Public Finance

Prepared by

DR.GamaL. I Hassan

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Chapter One

Public Goods

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We need studying this chapter to illustrate and understand the following topics

1- Characteristics of public goods

2- Pure public goods and pure private goods

3- Demand for a pure public goods

4- Efficient output of a pure public good

Chapter one

Public Goods[1]

Defense spending in United States increased rapidly in 2003 in response to global threats and the war of terrorism. Wars in Afghanistan and Iraq in 2002 and 2003 contributed to increased defense spending and Congress allocated more funds for defense and homeland security. Defense related spending in the United States is now close to 5 percent of GDR. When the federal government provides national defense, it must employed labor and procure capital in the form of weapons system aircraft, naval vessels, and land to use as military has and airfields. The production aspect of national defense is very similar to that of any business operation. Labor must be hired; work rules must be established; research and development contracts must be negotiated for no capital equipment and new products, such as weapons that can penetrate deep bunkers, stealth fighter planes and remote controlled aircraft. However, the similarity with business ends on the output side of the picture the output of the federal government agencies that supply national defense is not sold in the market to buyers like cars, cookies, or clothing. In fact, it is inconceivable to imagine defense services being packaged into neat bundles that can be sold over the counter to eager buyers. Although the production of national defense is similar to that of any other good, its consumption is fundamentally different. Products

[1] David N. Hyman "Public finace copyright, umited state of America, 2005

such as national defense are collectively consumed. As soon as we defend any one person, we defend all.

Because defense is not sold by the unit in markets and cannot be parceled out to individuals to enjoy in greater or smaller amounts according to their tastes, we all consume the total amount produced. We all pay taxes to finance the production of national defense and we must consume the amount made available, even though we might prefer to have more or less than the government provides. An issue that concerns us all is how much of our resources we allocate to services such as national defense.

This chapter explores the characteristics of goods methods of supplying public goods and show why it is efficient for people to share the costs of producing goods with shared benefits.

Characteristics of Public Goods

Many of goods and services actually provided by governments, such as national defense, would result positive externalities were they made available for sale to individual buyers in markets. To repeat, goods such as national defense cannot be sold as easily as candy ba in markets for the exclusive benefit of individual consumer. An entire class of goods, including environment protection, roads, and public safety, have benefits that must be shared by large groups of individuals. The production of these goods for sale in the marketplace would be accompanied by positive externalities because any such items purchased for individual use would provide external benefits to a large

number of this parties as well. Market provision of goods with benefits shared by people other than those who purchase their for their own use is unlikely to result in an efficiently large amount of output.

Goods with benefits that cannot be withheld from those who do riot pay and are shared by large group of consumers are public goods. Public goods are usual made available politically through the ballot box as people vote to decide how much to supply rather than through the marketplace, where those who care who care to pay the price can buy as much as they like for their own exclusive use. In most cases, government provision of public goods implies that the goods are freely available to all rather than being sold in markets. The costs of marking the good available are usually financed by taxes.

Let's begin our analysis of public goods by examining their characteristics more closely. Public goods are nonrival in consumption, meaning that a given quantity of a public good can be enjoyed by more than one consumer without decreasing the amounts enjoyed by rival consumers. For example, television and radio transmissions are nonrival in consumption. a given amount of programming per day can be enjoyed by a large number of consumers. When an additional viewer switches on a television set, the quantity of programming enjoyed by other viewers is not reduced. Similarly, the benefits of national defense services are nonrival. When the population of a nation increases, no citizen suffers a reduction in the quantity of national defense because more people are being defended at any time.

Goods that are rival in consumption are called private goods. A given quantity of fish available on a dock is said to be rival in consumption. As the number of fish made available to any one consumer increases, the quantity available for rival consumers who desire the fish decreases. Except when externalities are presented prices can efficiently allocate goods that are rival in consumption. The price serves the purpose of making any one person who desires a unit of the good consider the decrease in benefits to rivals who wish to consumer that unit.

Pricing a good that is non rival in consumption serves no useful purpose. After all, an additional consumer of nonrival good does not reduce the benefit to other who wish to consume it. In other words, the marginal cost of allowing additional people to consume a given amount of a good with nonrival benefits is zero. It is therefore inefficient to price goods that that are nonrival in consumption.

In most cases, it is also unfeasible to price units of a public good. This characteristic of public goods, call non exclusion, implies that it is too costly to develop a means of excluding those who refuse to pay from enjoying the benefits of a given quantity of a public good. For example, it is unfeasible to exclude those who refuse to pay for cleaner air from enjoying the benefits of a given amount of air quality improvement, one it has been supplied for the benefit of other people. Air quality improvement has the property of nonexclusion.

From a practical point of view, goods that are nonrival in consumption need not necessarily be subject to nonexclusion. Television

broadcasting services, as was pointed out above, are nonrival. However, it is feasible to exclude those who refuse to pay from the benefits of transmissions through cable provision of the broadcasts or use of signal coding for satellite transmission. Similarly, the benefits of roads are often non rival. However, it is feasible to use tolls to exclude those who refuse to pay. The characteristics of nonrival consumption and nonexclusion vary in degree from good to good. Much, however, can be learned from further investigation of the problems involved in making available efficient amounts of good that is both non rival in consumption and the benefits of which are nonexclusive.

Pure Public Goods and Pure Private Goods

Pure public good is non rival in consumption for an entire population of consumers and its benefits have the characteristic of nonexclusion. A given quantity of a pure public good is consumed by all members of a community as soon as it is produced for, or by, anyone member. In contract, a pure private good is one that, after producers receive compensation for the full opportunity costs of production, provides benefits only to the person who acquires the good, and not to anyone else. A pure private good is rival in consumption and its benefits are easily excluded from those who choose not to pay its market price.

Market exchange for pure private goods results in neither positive nor negative externalities. A pure public good on the other hand results in widely consumed external benefits to all people, even if made available only for one person. These two extremes can be considered as poles on a continuum, where goods are ranked according to their

degree of publicness or privateness in terms of the range and extent to which their production or consumption generates externalities.

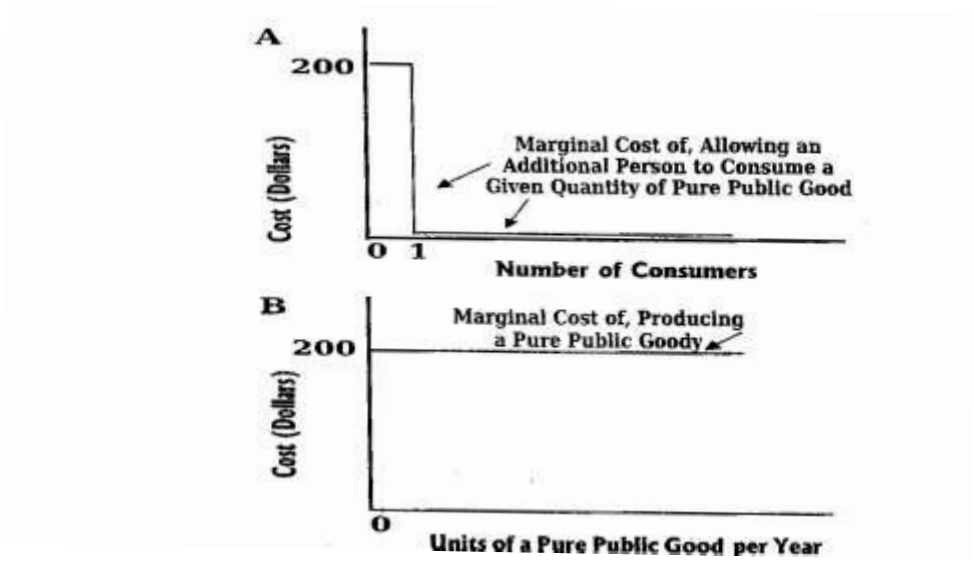
Pure public bads can also exist. These activities result in external costs affecting a wide range of the population. The quantities of public bads are of concern to all individuals. Air pollution, for example, is a pure public bad if pollutants diffuse in the atmosphere, thereby affecting all individuals, independent of the location of their residence. At the other extreme, national defense can be considered a pure public good. It is impossible to protect any one individual against harm from a foreign invasion or attack without protecting all other individuals in the nation at the same time.

The marginal cost of distributing a pure public good to an additional consumer is zero for a given amount of the public good. This follows from the non rival characteristic of pure public goods. Figure 1A, shows that the marginal cost of allowing additional people to consume certain amount of a pure public good falls to zero after the good has been made available for any one person. Be careful not to confuse distribution cost with production cost. The marginal costs of accommodating an additional consumer will be zero for a given quantity of a pure public good. However, the marginal cost of producing additional units of the public good will be positive, as is the case for all economic goods, because increasing the quantity of a pure public good requires additional resources. This is illustrated in Figure 1 B, where we assume that the average cost of a pure public good is constant. two unit of the public good cost twice as much as one unit. In this case, if the

average cost of the public good is $200 per unit, the marginal cost will also be $200

We can emphasize the distinction between pure public goods and pure private goods in still another way.[2] A pure public good is not divisible into units that can be apportioned among consumers. A given quantity of pure public good can only be shared rather than enjoyed individually its benefits are collectively consumed by the entire population. A unit of Apure private good on the other hand, can be enjoyed only by a single consumer. The more units of given amount

Marginal Costs of Consuming and Producing Pure Public Good



The diagram in A shows that the marginal cost of allowing an additional person to consume a give quantity of a pure public good falls to Zero after it is made available to any one person. The graph in B shows that the marginal cost of producing the good is always positive. In this case, the marginal cost of each extra unit of the good is $200

[2] This point is emphasized by samuelson in this classic papers on pure public goods: pau samuelson, the pure theory of public expenditure, review of economics and statistics 36 (November 1954): 387-389 and diagrammatic exposition of the theory of public expenditure, review of economics and statistics 37 (November (1955): 350 - 356

available to be consumed by one person, the less is available to rival consumers.

An example: Bread Versus Heat

A simple example will help to clarify the distinction between pure public goods and pure private goods. Suppose a community of a certain number of people is confined to a room. Decisions made in that room affect only those in the room and no one else. Each day, residents of the room receive a fixed quantity of bread and a certain amount of fuel to heat the room. The bread is a pure private good in the sense that it is possible to slice it and divide it among the individuals. The total amount of bread available each day equals the sum of the amounts consumed by the people in the room. If more bread is allocated to any one person, less will remain available per day for the others. Bread could be easily sold in a market where the price would be established each day by the interaction of demand and supply. Given the daily price of bread, the people in the room could adjust their consumption of bread according to their preferences and economic circumstances.

On the other hand, it is impossible to divide the room's heat among the people. All individuals in the room at any point in time experience the same temperature level. Assume that the room is large enough so that the effect of the heat emitted by additional bodies on the amount of fuel needed is negligible. Therefore, additional public can be accommodated in the room at a given temperature without using more or less fuel. It is impossible for one person to consume more heat in such a way as to reduce the amount made available to others. Finally, it

is impossible for different people in the room to consumer different quantities of heat; that is, the level of heat produced for any one individual is the level that are individuals must consume. Individual consumers heat will lack the ability to adjust the amount of heat, they consume in accordance with their own taste and economic circumstances. It is impossible for two individuals simultaneously to occupy a room in which the temperature is both 65 degrees and 78 degrees Fahrenheit. The level of heat in the room will have at the characteristics of pure public good for those who occupy the room.

An important consideration in discussing public goods is the rang of their benefits. Some public goods such as world peace, might conceivable provide collectively consumed benefits to every single individual, no matter where on the face of the earth. Some goods are collectively consumed within the confines of given nations, although others might produce collectively consumed benefits that are locally consumed. The geographic range of share benefits influences the desirability of having public goods supplied by various levels of government (for example, federal, state, or local). This problem is extensively investigated in the last part of this book.

Provision of Private Goods and Public Goods: Markets and Government

The supply of goods and services and mechanisms of distributing them among individuals reflect collectively agreed-upon institutional arrangements that have emerged in a community. It is difficult to make

generalizations about the most appropriate means for making goods and services available. Private goods that are individually consumed are sometimes supplied through markets by government, as is the case for certain transportation services, electricity, and other public utility services. On the other hand, many goods that are nonrival in consumption and which have characteristics of public goods are privately produced and supplied through markets. this is the case for certain recreational services sold through private clubs, television and other communication services, and private police protection. In many cases, goods and services are supplied both through markets under private production and by governments through political institutions. For example, both private and public schools are available. Recreational services and facilities, such as parks tennis courts, and golf courses, are supplied by both the government and the private sector.

It is possible to imagine, at the extreme, pure private goods being supplied through government and finance through taxation. For example, citizens could agree collectively to supply clothing through government and allow every person one identical suit of clothes per year at no direct change, financing the production and distribution of the clothing through taxation. Similarly, it is possible to envision goods that have the characteristic of public goods being produced privately and sold through markets when the costs of exclusion are not very high. This is the case for cable television services in which programming that is non rival in consumption is produce by profit- maximizing firms that sell monthly subscription to their programming services. The fee serves as a

exclusion device, marking the service available only those who sign a contract and agree to pay.

In practice, it is not possible to draw a neat line between pure private goods and pure public good. Many intermediate cases exist in which external benefits costs accrue only to some people and the transaction costs associated with trading goods with collectively consumed benefits are not prohibitive. In those cases, both private supply and government supply are. feasible, and it is often difficult to determine which supply method is appropriate.

