inflation by applying a *deflator*, the most common of which is the Consumer Price Index. Once adjusted, the dollars are expressed in the value of a single year, generally very close to the present because this is the value policy-makers will best understand. It is worth noting, the proper reference is to "inflation- adjusted dollars" and not "deflated dollars"

Pareto efficiency – The concept of Pareto efficiency is illustrated in Figure 1. In this example, it is supposed that two people may split a payment up to $100, if they can agree how to do it. They each currently receive $25 at point a. Point d represents where person 1 receives the entire $100 and point e is where person 2 receives the entire $100. The questions arises whether there may be a way of increasing the payment to each person without decreasing the payment currently received by the other. At any point in the shaded area bounded by $a - b - c$, either person can be made better off without making the other worse off. The line connecting points d and e represents the distribution of the entire $100 between the two people, but only between points b and c can one or both be made better off without making one worse off. Finding a distribution somewhere along this "frontier" makes maximum use of the $100, but any movement toward the shaded area increases the benefit to both people over where they are currently.

Price Elasticity – Recall that the *price elasticity* measures the percentage change in quantity demanded or supplied given a precentage change in price. Thus, a higher price elasticity of demand reveals that a change in price will be met with a relatively higher change in quantity demanded. Consumers or suppliers with a relatively higher price elasticity are thus more likely to change behavior than those having lower price elasticities.

Real discount rate – The real discount rate (r) approximately equals the nominal discount rate (i) minus the expected rate of inflation (m), and is calculated as:

$$r = \frac{(i-m)}{(1+m)}$$

A common approach to estimation the expected rate of inflation is to assume that real long-term bond yields will remain stable and to deduct this yield from the current long-term bond yield. If the yield on current long-term bonds is seven percent and the real long-term bond yield has been about three percent, the expected rate of inflation would be four percent. The real yield would be calculated over a time period approximately equal to the expected term of the project impacts.

Many suggest that a discount rate calculated purely on market values is inappropriate to use when considering public expenditures and argue that we should use a **social discount rate**. There is reason to believe that we value the time preference of money as individuals differently than we should as a society. The argument is that individuals view the opportunity cost of foregoing current consumption as much higher than should society, resulting in higher discount rates that discourage long-term investment (thus our current low rate of aggregate savings). Because of concern for future generations, the obligation to consider the general welfare of the citizenry, and the imperfections of markets, it is often said the social discount rate should be lower than the market discount rate. Others view these arguments as paternalistic and unconvincing, preferring something closer to a market discount rate (Rosen, 1985).

Shadow prices –

Summaries of Research Establishing Shadow Prices Frequently Used in Cost-Benefit Analyses

Shadow Price	Value
Value of Life	\$2 to \$3 million (\$1990)
Monetary Injury Costs per Person (Rice and MacKenzie 1989)	(\$1990)
eventually fatal	\$385,000
hospitalized/nonfatal	\$41,000
non-hospitalized/nonfatal	\$600
Per Person Cost of Injury (Viscusi 1993)	(\$1990)
less serious	\$25,000
more serious	\$50,000
Motor Vehicle Crash Injuries (Miller 1993)	(as a fraction of value of life)
spinal cord	0.66
brain	0.04
lower extremity	0.06
upper extremity	0.03
average for nonfatal crash	0.02
average for fatal crash	1.08
Average Victim Cost per Crime (Miller, Cohen and Rossman 1993)	(\$1900)
rape	\$64,000
robbery	\$26,000
assault	\$24,000
arson	\$52,000
Per Person Cost of Firearm Injuries (Max and Rice 1993)	(\$1990)
fatal injuries	\$374,000
injuries requiring hospitalizaton	\$33,000
injuries not requiring hospitalization	\$500
Per Person Cost of Crime (Long, Maller and Thornton 1981)	(\$1990)
robbery	\$27,000
burglary	\$13,000
larceny	\$6,000
drugs	\$6,000
Value of Travel Time Saved	(as a fraction of wage rate)
inter-urban (commuting) travel	0.40 to 0.50
work time	equal to wage rate

Source: Boardman, Greenberg, Vining, and Weimer, 1996, page. 391.

Social surplus –Figure 2 illustrates the concept of social surplus. In a competitive market with a quantity of good Q_0 at price P^*, consumers benefit in the area bounded by points $a - b - P^*$ because there would exist consumers who would be willing to purchase good Q at prices higher than P^* if quantities were less than Q_0. Similarly, producers benefit in the area bounded by $a - P^* - c$ because they are able to sell a quantity of good Q greater than they would were the quantity less than Q_0. This is allocatively efficient because anything that would cause more or less production of good Q to occur would reduce social surplus.

Value of life – There are a number of ways researchers have generated value-of-life estimates (Viscusi, 1993; Moore and Viscusi, 1990). The most common is to observe the wage premium needed to induce people to engage in high-risk work activities. Other studies have used contingent valuation methods. Similar studies have been used to place values on various types of serious injuries.

Value of time – Time, of course, has value. Most of the work related to value of time has dealt with travel in the context of transportation projects (Green, et al., 1997). These studies typically use contingent valuation methods or the revealed preference approach, where observations of actual choice behavior are made in the context of available alternatives. Time values are usually reported as some fraction of wage rates by income class.