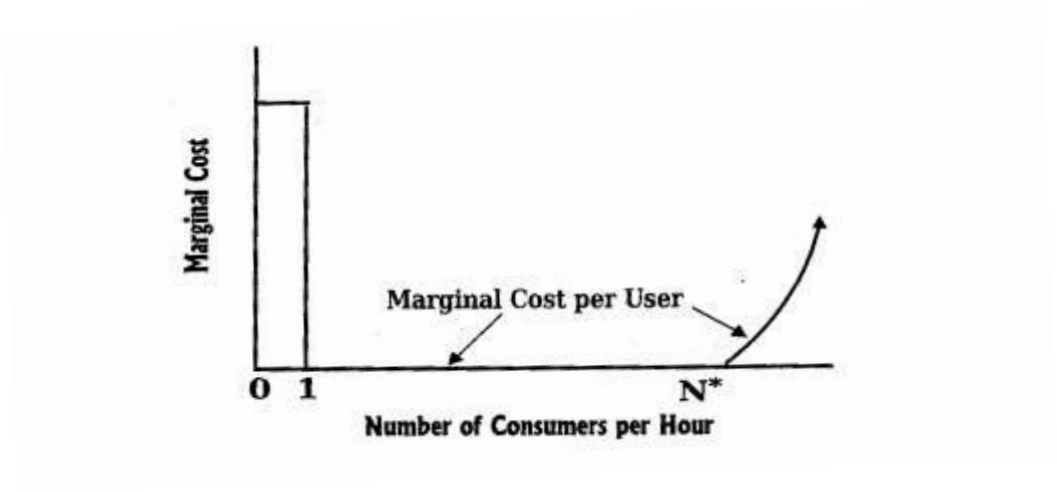
Convertible Public Goods and Private Goods With Externalities

Government supply through political institutions and private supply through markets are alternative means of making any good available. These two alternatives can be evaluated according to the extent to which externalities are associated with either the production or consumption of the good and the extent to which it is possible to develop a means of selling rights to use the good or service.

Congestible public goods are those for which crowding or congestion reduces the benefits to existing consumers when more consumers are accommodated. The marginal cost of accommodating an additional consumer is not zero after the point of congestion is reached. For example, an additional user of a congested road decreases the benefits to existing users by slowing down traffic and increasing the risk of an accident. This is illustrated in Figure 2 (P.146). After N* users of

a road have been accommodated per hour, the marginal cost of allowing another user on that road becomes positive.

Congestible Public Good



the marginal cost of allowing additional users to consume the congestible public goods falls to zero after the good is made available to any one user but then rises above zero after N* use are accommodated per hour.

Price – excludable public goods are those with benefits that can be priced. Private clubs are often set up to share facilities, such as tennis courts, swimming pool and dining areas for small groups. Membership right which are sold in the market, are sometimes negotiable and can be sold by their holders to others. By joining clubs and paying dues, members share in the cost facilities and services that they otherwise would be unable to afford. Dues and limits on the number of members

are determined by collective agreement existing members.[3] The dues ration the facilities of the club to avoid the effects of congestion. Other price excludable public goods include such public facilities as schools and hospitals. These goods can be priced, but their provision results in positive externalities.

Table 1 summarizes alternative means of producing, distributing, and financing goods and services. Goods and services have been divided into four categories:

1- Pure private goods

2- Price excludable public goods

3- Convertible public goods

4- Pure public goods

The first category represents goods that approximate the ideal of a pure private good that is individually consumed and subject to low – cost exclusion from benefits for those who do not pay for the right to receive such benefits. The production of these goods usually does not generate an externality, but some individuals believe that external benefits are associated with others who consume these goods. Such private goods might be sold in markets either by private firms or government. When sold in markets, their costs of production are financed by the revenue obtained from sales to individual buyers.

[3] See Todd Sandler and John T. Tschirhart, The economic theory of club: an evaluative Survey, Journal of economic literature 18 (December 1980): 1481 - 1521

Alternatively, they may be produced by government purchased by government from private firms, distributed free of direct change to eligible recipients, and financed by taxes. Such is the case for public welfare programs that give medical services, food, housing, and other service to low- income citizens who meet certain eligibility test. These services also could be sold at subsidized price with losses made up from tax financed subsidies. Second some goods can be individually consumed and are subject to exclusion, but their production or consumption is like to generate externalities. These are price excludable public goods. Again, such goods can be distributed through markets when produced either by private firms or government. The production or consumption of these goods can be subsidized to account for the positive externality associated with their sale. The good would be financed by both the revenue from sales and the taxes used to finance the subsidy. Such is the case for private and public hospitals, mass transit facilities, and schooling. These goods also can be produced by government and distributed with no direct change. In such cases, however the quantity and quality of the service would be determined collectively through political institutions, and costs would be financed through taxation. This is the case for public schooling, public sanitation service and government-supplied inoculations that are available public health facilities.

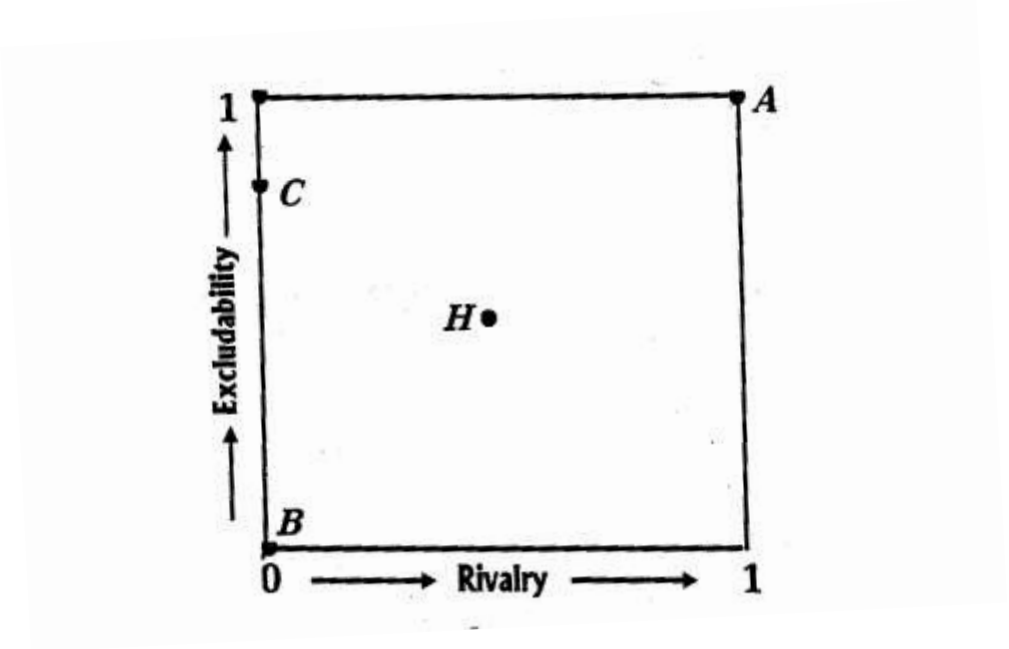
Convertible public goods are nonrival in consumption only up to a certain point. After the number of consumers exceeds a certain amount, the goods become at least partially rival in consumption. An increase in

the use of the good by one consumer decreases the benefits from a given amount of the good that can be enjoyed by others. Exclusion from benefits of these goods is often possible through application of certain fees. convertible public goods, in some cases, are also price excludable public goods. These goods are often in the form of services flowing from shared facilities that can be distributed in markets either by government or by firms through the sale of admissions, memberships, or other use related fees; these might receive public subsidies. Privately supplied examples include clubs for sharing recreational or other facilities, amusement parks, theaters, and sporting events. Government supplied goods of this type might be partially or fully financed by taxes. Public parks are an example, as are other forms of public recreation, civic centers, auditoriums, roads, bridges, and similar public facilities.

Pure public goods result in collectively consumed benefits that are not subject to crowding and are subject to high-cost exclusion. It is difficult to sell use rights to the benefits of these goods, and markets are unlikely to provide a convenient mechanism for distributing them. Conceivably, they could be produced privately through voluntary contributions, with the quantity and quality of service provided being contingent on the amount of revenue collected. Private charity is often provided and financed in this manner. However, goods resembling pure public goods are most likely to be distributed free of direct charge by governments, with the quantity and quality of the service determined through political institutions and financed by taxes. Such is the case for

national defense, environmental protection, and others goods resembling pure public goods.

Classifying goods according to the degree of rivalry and excludability of benefits from their use



A pure public good corresponds to point B, where there is rivalry for benefits and excludability from benefits is impossible, pure private good corresponds to point A on the graph. A non-rival good, such as TV transmissions, for which exclusion is possible corresponds to a point like C. a congestible public good for whi it is possible to charge for use, such as a limited access highway corresponds to a point like H.

Semipublic goods exist in a continuum ranging from pure private goods to pure public goods. Figure 3 shows how goods could be categorized according to the degree of rivalry in consumption and the degree of excludability. The horizontal axis of the graph plots the extent

to which the benefits of the good are rival on a scale of zero to one. A pure private good with benefits that are fully rival in consumption would rate a value of one on the horizontal axis while a pure public good with benefits that are completely non rival in consumption would rate a zero on the horizontal axis. A congestible public good with benefits that are only partially non rival would be assigned a number from between zero and one on the horizontal axis depending on the degree of its convertibility.

The vertical axis measures the excludability of the good on a scale of zero to one. A pure private good, which is perfectly excludable because its benefits can be fully withheld from someone who does not pay, would be assigned a one on the vertical axis. Similarly, a pure public good that is not price excludable would be assigned a zero. Goods such as highways for which tolls can be charged and other priced excludable goods would be assigned a number between zero and one depending on the case to which the benefits of the product can be priced.

According to this classification scheme, a pure private good would correspond to point A on the graph. At that point, there is full excludability and full rival for the benefits of the good. Similarly, a pure public good would correspond to point B at which the benefits and full non rival and price excludability is impossible. Some goods, such as cable TV transmissions, would correspond to a point on the vertical axis like C. For such a produce the benefits are nonrival, but price exclusion is relatively easy because signals can be scrambled and those who

decline to pay for a hookup can be denied the benefits. A highway subject to congestion would correspond to point like H, where there is a degree of rivalry and price exclusion is possible through tolls.

Education as a Public Good

Education is service that has some characteristics of a public good while at the same time having characteristics of a private good. Education is commonly believed to result in widely ranging external benefits when it is provided at least at some minimal level to all children in a society. However, at the same time, the exclusion principal can easily be applied to educational services so that it can be withheld from those who do not pay for it. Education is a clear example of a partially public good. Decisions must be made, therefore, about how to supply it. Education can be made available through the marketplace like any private good. Education can also be supplied by governments and given out free of charge in equal amounts to all children in a society.

In the United States, as well as in most other nations, a mix of both private and public schools has emerged both through the marketplace and political interaction as a means of supplying education. However, in the United States and in most other nations as well, on the primary and secondary level education is mainly a government-supplied service. For example, in the United States approximately 90 percent of children attend public elementary and secondary schools. For higher education there are, of course, many public colleges and universities. But few public institutions of higher learning fully finance their activities with tax revenues. Students at colleges and universities pay a portion of the cost

of their education through tuition and fees and these prices have been increasing in recent years. Furthermore, about 40 percent of students at institutions of higher learning in the United States attend private schools.

It is clearly feasible to price educational services and because the marginal cost of educating a student is certainly not zero, a zero price for the service is not an efficient alternative. Nonetheless, it is commonly agreed that education is such an important generate of positive externalities that it should be universally subsidized by government tax revenues. In the case of elementary and secondary education, the subsidization is complete and the price to families of children attending public schools is set at zero. In the United States, the costs of providing educational service is financed with a combination of local, state, and federal tax revenue with the bulk of the revenue (more than 90 percent) coming from state and local tax coffers. State governments, through direct appropriation to colleges and universities, also heavily subsidies higher education. Federal subsidies to individuals and institutions and tax credits to individuals also her finance higher education. Education on the elementary and secondary level is almost universally compulsory up to a certain age. Thus, governments intervene in the supply of education to make sure every citizen consumer at least a minimal amount of this service.

What are the externalities associated with the production and consumption of education that result in such universal support of government supply and subsidization? Many believe that wide ranging externalities exist when we live in a society where we can be sure

everyone has a minimal level of education so that they can be productive citizens. We want to be sure everyone can read, have minimal computational skills so that they can manage their finances, and have adequate appreciation of public institutions and the duties of citizens to each other. this minimal level of education helps us all live in a reasonably civil society and therefore has a component that can be viewed as a public good that is equally con sunned by all. Education has a socializing function. It provides students with the ability to function effectively in a society by following rules, obeying orders, and working together with colleagues. It also provides students with such basic Skills as punctuality, ability to follow directions, and other skills that increase their productivity as workers.[4] Universal education also screens students by helping them to identify their abilities and to choose appropriate occupations as adults. In this way another public good aspect of education is its function of providing a better match of workers to jobs, thereby increasing productivity levels for a nation.

Many believe that some citizens would purchase less than the efficient amounts of education for their children if it were provided in a competitive market. If this were the case, many brilliant minds could be deprived of sufficient education and we would all be deprived of the possible future contributions to society. Further, some parents might not value education as much as other and this could deprive their children of inadequate education. Whether or not underconsumption of education would actually result, it is clear that this idea is behind the principal of

[4] See Andrew Weiss human capital versus signaling explanations of wages, journal of economic perspectives 9,4(fall 1995); 133-154

free and compulsory public education public education helps integrate all children into society. Education is especially useful for helping immigrant groups to understand the basics of an adopted culture and political system and to learn a new language.

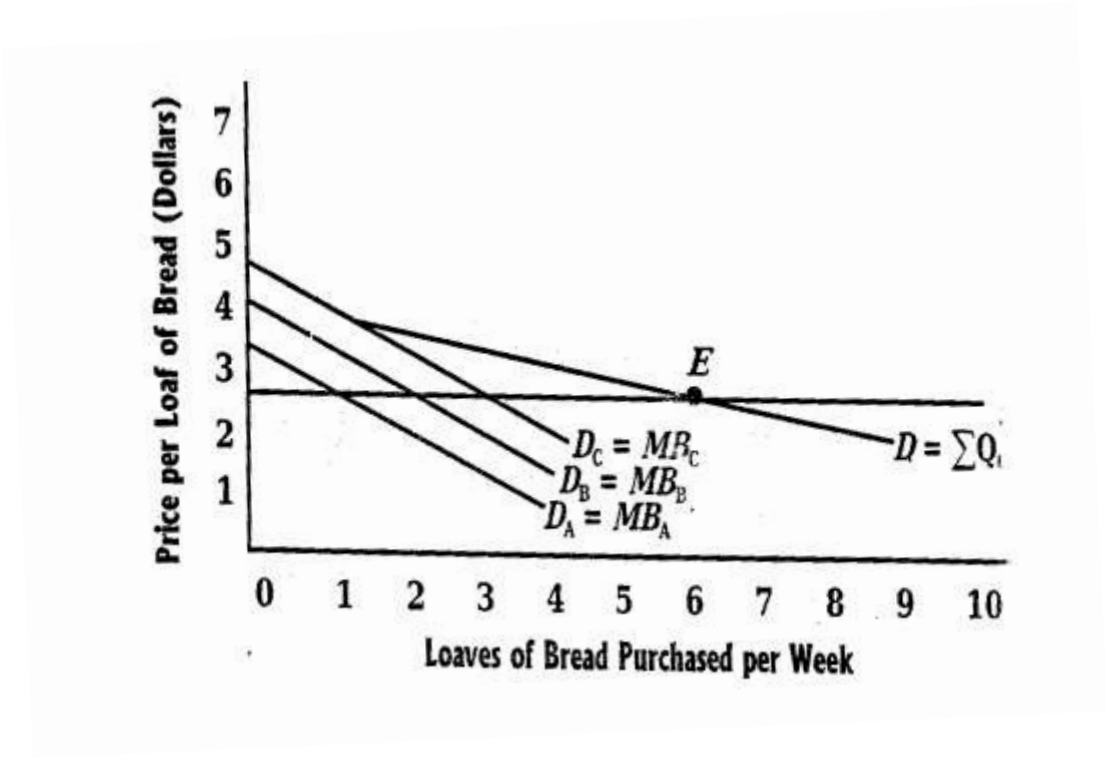
However, the fact remains that education has characteristics of a private good. No good. No government can guarantee that all children in a society receive an equal amount of education. Wide disparities exist the quantity and quality of education provided amount school districts in the United States. Production of given output of education might take varying amount of inputs depending on the students being taught. Areas where schools have a disproportionate number of disadvantaged students, higher expenditures per pup are necessary to achieve the same level of output as those areas where students have better home environments. Most studies show that the level of support parents can give students at home increases with household income and home support is an important factor in learning for children.

Even if it were possible to equalize the quality and quantity of education provided in public schools, there is no way to prevent parents who want more than this standardized quantity and quality of education for their children from buying it in the marketplace. And since upper – income parents have more ability to pay for educational services, their children are more likely to obtain supplementary instruction or attend private schools where the quality and quantity of instruction could be higher.

Demand for a Pure Public Good

The demand for pure public good must be interpreted differently from the demand for a pure private good. The market demand curve for a pure private good gives the sum of the quantities demanded by all consumers at each possible price per unit of the good. the market demand curve for a pure private good, such as bread, is illustrated in

Demand for aPrivate Good



The demand for a private good is obtained by adding the quantity demanded by each consumer at each possible price. The efficiency output is six units per week, which corresponds to point E. at a E of $3 per loaf, $MB_A = MB_B = MB_C = M$

Figure 4. for any given price, a point on the market demand curve for a pure private good found by dimply adding the quantity that each individual would purchase at that price. The individual demands curve are added laterally over the horizontal axis obtain the market demand curve.

In Figure there are only three consumers of private good. At a price of \$3 per loaf, the person who demand curve is D_A purchases one loaf per week. That the quantity for which the price equals his marginal benefit per week $(MB_A = \$3)$. The person whose demand curve is represented by D_B purchases two loaves per week at a price of \$3 per loaf. At that amount of w The purchase of bread, $MB_B = \$3$. Finally, the person with demand curve D_C purchases three loaves per week at a price of \$3 per loaf because MBc = \$3 at that amount of weekly consumption. The total market quantity demanded by these three consumers is six loaves per week at a price of \$3 per loaf. this is represented by point E on the market demand curve. Until the price falls below \$4 per loaf, the only individual purchasing the good will be the one whose demand curve is represented by D_C. at Lower prices, the other individuals whose demands are represented by D_E and D_A progressively enter the market, and the quantities that they demand as prices are lowered are added to that of the consumer whose demand is D_C. The market demand curve for the private good is labeled D =ΣQ_D

For a pure public good, all consumers must consume the same quantity of the good. Purchasers of a pure public good would not be able to adjust their consumption so that one person had one unit per

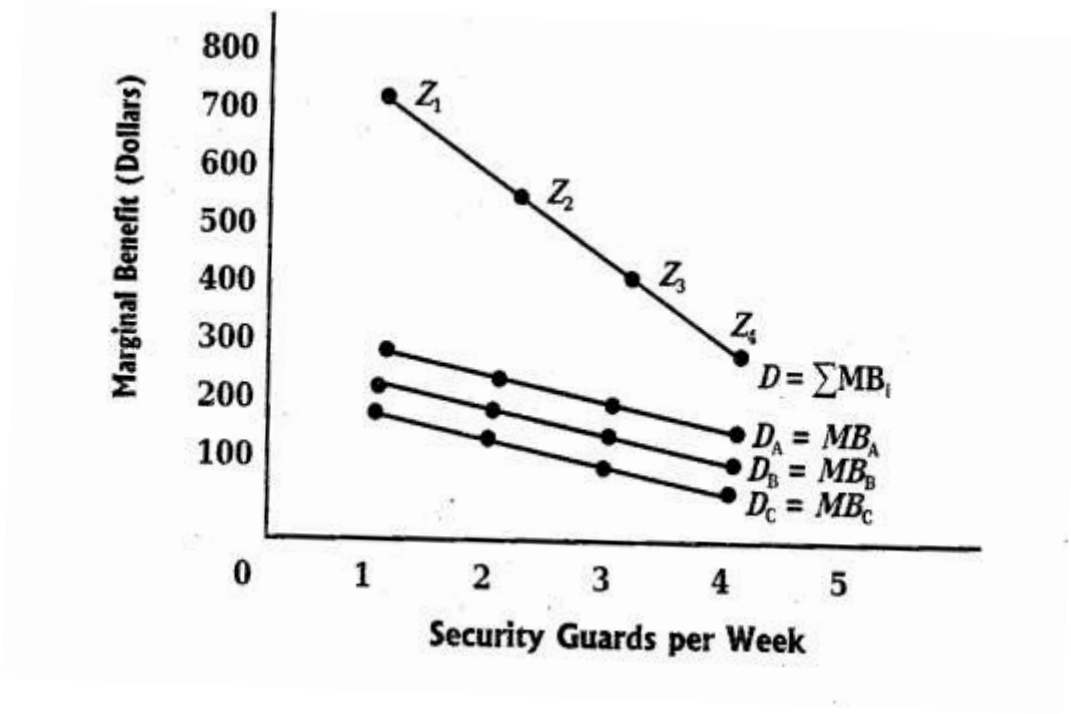
week, while another person enjoyed two units per week, and still another had three units per week. If consumer A had three units per week, all other people would consume three units per week. For a pure public good, consumers cannot adjust the amounts purchased until the price of the good equals their marginal benefit from the good per week. In fact, a pure public good cannot be priced because of its nonexclusion property.

How then can a demand curve for a pure public good be derived? The variables on the vertical axis are not market prices. Instead, they are the maximum amounts that people would pay per unit of the pure public good as a function of the amount of the good actually available. For example, suppose the three consumers live together in a small community and desire to provide themselves with security protection. The quantity of security protection can be measure by the number of security guards hired per week patrol their community security guards represent pure public good for these three consumers. No way exists for any one person in this community of three hire a security guard for his own benefit without benefiting his neighbors.

Figure 5 shows each person's demand curve for security guards. A point on any of the individual demand curves represents the maximum amount that the consumer would pay to get each unit of the corresponding quantity of the public good. This maximum amount is the marginal benefit of security protection at each quantity each individual's demand curve shows how the marginal benefit of security guards declines as more are made available.

The total amount that would be given up per security guard hired per week is the sum of the annual weekly marginal benefits of each of

Demand for Pure Public Good



the demand curve for a pure public good is obtained by summing the individual marginal benefits at each quantity

the three consumer's points on the aggregate demand curve for a pure public good could be obtained by adding each person's marginal benefit at each possible quantity. The demand curve for a pure public good is obtained by summing the individual demand curves vertically: the marginal benefit, or demand price, that each person would pay per unit of the public good is summed at each quantity of the good, because all people must consume the same quantity.

Vertically, marginal benefit, or demand price, that are person would pay per unit of the public good summed at each quantity of the good, because all people must consume the same quantity.

For example, the person with the demand curve D_A would pay a maximum of $\$300$ per security guard only one guard were provided per week. Similarly, the maximum amounts the people with demand curve D_B and D_C would give up per security guard if only one were provided per week would be $\$250$ and $\$200$ respectively. A point on the market demand curve therefore is obtained by adding these maximum amounts. Because the maximum amounts reflect the marginal benefit of security protection, the point on the market demand curve represented by point Z_1corresponds to the sum of the marginal benefits of all three consumers. This equals $\$750$ per year when only one security guard is provided.

The marginal benefit of additional units of pure public good declines in the same fashion as do those of pure private goods. The amount per security guard that could be collected if two guards were made available per week is less that which could be collected per guard when only one is provided per week. This too is Shown in figure 5. the maximum amount per guard that each of the three consumers would give up when two guards are made available per week is $\$ 250$ for A, $\$200$ for B, and $\$150$ for C. Therefore, the sum of the marginal benefits when two security guards per week are provided is $\$600$, as represented by point Z_2 in Figure 5. Adding the marginal benefit received by each consumer

from any number of security guards in this way gives points on the demand curve for the pure public good. This curve is labeled D = ΣMB_i

Efficient Output of a Pure Public Good

Efficiency requires that all economic activities be undertaken up to the point that their marginal social benefit is equated with their marginal social cost. This principal holds for pure public goods as well.

Suppose a person were to attempt to produce or purchase a pure public good for her own use. By making a unit of public good available in the community this person will generate benefits not only for herself but also for every other member of the community in which she resides. The marginal social benefit of this good will be more than the extra benefit to its purchaser. Additional benefits will accrue to each and every other person who will simultaneously enjoy each unit made available. Summing up these benefits to all people in the community gives the marginal social benefit for each extra unit of output produced. The marginal social benefit of any given amount of a pure public good is the sum of the individual marginal benefits received by all consumers.

The efficient quantity per time period of a pure public good corresponds to the point at which output is increased so that the sum of the marginal benefits of consumers equals the marginal social cost of the good. The efficiency conditions for a pure public good are:

$$MSB = \Sigma MB = MSC \qquad (1)$$

Market sale of a pure public good for individual purchase would generate wide ranging positive externalities, because a purchaser of the good would consider only his marginal benefit in deciding how much to buy. The marginal external benefit would be the sum of the marginal benefits to all other consumer when individual buyers do not take the marginal external benefit into account, sale of the good to individual in a market is likely to result in less than the efficient annual quantity. a pure private good has no external benefits of additional production. In evaluating the benefit of extra production, it is necessary to count only the benefit received by the individual who actually purchases and consumes the extra output

The efficiency conditions for a pure public good can also be written as

$$\text{MSB} = MB_i + \sum_{j=1}^{n-1} MB_j = \text{MSC} \qquad (2)$$

Equation 2 states the marginal social benefit of a unit of a pure public good as the sum of the benefits accruing to any one person acquiring it (MB_i) and of the extra benefits that accrue to the remaining $(\text{n}-1)$ members of the community $\left(\sum MB_i\right)$. The marginal social benefit is the sum of an individual benefit and an external benefit accruing to all other members of the community. The summation term.

$$\sum_{j=1}^{n-1} MB_j$$

Represents the marginal external benefit of unit of a pure public good made available to any one person. The production of a pure public good generates external benefits that are positively valued by all members of a community.

A Numerical Example

Table 2 provides data on the marginal benefits of three consumers who desire security protection in a community. These data summarize the numbers used to derive the demand curve for security protection in Figure 5. In the table, the marginal benefits of as many as four security guards per week are shown for each consumer.

Suppose the weekly cost per security guard is $450.if as many guards as desired can be hired at that rat the average cost of security protection would be constant at $450 per unit. In this case, a unit of security protection per week is presumed to be perfectly correlated with the services of one security guard per week because average cost is constant, it is also equal to the marginal cost. Assuming no negative externalities associated with security protection, the marginal social cost of security protection also will be constant and equal to $450.

Table 2 also shows the sum of the marginal benefits. $\sum MB_j$ of security guards for the three consumers at each weekly quantity. Figure 6 plots the marginal benefit curve of each of the three consumers on the same s of axes as the marginal social cost curve. This latter curve is a straight line drawn at $450. Also plotted of the axes is the sum of the marginal benefits for the three consumers at each level of output. This

latter curve gives the marginal social benefit of alternative weekly amounts of security protection.

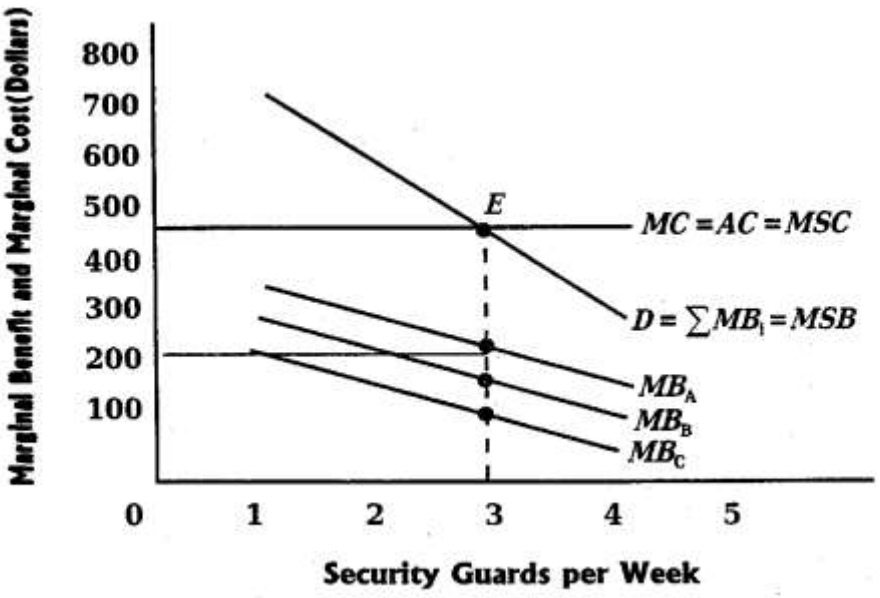
The efficient number of security guards for the three members of the community is three per week. At that level of supply, corresponding to point E, the sum of the marginal benefits equals the marginal social cost. At that level of weekly supply, the marginal social benefit equals the marginal social cost for members of the community.

Figure 6 can quickly show why market provision of security protection would not result in the efficient output. If the services of security guards were available to individuals only through markets purchases, the quantity supplied to this community would be zero! This is because it costs $450 per week to hire each security guard. No single resident alone values the services of the first security guard that highly. The most any one person would pay for a security guard is $300 per week. The marginal benefit of the first security guard for any one buyer falls short of the market price per unit necessary to cover the marginal costs of sellers

Hypothetical Marginal Benefits Of Security Protection For A Community Of Three People

	Number of security Guards per week			
	1	2	3	4
MB_A	$300	$250	$200	$ 150
MB_R	250	200	150	100
MB_C	200	150	100	50
$\sum MB_i$	$750	$600	$450	$300

Efficient Output of a Pure Public Good



The efficient output occurs at point E, which corresponds to the security guards per week. At that point MB1 = MSC. The line equilibrium is also at point E. At that point, voluntary contributions the three people would cover the cost of the public good. Each person would demand three security guards per week at a price per week equal to the marginal benefit received from three guards per week.

However, an output of zero is inefficient. The market equilibrium would be inefficient because, as is shown in Figure 6, the sum of the marginal benefits of the three consumers when one security guard per week is provided exceeds the marginal social cost of making that guard available. The marginal social benefit of the first guard is $750, while the marginal social cost is only $450. Therefore, it is certainly inefficient not to hire at least one security guard per week. The efficient output is actually three security guards per week, corresponding to point E in Figure 6. At that point, the sum of the individual marginal benefits equals the marginal social cost of security protection.

A Cooperative Method of Efficiently Supplying Pure Public Goods: Voluntary Contributions and Cost Sharing

To achieve the efficient output of three guards per week, members of the community will have to cooperate to share the costs per unit of security protection. By sharing the costs, members can pool their resources to enjoy public goods that they could not afford if they had to purchase them on their own in a market. In small communities, pure public goods conceivable could be made available in the efficient amounts and financed by contributions. Understanding why this is unlikely to occur in larger communities is the key to understanding the reasons that citizens resort the governments to provide many public goods. It also helps provide insights into the reasons government finance most of their activities with compulsory taxes instead of voluntary contributions[5]

Suppose the three people previously discussed to cooperate to satisfy and finance their desires for security protection. These people are confronted with the problem of financing a pure public good that collectively consumed by them alone. All three must consume the identical quantity of security protection per week and must voluntarily contribute to cover the annual costs of making the protection available. Remember, it costs $450 per week for each security guard, and no

[5] **A classic model of a cooperative mechanism for supplying public good was developed by Erik Lindahl in the early 1990s. see Erik lindahl Just Taxation: A positive Solution, In Clssics in the theory of public finance, eds Richard A. Musgrave and Alan T. Peacock (New York) Cromwell-collier, 1958): 168 – 177. Also see cecil Bohanan, McCale Lindahl, comment, public finance 38(1983): 326 -331.**

member of the community will purchase security protection service if he has to pay for it along.

Suppose the three people pool their resources hire security guards. If they can obtain enough fur in this way, they will be able to make themselves bet off by acquiring benefits none of them can individually afford. They will continue to cooperate in this way by hiring guards up to the point at which their pooled contributions can no longer finance additional guards.

Suppose they try to hire one guard per week. How much would they collect in contributions? Figure 6 shows that A would contribute $\$300$ for the first guard, B would contribute $\$250$, and C would contribute $\$200$. These amounts represent the marginal benefits for these people when only one guard per week is hired because the sum of the voluntary contributions exceeds the marginal cost of the first guard, the members concluded that it might be worthwhile to try to finance two guards per week instead. Hiring only one guard per week leaves a budget surplus for security protection. The budget surplus indicates that the marginal social benefit of the first security guard in the community exceeds the marginal social cost of providing the protection.

The sum of the marginal benefits of two security guards per week is $\$600$. The members of the community would contribute $\$600$ per guard if two would be hired per week. This also exceeds the marginal cost of making two guards per week available. The members of the community would collect more than enough funds to finance two units of security protection per week. The community security budget still has a

surplus as long as each member faithfully contributes an amount equal to the marginal benefit per guard. The total cost of two guards per week would be $\$900$. Because each person contributes an amount equal to the marginal benefit per guard, the total amounts collected to finance two security guards would be $\$500$ from A, $\$400$ from D and $\$300$ from C. The total revenue would be $\$1{,}200$. The surplus is $\$300$ per week.

The marginal benefits when three guards per week are available are MB_A = $\$200$ MB_B = $\$150$, and MB_C = $\$100$. The sum of the marginal benefits exactly equal to the marginal cost of the third guard, $\$450$. The community can finance still another unit of security protection. The total cost of three security guards per week is $\$1{,}350$. Person A contributes $\$200$ per guard or $\$600$ per week for three guards. Person B contributes $\$150$ per guard and pays $\$450$ per week for three guards. Finally C contributes $\$100$ per guard, making a total weekly contribution equal to $\$300$ for three guards. The total contributions exactly equal the total cost of $\$1{,}350$ per week for three guards. This occurs at point E in Figure 6, where the. $\sum MB_i$curve for the public good intersects the marginal cost curve for the good. At point E, MSB = $\sum MB_i$= MC = MSC for the three consumers.

Any output greater than three could not be financed with voluntary contributions, because the sum of the marginal benefits of security protection in excess of three guards per week would fall short of the marginal cost of that level of security voluntary contributions would fail to collect enough to finance more than three security guards per week.

The equilibrium achieved through voluntary contributions results in the support of three security guards per week, which is efficient. This is because MSB = MSC at the equilibrium number of guards per week. Thus, voluntary contributions in small groups can achieve the efficient output of a pure public good.

The Lindahl Equilibrium

Point E in Figure 6 is called a Lindahl equilibrium, after the Swedish economist Erik Lindahl.[6] The voluntary contribution per unit of the public good of each member of the community equals her marginal benefit of the public good at the efficient level of output. These equilibrium contributions per unit of the public good are sometimes called Lindahl prices. If the good were made available at these prices per unit for each of the consumers, the quantity demanded by each consumer would be the efficient amount of three security guards per week.

In effect, the Lindahl equilibrium also could be achieved by assigning each participant a Lindahl price per unit of the public good. Each person would have to be assigned a price that equals her marginal benefit at the efficient output of the good. In equilibrium, all three individuals would unanimously agree on the efficient quantity of the good to be made available, given the assigned Lindahl prices. In the preceding example the Lindahl prices for each security guard would have to equal each community member's marginal benefits at the efficient output of three guards per week, disagreement about the

[6] Erik Lindahl “just taxation”

quantity of the good arose the Lindahl prices per unit of the good would have to be adjusted until all individuals demand the quantity for which MSB = MSC. If disagreement ensued about the Lindahl prices, the quantity of the good would have to be adjusted until all individuals accepted their share and no surplus or deficit in the budget existed at the efficient output.

The solution to the model is similar to market equilibrium, because it results in a set of price share per unit of the good that are unanimously accepted to finance the cost of production of a simultaneously agreed-upon quantity No one is forced or coeroded enter into the agreement. Given the distribution of income and other factors that affect the demands (or willingness to pay) of the three individuals for security protection, the outcome is a determinate quantity of the public good and an associated cost - sharing scheme. The voluntary cooperation model presented is one in which contributions are accepted for alternative quantities of the public good which, in turn, are compared with the marginal cost of additional production Other similar models have auctioneer-announcing schemes for the division of the cost per unit of a public good in terms of the percentages to be borne by each individual, independent of the number of units produced. This ensures that the budget will always be in balance. Such tax sharing schemes continually are called out until the quantity demanded of the public good is the same for all individuals.[7] The result in both cases is identical: the public good is produced at the level where the sum of the

[7] This is the approach used by Lindahl in his classic model

marginal benefits is equal to the marginal social cost, and each individual's Lindahl price in equilibrium reflects that person's marginal benefit at the equilibrium level of production.

Generalizing the Results

The Lindahl equilibrium consists of an agreement of the division of the costs of producing the equilibrium quantity of a pure public good. Conditions for equilibrium can now be generalized. Call t_i the amount contributed by each person for any quantity of pure public good made available and Q* the equilibrium annual quantity of the pure public good. The equilibrium under the model of voluntary cooperation meets the following conditions:

1- The amount contributed per unit of the public good by each person, t_i, must be adjusted so that each individual desires the identical amount of the public good. This requirement stems from the nature of public goods. It is impossible for any one member of a community to consume, for example, more security protection than another, assuming that protection is truly a public good.

2- The sum of the amounts contributed by each member of the community per unit must equal the marginal social cost of producing the public good. When marginal social cost equals the average cost of the good, this implies that the voluntary contributions will constitute

amount sufficient to finance the good without any surplus or deficit.[8] The revenue collected can be expressed as the sum of the cost shares per unit of the public good, multiplied by the number of units produced in equilibrium, the total cost of production is average cost, AC. multiplied by the quantity produced, it follows that.

$$\Sigma t_i Q^* = MC\ (Q^*) = AC\ (Q^*). \qquad (3)$$

Or

$$\Sigma t_i = MC = AC$$

3- All individuals must agree voluntarily, with no coercion whatsoever, on the cost-sharing arrangement and the quantity of the good. The equilibrium must occur under unanimous consent. This ensures an efficient outcome, because any individual made worse off by any arrangement can block its approval.

[8] When marginal costs of producing the pure public good are increasing MC > AC at any given quantity. This implies that ΣMB_i = AC at the efficient output for which ΣMB_i =MC, in this case, the sum of voluntary contributions per unit exceeds the average cost of production in equilibrium. The equilibrium budget will have a surplus, which could be returned as a lump-sum payment to members of the community after the cost of the public good in financed

Questions for review

1- What are the essential differences between pure public goods and pure private goods?

2- Although the marginal cost of producing a pure public good is always positive, some consumers can enjoy the benefits of pure public goods at zero marginal costs. Explain the apparent paradox, if there is one!

3- Why does the definition of a pure public good imply that its benefits are not subject to congestion?

4- How does the condition for efficiency differ between pure public goods and pure private goods?

5- What problems are likely to arise if people try to apply public goods for themselves without cooperation and sharing costs?

6- In what sense does the demand curve for a pure public good differ from that of a pure private good?

7- How will shares in the finance of public goods vary among contributors in a model of voluntary cooperative supply of such goods?

8- Give some examples of goods sold by governments in markets. Also, think of examples of partially public goods produced and distributed by private firms for profit.

9- Suppose the price of hiring a security guard increase from $450 to $600 per week. Using the data in Table 2 show how this will affect the Lindahl equilibrium.

10- USD the data in Table 2 to show a decrease in the demand for security protection by any one voter will affect the Lindahl equilibrium.

Problem

1- The following table shows how the marginal benefit of a service varies for four consumers:

Marginal benefit (in Dollars				
	Consumers			
	Alice	Ben	Carolyn	Don
Quantity				
1	1000	800	600	400
2	800	600	400	200
3	600	400	200	100
4	400	200	100	50

a- Suppose the service is a pure private good and is sold in a competitive market with the only buyers being the four people whose marginal benefits are shown in the table. If the market price of the product is $400, what is the quantity demanded?

b- Suppose the service is a pure public good with the only consumers being the four people whose marginal benefits are shown in the table. What is the marginal social benefit of two units of the service?

C- If the marginal social cost of the good is $\$2,000$, what is the efficient output assuming that it is a pure private good?

d- if the marginal social cost of the good is $\$2,000$, what is the efficient output assuming it is a pure public good?

2- suppose the marginal cost of a pure public good increases as more is purchased by a community prove that the Lindahl equilibrium will result in budget surplus at the efficient annual output of the pure public good.

3- Suppose the services of a road are subject to congestion after $50,000$ vehicles per hour enter the road. Assume that it is feasible to price road service on an hourly basis. Use a graph like that drawn Figure 2! To show how the services of the road should be priced per hour when fewer than and more than $50,000$ vehicles per hour are expected so as achieve efficiency.

4- The following table shows how the marginal benefit enjoyed by John, Mary, Loren and all other consumers' outdoor rock concerts varies with the number made available by a city government per summer.

Marginal benefit of number of Rock concerts per consumer (in Dollars)				
	Number of Concerts			
	1	2	3	4
Consumers				
John	150	125	100	75
Mary	125	100	75	500
Loren	100	75	50	25
All Others	600	400	200	100

a- Derive the demand curve for rock concerts assuming that it is a pure public good.

b- If the marginal cost of producing rock concerts is $1,000 no matter how many are produced, then what is the efficient number of concerts to have each summer? What would be the efficient number of concerts to produce if the marginal cost of production were $425 instead of $1,000?

5- Suppose the marginal cost of producing rock concerts is only $250 per concert no matter how many are produced. Use the data from the previous question to calculate the efficient number of concerts. If a Lindahl scheme is used to finance the concerts, what prices of admission should be changed to John, Loren, and Mary.

Exercises

Question on chapter one

Characteristics of an underdeveloped country

Part A True – false questions

1- The public goods are similar to any other good in both its production consumption.

2- The public good are collectively consumed.

3- The public good can be parceled out to individuals to enjoy in greater or smaller amount according to their tastes.

4- The production aspect of public goods is similar to that of any business operation.

5- The consumption of public good is fundamentally different of the private good.

6- The pure public good is sold by the unit in markets.

7- The pure public good can be parceled out into individuals to enjoy in greater or smaller amounts according to their tastes.

8- Public goods are usually made available politically through the ballot box as people vote to decide how much to supply rather than through the marketplace

9- In most cases, government provision of public goods implies that the good are freely available to all rather than being sold in markets.

10- In case existing externalities, the prices can inefficiently allocate goods that are rival in consumption

11- The goods that are non-rival in consumption need necessarily be subject to non-exclusion.

12- Market exchange for pure private goods result in neither positive nor negative externalities.

13- The goods are ranked according to their degree of publicness or privateness in terms of the range and extent to which their production or consumption generates externalities.

14- It is not possible to draw a neat line between pure private good and pure public goods.

15- Pure private goods might be sold in markets either by private firms or government.

16- The demand for both a pure public good and a pure private good is similar.

17- The market demand curve for a pure public good gives the sum of the quantities demanded by all consumers at each possible price per unit of the good.

18) The market demand curve for a pure public good is obtained by the vertical summation of the individual marginal benefits at given quantity.

19- The market demand curve for a pure private good is obtained by horizontal summation of the individual demand and curves.

20- Market provision of goods with benefits shared by people other than those who purchase them for their own use is likely to result in an efficiently large amount of output

21- The marginal cost of consuming additional unit of congestible public good is zero permanently.

22- A unit of a pure private good can be enjoyed only by a single consumer.

23- Market failure refers to the situation in which the private market fails to produce the efficient amount of output.

24- Any product supplied by government is a public good.

25- A movie show in an uncrowded movie theater is both non excludable and non-rival in consumption.

26- Public goods – but not private goods – face the free rider problem.

27- The marginal benefit curve for a public good is obtained the same way as the marginal benefit curve for private good.

28- The production of public goods is very different to that of any business operation.

29- Public goods is easy to sold in the markets.

30- Goods that are non-rivaling consumption need not necessarily be subject to non – exclusion.

31- The costs of private goods production are financed by the revenue obtained from sales to individual buyers.

32- The marginal cost of accommodating an additional consumer is larger than Zero after the point of congestion is reached.

33- Purchasers of a pure public goods wouldn't able to adjust their consumption.

Part B : multiple – choice questions

Circle the appropriate answer:

1- The road is considered _____ as it is _____

a) public good / non –excludable and ono rival

b) private good/ excludable and rival.

c) public good/ excludable and rival

d) private good/ non excludable and non-rival

2- _____ In consumption earn that a given quantity of a public good can be enjoyed by more than one consumer without decreasing the amounts enjoyed by others.

a) rival b) non-excludable c) excludable d) non –rival

3) The marginal cost of consuming congestible public good is_____ after the point of congestion is reached

a) greater than or equal zero b) less than or equal zero

c) greater than zero d) zero

4- The marginal cost of consuming congestible public good is_____ before the point of congestion is reached

a) greater than or equal zero b) less than or equal zero

c) greater than zero d) zero

4- In case_____members share in the cost of facilities and services that they otherwise would be unable to afford

a) pure private goods b) price-excludable public goods

c) congestible public goods d) pure public goods

6- _____ are non-rival in consumption only to a certain point

a) pure private goods b) price-excludable public goods

c) congestible public goods d) pure public goods

7- _____ represents good that approximate is individually consumed and subject to low cost exclusion from benefits for those who do not pay for the right to receive such benefits.

a) pure private goods b) price-excludable public goods

c) congestible public goods d) pure public goods

8- _____ can be individually consumed and are subject to exclusion, but their production or consumption is likely to generate externalities

a) pure private goods b) price-excludable public goods

c) congestible public goods d) pure public goods

9-Television broadcasting services is considered _____ in consumption.

a) non rival and non – exclusion b) rival and exclusion

c) non rival and exclusion d) rival and non-exclusion

10-The national defense is considered public good that result in _____

a) positive and negative externalities

b) neither positive nor negative externalities

c) negative externalities

d) positive externalities

11-The marginal cos of distributing a pure public good to an additional consumer is _____ for a given amount of the public good.

a) zero b) >1 c) <1 d) = 1

12) The marginal cost of producing additional units of the public good will be _____

a) increasingly b) decreasingly c) constant d) zero

13) Which of the following is not a source of market failure?

a) the existence of public goods

b) the presence of externalities

c) the fact that some goods are rival in consumption

d) the existence of monopolies

14- Market failure refers to the situation when

a) market does not create a deadweight loss.

b) markets use resource inefficiently.

c) the government prohibits freeriding

d) non e of the above

15-Which of the following is non rival and excludable?

a) the defense services provided by a new stealth bomber

b) a pair of plants

c) A beautiful sunset

d) an uncrowded theme park such as Walt Disney World

16- To two fishermen, a codfish swimming in the middle of the ocean is a good that is

a) non-rival and non – excludable b) non-rival and excludable

c) rival and non-excludable d) rival and non-excludable

17- To two farmers, a steer (owned by a one of the farmers) grazing in the middle of the farmer's pasture is

a) non rival and non – excludable b) non rival and excludable

c) rival and non-excludable d) rival and excludable

18- Free rider is someone who _____

a) does not pay taxes

b) cannot be excluded from consuming a public good even though he or she did not pay for the good.

c) paid more than his or her fir share for the provision of a public good.

d) cannot be forced to pay for his or her consumption of a private good.

19- Governments provide pure public goods such as national defense because

a) government know how to produce these goods

b) of the free rider problems that result in underproduction by private markets.

c) people do not value national defense very highly.

d) of the potential that private firms will make excess profits.

20- The economy's marginal benefit curve for a public good is obtained by

a) summing the individual marginal cost curves horizontally.

b) summing the individual marginal cost curves vertically.

c) summing the individual marginal benefit curves horizontally.

d) summing the individual marginal benefit curves vertically

21- The efficient amount of a public good

a) is as much as the public demands.

b) cannot be provided unless the problem for non- excludability is overcome

c) Equates total benefit and total cost.

d) is such that the marginal benefit equals the marginal cost

22- Public goods have:

a) positive externalities

b) neither (a) nor (b)

c) negative externalities

d) (a) and (b)

23- Private goods have:

a) positive externalities

b) neither (a) nor (b)

c) negative externalities

d) (a) and (b)

24- The same amount is available to somebody this means

a) rival in consumption

b) excludable.

c) non –rival in consumption

d) non-excludable

25- TV broadcasting services are

a) non rival in consumption

b) rival in consumption

c) excludable

d) (a) and (b)

26- Which is not necessarily true of a public good?

a) it costs nothing to let an additional person consume it

b) it costs lot to keep an additional person from consuming it

c) it is supplied by the public sector

d) it can be a negative thing, that is, a public bad.

27- One person's use diminish other people's utility from that good this means

a) rival in consumption b) non rival in consumption

c) excludable d) non – excludable

28- Are those for which crowding reduces the benefits to existing consumers when more consumers are accommodated

a) pure public goods b) pure private goods

c) congestible public goods d) price - excludable public goods

29- Scope of public finance includes:

a) public revenue b) public debt

c) public expenditure d) all of these

30) Non – exclusion principle is related to:

a) private goods b) public goods

c) merit goods d) mixed good

31- Education is an example of:

a) public goods

b) merit goods

c) social good

d) club good

32- Public goods are:

a) excludable

b) non – excludable

c) marketable

d) all of these

33- non rivalry and non - excludability are the characteristics of:

a) normal goods

b) demerit goods

c) inferior goods

d) public goods

34- Public goods are non- rival if:

a) some people cannot be prevented from consuming it

b) consumption by one person reduces consumption of other individuals

c) some people are excluded from consuming it

d) all the above

Part C: Problems – Graph if possible)

The following table shows how the marginal benefit of a service varies for four consumers:

Quantity	Marginal benefit (in dollars)			
	consumers			
	A	B	C	D
1	2000	1500	1000	500
2	1500	1000	500	400
3	1000	500	400	300
4	500	400	300	200

a) Suppose the service is a pure private good and sold in a competitive market with the only buyers being the four people whose marginal benefits are shown in the table if the markets price of the product is $400, what is the quantity demanded?

b) If the marginal social cost of the good is $2200, what is the efficient output assuming that is a pure private good?

c) If the marginal social cost of the good is $2200, what is the efficient output assuming it is a pure public good?

d) Suppose the service is a pure public good with the only consumers being the four people whose marginal benefits are shown in the table. What is the marginal social benefit of two units of the service?

2) The following table shows how the marginal benefit enjoyed by Alice, Ben, Carolyne and all other consumers outdoor rock concerts varies with the number mac available by a city government per

Marginal benefit of number of rock concerts per consumer (in dollars)				
	Number of concerts			
consumers	1	2	3	4
Alice	175	125	100	50
Ben	125	75	75	75
Carolyn	200	400	100	25
All other	500	100	150	100

a) If the marginal cost of producing rock concerts is $ 1,000 no matter how many are produced, then wat is the efficient number of concerts to have each summer? What would be the efficient number of concerts to produce if the marginal cost of production were $425 instead of $1,000?

3) You have the following goods; fill the following table by it in the appropriate space:

Higher education- fish in ocean- national defense - clothes - gasoline- tablet computer – street lighting- road- toll road.

	excludable: Yes	excludable: No
rival: Yes	Private goods	
rival: no		Public goods

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Chapter two

Taxation and income distribution

Chapter 2.

Taxation and Income Distribution

The main goat of this chapter is to understanding the following topics

1- Progressive tax system at perfect computation market

2- Proportional tax system at perfect compilation market

3-progressive and proportional tax system at monopoly market

Chapter two

Taxation and income distribution

American policy debates about the tax system are dominated by the question of whether its burden is distributed fairly. A sensible discussion of this nonnative issue requires some understanding of the positive question of how taxes affect the distribution income. A simple way to determine how taxes change the income distribution would be to conduct a survey in which each person is asked how many dollars he or she pays to the tax collector each year. Simple–but usually wrong. An example demonstrates that assessing correctly the burden of taxation is much more complicated.

Suppose the price of a bottle of wine is $10. The government imposes a tax of $1 per bottle, to be collected in the following way: Every time a bottle is purchased the tax collector (who is lurking about the store) takes a dollar register A casual observer might conclude that the wine seller is paying the tax.

However, suppose that a few weeks after it imposition, the tax induces a price rise to $11 per bottle. Clearly, the proprietor receives the same amount per bottle as he did before the tax. The tax has apparently made him no worse OIT. Consumers pay the entire tax in the form of higher prices. On the other hand, suppose that after the tax the price increases to only $10.30. In the case, the proprietor keeps only $9.30 for each bottle sold, he is worse off by cents per bottle. Consumers are also worse off, however, because they 70 have to pay

30 cents more per bottle. In this case, producers and consumers. Share the burden of the tax. Yet another possibility is that after the tax is imposed, the price stays at $10. If this happens, the consumer is no worse off. While the seller bears the full burden of the tax.

The statutory incidence of a tax indicates who is legally responsible for the tax. All three cases in the preceding paragraph are identical in the sense that the statutory incidence is on the seller. But the situations differ drastically with respect to who really bears the burden. Because prices may change in response to the tax, knowledge of statutory incidence tells us essentially nothing about who really pays the tax. In contrast, the economic incidence of a tax the change in the distribution of private real income induced by a tax. Our focus in this chapter is on the forces that determine the extent to which statutory and economic incidence differ –the amount of tax shifting. Several observations should be kept in mind in any discussion of how taxes affect the distribution of income.

A New York Times editorialist once criticized a study of the distribution of the tax burden because the study assumed that all money taken in by the Federal state and local governments came from individuals. Whether payments were made by people (or) companies [Norris. 1999]. the statement reflects a common fallacy. That businesses have an independent ability to bear a tax. True, the US legal system treats certain institutions such as corporations as if they were people. Although for many purposes this is a convenient fiction it

sometimes creates confusion from an economist's point. Of view, people - stockholders, landlords consumers—bear taxes a corporation cannot.

Given that only people can bear taxes, how should they be classified for purposes of incidence analysis. Often their role in production-- what inputs they supply to the production process -- is used. (Inputs are often referred to as factors of production) The focus is on how the tax system changes the distribution of income among capitalist. Laborers, and landlords. This is referred to as the functional distribution of income...

Framing the analysis this way seems a bit old-fashioned. perhaps in 18th- century England property owners never worked and workers owned no property. But in the contemporary United States, many people who derive most of their income from labor also have savings accounts and/or common stocks. (Often, these assets are held for individuals in pensions.) Similarly, some people own huge amounts of capital and also work full time. Thus, it seems more relevant to study how taxes affect the way in which total income is distributed among people: the size distribution of income. Given information on what proportion of people's income is from capital land, and, labor, changes in the functional distribution can be translated into changes in the size distribution. For example, a tax that lowers the relative return on capital tends to hurt those at the top of the income distribution because a relatively high proportion of the incomes of the rich is from capital.

Other classification schemes might be interesting for particular problems. When increases in the federal tax on cigarettes are proposed, the incidence by region receives a great deal of attention. (Are people from tobacco- growing states going to suffer disproportionate harm?) Alternatively, when proposals are made change the taxation of land in urban areas, analysis often look at incidence by race. It is easy to think of further examples based on sex, age, and so forth.

In the previous wine tax example, it is natural assume that the distributional effects of the tax depend crucially on people's spending patterns. To the extent that the price of wine increases. The people who tend to consume a lot of wine are made worse off. However, if the tax reduces the demand for wine. The factor employed in wine production may suffer income losses. thus, the tax can also change the income distribution by affecting the sources of income. Suppose that poor people spend a relatively large proportion of the incomes on wine, but that vineyards tend to be owned by the rich. Then on the uses of income side, the tax redistributes income away from the poor, but on the sources side, it redistributes income away from the rich. The overall incidence depends on how both the sources and uses of income are affected. This distinction important for understanding the debate over former Vice President Gore's proposal to clean up the Florid. Everglades. Because the ecology of the Everglades is harmed by the run off from sugar fields, he argued that sugar products be subjected to a special tax and the proceeds used to finance a cleanup. Opposition came not only from consumer groups who were concerned about the

price of products using sugar but also from Florida workers, who realized that by reducing the demand for sugar, such a tax would hurt their incomes.

In practice, economists commonly ignore effects on the sources side when considering a tax on a commodity and ignore the uses side when analyzing a tax on an input. This procedure is appropriate if the most systematic a effects of a commodity tax are on the uses of income and those of a factor tax on the sources of income. The assumption simplifies analyses, but its correctness must be considered for each case. (See Fullerton and Rogers 1997).

We have emphasized that the incidence problem is fundamentally one of determining how taxes change prices. Clearly, different models of price determination may give quite different answers to the question of who really bears a tax. This chapter considers several different models and compares the results.

A closely related issue is the time dimension of the analysis. Incidence depends on changes in prices but change takes time. In most cases, responses are larger in the long run than the short run. Thus s the short and long run incidence of tax may differ and the time frame that is relevant for given policy question must be specified.

Balanced budget incidence computes the combined effects of levying taxes and government spending financed by those taxes. In general, the distributional effect of a tax depends on how the government spends the money. Expenditures on AIDS research have a

very different distributional impact than spending on hot lunches for schoolchildren. Some studies assume the government spends the tax revenue exactly as the consumers would if they had received the money. This is equivalent to returning the revenue as a lump sum and letting consumers spend it.

Tax revenues are usually not earmarked for particular expenditures. It is then desirable to be able to abstract from the question of how the government spends the money. The idea is to examine how incidence differs when one tax is replaced with another holding the government budget constant. This is called differential tax incidence. Because differential incidence looks at changes in taxes, a reference point is needed. The hypothetical other tax used as th of comparison is often assumed to be a lump sum tax- a tax for which the individual's liability does not depend upon behavior. (For example, a 10 percent income tax is not a lump sum tax because it depends on how much the individual earns. But a head tax of $500 independent of earnings is a lump sum tax.

Finally, absolute tax incidence examines the effects of a tax when there is no change in either other taxes or government expenditure. Absolute incidence is of most interest for macroeconomic models in which tax levels are changed to achieve some stabilization goal.

Suppose that an investigator has managed to calculate every person's real share of a particular tax- the economic incidence as defined previously. The bottom line of such an exercise is often a characterization of the tax as proportional progressive, or regressive.

The definition of proportional is straightforward; it describes a situation in which the ratio of taxes paid to income is constant regardless of income level.[9]

Defining progressive and regressive is not easy and unfortunately, ambiguities in definition sometimes confuse public debate. A natural way to define these words is in terms of the average tax rate, the ratio of taxes paid to income. If the average tax rate increases with income, the system is progressive; if it falls, the tax is regressive.

Income	Tax liability	Average tax rate	Marginal tax rate
$2.000	-$200	-0.10	0,2
3,000	0	0	0,2
5,000	400	0,08	0,2
10,000	1,400	0,14	0,2
30,000	5,400	0,18	0,2

Confusion arises because some people think of progressiveness in terms of the marginal tax rate--the change in taxes paid with respect to a change in income to illustrate the distinction, consider the following very simple income tax structure. Each individual computer her tax bill by subtracting $3,000 from income and paying an amount equal to 20 percent of the remainder. (If the difference is negative, the individual gets a subsidy equal to 20 percent of the figure. Table 1 shows the amount of tax paid, the average tax rate, and the marginal tax rate for each of several income levels. The average rates increase with income.

[9] However, the definition of income is not straightforward; see chapter 5

However, the marginal tax rate is constant at $0{,}2$ because for each additional dollar earned, the individual pays an additional 20 cents, regardless of income level people could disagree about the progressiveness of this tax system and each be right according to the own definitions. It is therefore very important to make the definition clear when using the terms regressive and progressive. From here on, we assume they are defined in terms of average tax rates.

Measuring how progressive a tax system is presents an even harder task than defining progressiveness. Many reasonable alternatives have been proposed, and we consider two simple,[10] the first says that the greater the increase in ones. Rates as income increases, the more progressive the system. Algebraically, let T_0 and T_1 be the true (as opposed to statutory) tax liabilities at income levels I_0 and I_1, respectively (I_1 is greater than I_0).The measurement of progressiveness V_1, is average tax.

$$V_1 = \frac{\frac{T_1 - T_0}{I_1 - I_0}}{I_1 - I_0} \qquad (1)$$

Once the analyst computes the values of T_1 and T_0 and substitutes into Equation (1). The tax system with the higher value of V_1 is said to be more progressive.

The second possibility is to say that one tax system is more progressive than another if its elasticity of tax with respect to income (I.e., the percentage change in tax revenue divided by percentage

[10] See Formby, Smith and Sykes (1986)

change in income) is higher. Here the expression to be evaluated is V_2, defined as

$$V_2 = \frac{T_1 - T_0}{T_0} \div \frac{I_1 - I_0}{I_0} \qquad (2)$$

Now consider the following proposal: Everyone's tax liability is to be increased by 20 percent of the amount of tax he or she currently pays. This proposal would increase the tax liability of a person who formerly paid T_0 to $1.2 \times T_0$. And the liability that was formerly T_1 to $1.2 \times T_1$. Member of Congress A says the proposal will make the tax system more progressive while member of Congress B says it has no effect of progressiveness whatsoever. Who is right? It depends on $1.2 \times T_0$ and $1.2 \times T_1$ for T_0 and T_1, respectively, equation (1), V_1 increases by 20 percent. The propose thus increases progressiveness. On the other hand, if the same substitution is done in Equation (2), the value of V_2 is unchanged. (Both the numerator and denominator are multiplied by 1.2, which cancels out the effect). The lesson here is that even very intuitively appealing intelligent public debate different answers.[11] Again, requires that people make the definitions clear.

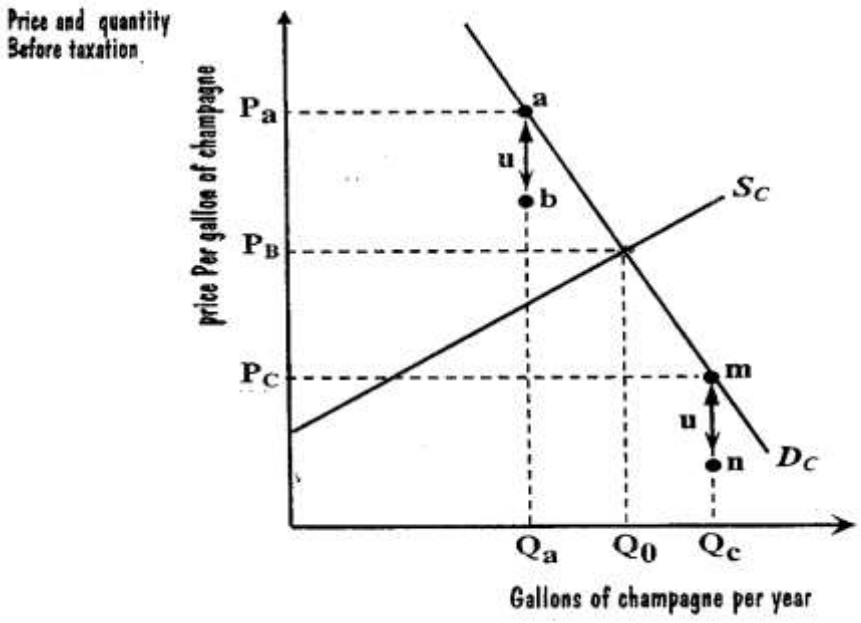
With preliminaries out of the way, we turn now to the fundamental issue of this chapter how taxes affect the income distribution. Recall that the essence of the problem is that taxes induce changes in relative prices. Knowing how prices are determined is therefore critical to the

[11] Note also that V_1 and V_2 in general depend on the level of income. That is even a Single tax system does not usually have a constant V_1 and V_2 this further complicates discussion of the degree of progressiveness.

analysis. In this section we analyze partial equilibrium models of price determination – models that look only at the market in which the tax is imposed and ignore the ramifications in other markets. This kind of analysis is most appropriate when the market for the taxed commodity is relatively small compared to the economy as a whole. The vehicle for our analysis is the supply and demand model of perfect competition.

We study first the incidence of a unit tax, so named because it is levied as a fixed amount per unit of a commodity sold. For example, the federal government imposes a tax on champagne of $\$3.40$ per wine gallon and a tax on cigarettes of 39 cents per pack. Suppose that the price and quantity of champagne are determined competitively by supply (S_c) and demand (D_C) as in. Before imposition of the tax, the quantity demanded and price. Are Q_0 and P_0, respectively.

Figure (1)



Now suppose that a unit tax of $u per gallon imposed on each purchase, and the statutory incidence is on buyers. A key step in incidence analysis is recognize that in the presence of a tax, the price pays by consumers and the price received by suppliers differs previously, we could use a supply demand analysis determine the single market price. Now, this analysis must be modified to accommodate two different price of one for buyers and one for sellers.

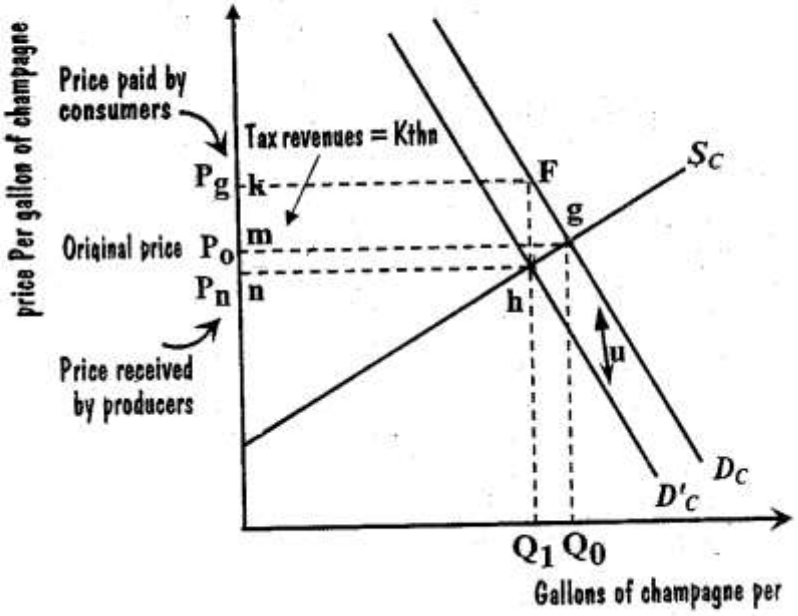
We begin by determining how the tax affects the demand schedule, consider an arbitrary point a on the demand curve. This point indicates that the maximum price per gallon that people would be willing to pay for Q_a gallon is P_a. After the unit tax of u is imposed the most that people would be willing to spend for Q_a is still P_a . There is no reason to believe the tax affects the underlying valuation people place on champagne. However, when people pay P_a per gallon, producers no longer receive the whole amount. Instead, they receive only $(P_a - u)$, an amount that is labeled point b in. in other words, after the unit tax is imposed, a is no longer a point on the demand curve as perceived by suppliers point b is on the demand curve as perceived by suppliers, because they realize that if Q_a is supplied , they receive only $(P_a - u)$ per gallon. It is irrelevant to the suppliers how much consumers pay per gallon; all that matters to suppliers is the amount they receive per gallon.

Of course, point a was chosen arbitrarily. At any other point on the demand curve, the story is just the same. thus, for example, after the tax is imposed, the price received by suppliers for output Q_C is at point

n. which is found by subtracting the distance u from point m. Repeating this process at every point along the demand curve, we generate a new demand curve located exactly u dollars below the old one. The demand curve so constructed is labeled D'_C. Schedule D'_C is relevant to suppliers because it shows how much they receive for each unit sold.

Incidence of a unit tax imposed on the demand side

Figure (2)



We are now in a position to find the equilibrium quantity of champagne after the unit tax is imposed. The equilibrium is where the supply equals demand as perceived by suppliers, output Q_1 in. thus, the tax lowers the quantity sold from Q_0 to Q_1.

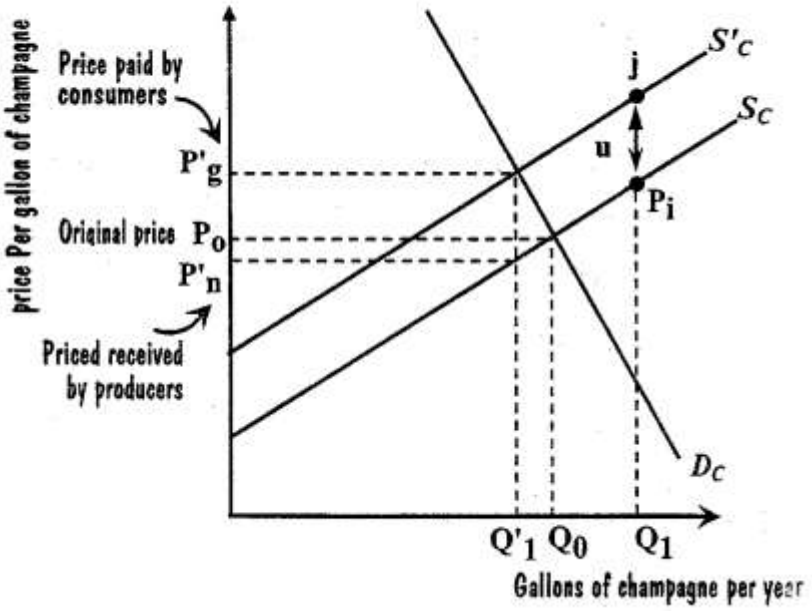
The next step is to find the new equilibrium price. as noted earlier, there are really two prices at the new equilibrium: the price received by producers, and the price paid by consumers. The price received by producers is at the intersection of their effective demand and supply curves, which occurs at P_n. The price paid by consumers is P_n plus u, the unit tax. To find this price geometrically, we must go up from P_n a vertical distance exactly equal to u. But by construction, the distance between schedules D_C. And D_C is equal to u. Hence, to find the price paid by consumers, we simply go up from the intersection of D_C and S_C to the original demand curve D_C. The price so determined is P_g. Because P_g includes the tax, it is often referred to as the price gross of tax. On the other hand, P_n is the price net of tax.

The tax makes consumers worse off because P_g, the new price they face, is higher than the original price P_O. But the consumer price does not increase by the full amount of the tax–$(P_g - P_O)$ is less than u. Producers also pay part of the tax in the form of a lower price received per gallon. Producers now receive only P_n, while before the tax they received P_O. Thus, the tax makes both producers and consumers worse off.[12] Notice that consumers and producers split the tax in the sense that the increase in the consumer price $(P_g - P_O)$ and the decrease in the producer price $(P_O - P_n)$ just add up to $u.

[12] In terms of surplus measure consumers are worse off by area mkfg and producer the loss of total surplus exceeds the tax revenue by triangle fhg this is the excess burden of the tax as explained in chapter 13. For a review of consumer and producer surplus, see the apprendix to chapter 3

incidence of a unit tax imposed on the spply side

Figure (3)



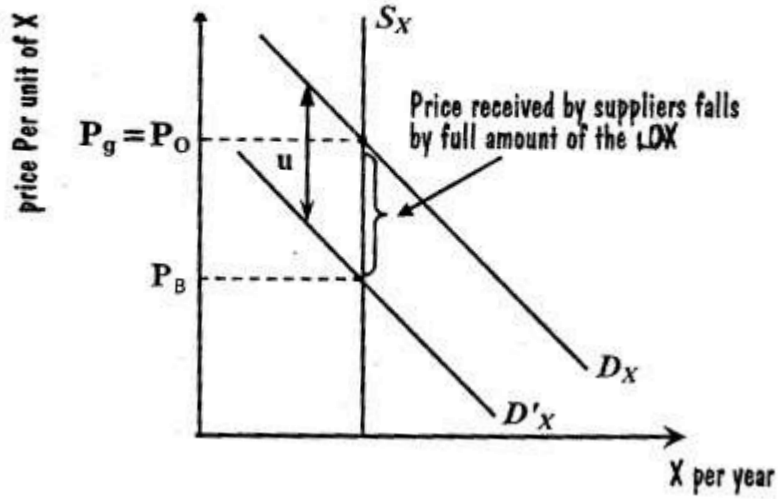
By definition, revenues collected are the product of the number of unit purchased, Q_1, and the tax per unit, U Geometrically, Q_1 is the width of rectangle kfhn and u is height, so tax revenues are the area of this rectangle. This analysis has two important implications:

The incidence of a unit tax is independent of whether it is levied on consumers or producers. Suppose the same tax u had been levied on the suppliers of champagne instead of the consumers. Consider an arbitrary price P_i on the original supply curve in the supply curve indicates that for suppliers to produce Q_1units, they must receive at leat P_i per unit After the unit tax, suppliers still need to receive P_i per unit. For them to do so, however, consumers must pay price P_i + u per unit, which is shown geometrically as point j. It should now be clear where

the argument is heading. To find the supply curve as it is perceived by Consumers, S_c must be shifted up by the amount of the unit tax. This new supply curve is labeled S'_c . the post tax equilibrium is at Q'_i, where the schedules S'_c and D_c intersect. The price at the intersection. P'_g, is the price paid by consumers. To find the price received by producers , we must subtract u from P'_g, giving us P'_n. A glance at indicates that $Q'_1 = Q_1$, $P'_g = P_g$,, and $P'_n = P_n$. Thus, the incidence of the unit tax is independent of the side of the market on which it is levied.

Tax incidence when supply is perfectly inelastic

Figure (4)



This is the same as our statement that the statutory incidence of a tax tells us nothing of the economic incidence of the tax. It is irrelevant whether the tax collector (figuratively) stands next to consumers and taxes u dollars every time they pay for a gallon of champagne or stands next to sellers and collects u dollars form them whenever they sell a

gallon and prove that what matters is the size of the disparity the tax introduces between the price paid by consumers and the price received by producers, and not on which side of the market the disparity is introduced. The tax induced difference between the price paid by consumers and the price received by producers is referred to as the tax wedge.

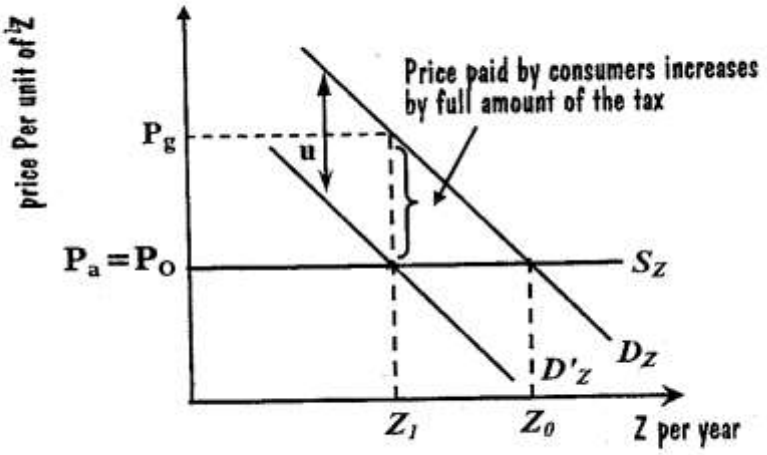
The incidence of a unit tax depends on the elasticities of supply and demand consumers bear the brunt of the tax the amount they pay how's up much more than the amount received by producers goes down. This result is strictly determined by the shapes of the demand and supply curves. In general, the more elastic the demand curve, the less the tax borne by consumers, ceteris paribus. Similarly, the more elastic the supply curve, the less the tax borne by producers, *certeris paribus*. Intuitively, elasticity provides a rough measure of an economic agent's ability to escape the tax. The more elastic the demands. The easier it is for consumers to turn to other products when the price goes up, and therefore more of the tax must be home by suppliers. Conversely, if consumers purchase the same amount regardless of price, the whole burden can be shifted to them. Similar considerations apply to the supply side.

Illustrations of extreme cases are provided in commodity X is supplied perfectly in elastically when a unit tax is imposed, the effective demand curve becomes D'_X. As before, the price received by producers (P_n) is at the intersection of S_X and D'_X. Note that P_n is exactly u less than P_o. Thus, the price received by producers falls by exactly the

amount of the tax. At the same time, the price paid by consumers P_g (=P_n + u), remains at P_o. When supply is perfectly in elastic. Producers bear the entire burden represents an opposite extreme. The supply of commodity Z is perfectly elastic. Imposition of a unit tax leads to demand curve D'_Z.. At the new equilibrium quantity demanded is Z_1 and the price received by producers, P_n, is still P_o. The price paid by consumers P_g is therefore P_o + u. In this case, consumers bear the entire burden of the tax[13].

Tax incidence when supply is perfectly elastic

Figure (5)



The cigarette Tax Debate. Recently, the United States has been engaging in a major policy debate regarding cigarette taxation. in 2000, the 24 cent per pack federal tax was raised to 34 cents, and it is now 39 cents, but certain legislators would like to go further and increase the tax to $1 or more. Some proponents of the higher tax seem to be interested primarily in discouraging smoking, and others care more

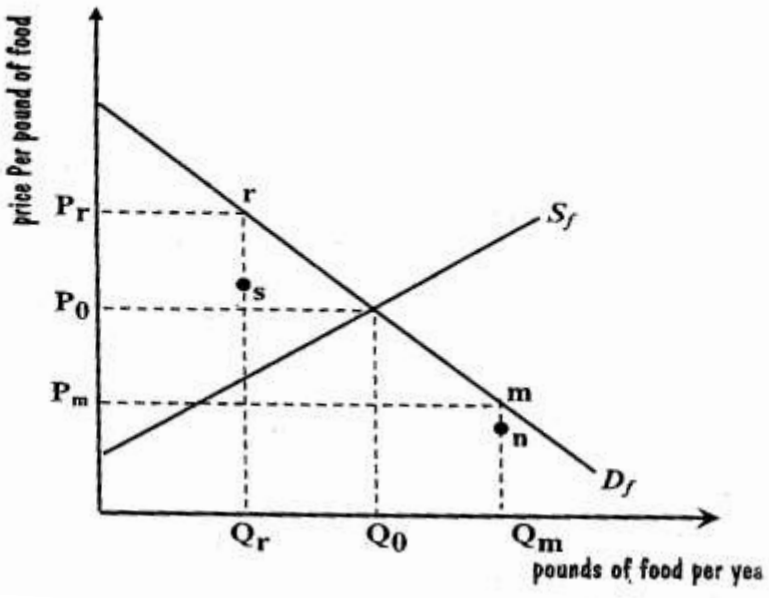
[13] -Note that as long as input costs are constant, the long-run supply curve for a competitive market is horizontal as in Hence, under these conditions, in the long run consumers bear the entire burden of the tax

about punishing tobacco producers. Those who want to discourage smoking are implicitly assuming that the tax will drive up the price paid by consumers and those who want to punish the tobacco producers expect the price they receive to go down. How can one determine which effect would prevail? Our model of tax incidence tells us what we need to find out: the supply and demand elasticities in the cigarette market.

We now turn to the incidence of an ad valorem tax, a tax with a rate given as a proportion of the price. For example, the state of Tennessee levies a 6 percent tax on purchases of food. Virtually all state and local taxes on restaurant meals and clothing are ad valorem.

Figure (6)

ntroducing an
d valorem tax

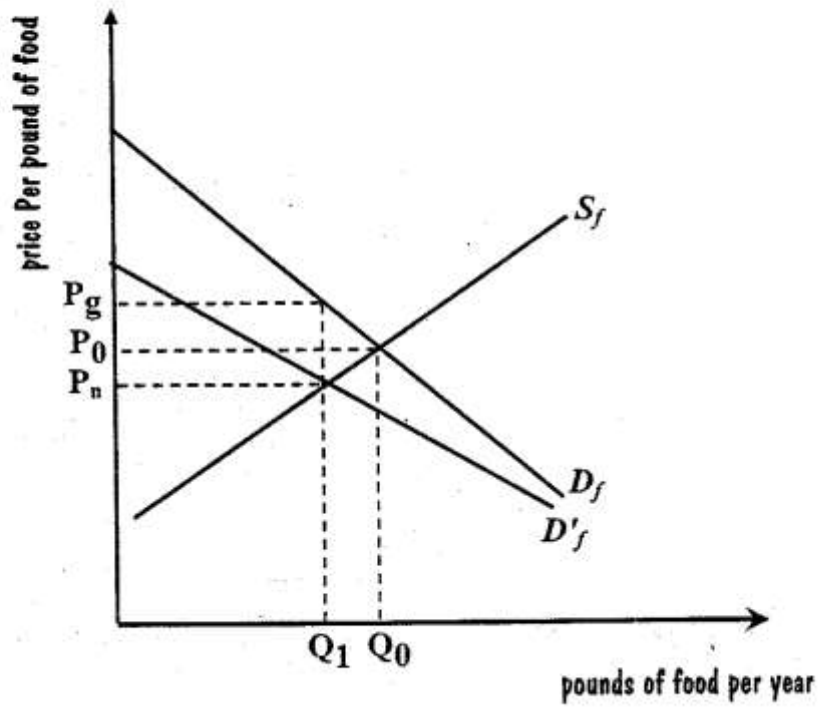


Luckily, the analysis of ad valorem taxes is very similar to that of unit taxes. The basic strategy is still to find out how the tax changes the effective demand curve and compute the new equilibrium. However, instead of moving the curve down by the same absolute amount for each quantity, the ad valorem tax lowers it by the same proportion. To show this consider the demand (D_t) and supply $(D_t,)$ curves for food in the absence of taxation. the equilibrium price and quantity are P_O and Q_O, respectively. Now suppose that a tax of 25 percent of the gross price is levied on the consumption of food.[14] Consider point m on D_f. After the tax is imposed, P_m is still the most that consumers will pay $Q_m$pound of food; the amount producers will receive is 75 percent of the vertical distance between point m and the horizontal axis, which is labeled point n. Hence, point n is one point on the demand curve perceived by producers. Similarly, the price at point r migrates down one quarter of the way between it and the horizontal axis to point S. Repeating this exercise for every point on D_f. The effective demand curve facing suppliers is determined as D'_f in from here, the analysis proceeds exactly as for a unit tax: The equilibrium is where S_f and D'_f intersect, with the quantity exchanged Q_1, the price received by food producers P_n and the price paid by consumers P_g. As before, the incidence of the tax is determined by the elasticities of supply and demand.

[14] Measuring ad valorem rates involves a fundamental ambiguity. Is the tax measured as a percentage of the net of gross price? In this example, the tax is 25 percent of the gross price, which is equivalent to a rate of 33 of net price. If price paid by the consumer were $1, the tax paid would be 25 cents and the price received by producers would be 75 cents. Expressing the 25 cent tax bill as a fraction of 75 cents gives u, a 33 percent rate as a proportion of the net price.

introducing an
ad valorem tax

Figure (7)



This analysis is applicable to any number of situations. Suppose that valorem tax were relabeled so that it represented the market for rental housing instead of the food market. Then we could show that the burden of the property tax doesn't depend on whether landlords or tenants pay the property tax. This is counter to the usual perception that landlords bear the burden simply because they write the check.

So far we have discussed taxes on goods, but the analysis can also be applied to factors of production.

The payroll tax, Consider the payroll tax used to finance the social security system. As noted, a tax equal to 7.65 percent of workers' earnings must be paid by their employers and a tax at the same rate paid by the workers themselves - a total of 15.3 percent. This division has a long history and is a consequence of our lawmakers' belief that the payroll tax should be shared equally by employers and employees. But the statutory distinction between workers and bosses is irrelevant. As suggested earlier, the incidence of this labor tax is determined only by the wedge the tax puts between what employees receive and employers pay.

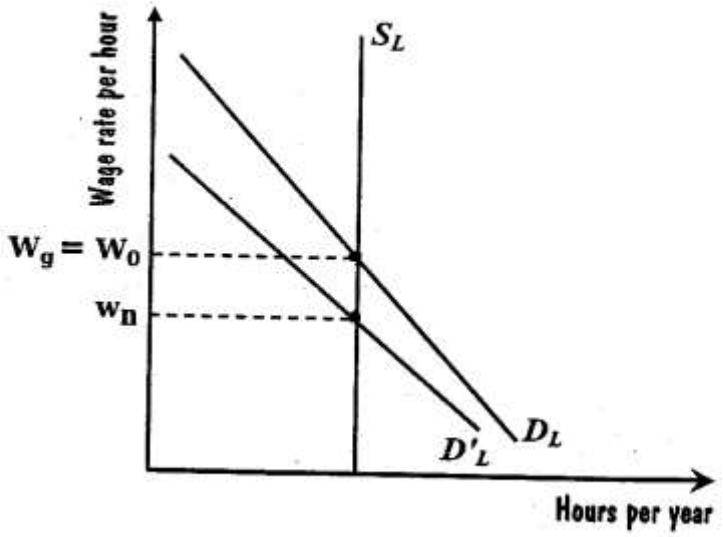
This point is illustrated in Figure 8 where D_L is the demand for labor and S_L is the supply of labor. For purposes of illustration, assume S_L to be perfectly inelastic. Before taxation, the wage is W_O. The ad valorem tax on labor moves the effective demand curve to D_L. As usual, the distance between D_L. And D_L is the wedge between what is paid for an item and what is received by those who supply it. After the tax is imposed, the wage received by workers falls to W_n On the other hand, W_g, the price paid by employers, stays at W_O in this example, despite the statutory division of the tax, the wage rate received by workers falls by exactly the amount of the tax- they bear the entire burden.

Of course, we could have gotten just the opposite result by drawing the supply curve as perfectly elastic. The key point to remember is that nothing about the incidence of a tax can be known without information on the relevant behavioral elasticities. In fact, there is some evidence that the elasticity of the total supply of hours of work in the United

States is about zero [Heckman, 1993]. At least in the short run, labor probably bears most of the payroll tax, despite the congressional attempt to split the burden evenly.

incidence of a payroll tax with an inelastic supply of labor

Figure (8)



Capital taxation in a Global Economy. The strategy for analyzing a tax on capital is essentially the same as that for analyzing a tax on labor– draw the supply and demand curves, shift or pivot the relevant curve by an amount depending on the tax rate, and see how the after – tax equilibrium compares with the original one. In an economy that is closed to trade, it is reasonable to assume that the demand curve slopes down (firms demand less capital when its price goes up), and that the supply of capital slopes up (people when its price goes up), and that the supply of capital slopes up (people supply more capital (I.e., save more) when the return to saving increases). In this case, the owners of capital bear

some of the burden of the tax, the precise amount depending on the supply and demand elasticities.

Suppose now that the economy is open and capital is perfectly mob across countries. In effect, there is a single global market for capital and it suppliers of capital cannot earn the going world rate of return in a particular country, they will take it out of that country and put it in another. In terms of a supply and demand diagram, the supply of capital to a particular country is perfectly elastic – its citizens can purchase all the capital they want at the going rate of return, but none whatsoever at a lower rate. The implications for the incidence of a tax on capital are striking. As in the before- tax price paid by the users of capital rises by exactly the amount of the tax, and the suppliers of capital bear no burden whatsoever. Intuitively, capital simply moves abroad if it has to bear any of the tax; hence, the before-tax rate of return has to rise.

Now, even in today's highly integrated world economy. Capital is not perfectly mobile across countries. Moreover, for a country like the United States whose capital market is large relative to the world market, it is doubtful that the supply curve is perfectly horizontal. Nevertheless, policymakers who ignore globalization will tend to overestimate their ability to place the burden of taxation on owners of capital. To the extent that capital is internationally mobile, taxes on capitalists are shifted to others, and the apparent progressivity of taxes on capital is illusory.

The assumption of competitive markets has played a major role in our analysis. We now discuss how the result might change under alternative market structures.

Monopoly. The polar opposite of competition is monopoly – one seller depicts a monopolist that produces commodity X. Before any taxation. The demand curve facing the monopolist is D_X, and the associated marginal revenue curve is MR_X. the marginal cost curve for the production of X is MC_X. And the average total cost curve, ATC_X. As usual, the condition for profit maximization is that production be carried to the point where marginal revenue equals marginal cost, at output X_O, where the price charged is P_O. Economic profit per unit is the difference between average revenue and average total cost, distance ab. the number of units sold is db. Hence, total profit is ab times ad, which is the area of rectangle abdc.

Now suppose that a unit tax of u is levied on X. For exactly the same reasons as before, the effective demand curve facing the producer shifts down by a vertical distance equal to u [15]in this demand curve is labeled D'_x. At the same time, the marginal revenue curve facing the firm also shifts down by distance u because the tax reduces the firm's incremental revenue for each unit sold. The new effective marginal revenue curve is labeled MR'_X.

[15] Alternatively we could shift the marginal cost curve up by u. the final outcomes ate identical.

Equilibrium of a monopolist

Figure (9)

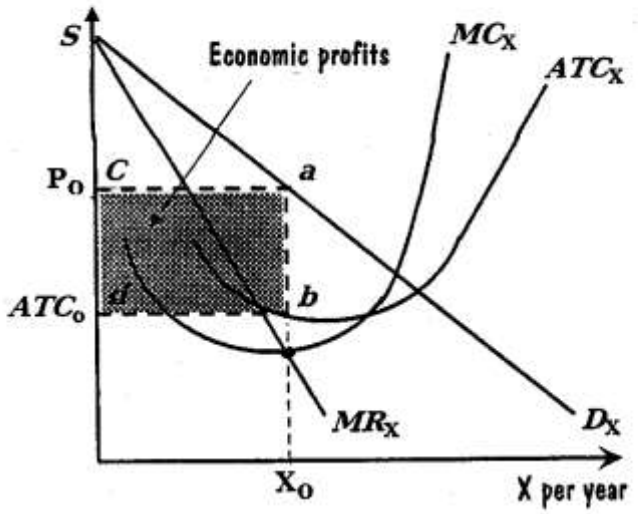
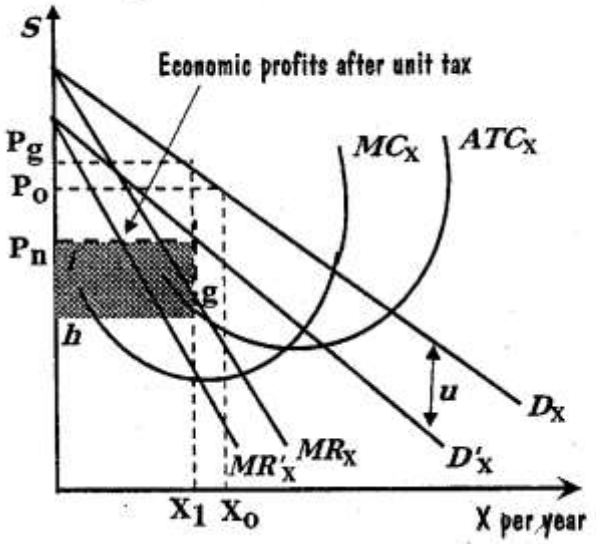


Figure (10)

imposition of a unit tax on a monopolist



The profit maximizing output X_1, is found at the intersection of $MR'_X$and MC'_X. Using output X_1, we find the price received by the monopolist by going up to D'_X . the demand curve facing him, and locate price P_n. The price paid by consumers is determined by adding u to P_n, which is shown as price P_g on the diagram. After − tax profit per

unit is the difference between the price received by the monopolist and average total cost, distance fg. Number of units sold is if. Therefore, monopoly economic profits after tax are measured by area fghi.

What are the effects of the tax? Quantity demanded goes down ($X_1 < X_0$); the price paid by consumers goes up ($P_g > P_o$); and the price received by the monopolist goes down ($P_n < P_o$). Note that monopoly profits are lower under the tax area fghi in is smaller than area abdc in Despite its market power. a monopolist is generally made worse off by a unit tax on the product it sells. Public debates often assume that a firm with market power can simply pass on all taxes to consumers. this analysis shows that even a completely greedy and grasping monopolist must bear some of the burden. As before. The precise share of the burden borne by consumers depends on the elasticity of the demand schedule.

It is straightforward to repeat the exercise for an ad valorem tax on the monopolist (D_X and MR_X pivot instead of moving down in a parallel fashion) this is left as an exercise for the reader.

Oligopoly. Between the polar extremes of perfect competition and monopoly is the oligopoly market structure in which there are a few. Sellers. Unfortunately, there is no well- developed theory of tax incidence in oligopoly. The reason for this embarrassing fact is simple: incidence depends primarily on how relative prices change when taxes are imposed, but there is no generally accepted theory of oligopolistic price determination.

Still, we can get a sense of the issues involved by imagining the problem faced by the firms in an oligopolistic market. From the firm' point of view, the ideal situation would be for them to collude and jointly produce the output that maximizes the profits of the entire industry. This output level is referred to as the cartel solution. (A cartel is just a group of producers that act together to maximize profits. The international oil cartel OPEC is the most famous example) the cartel solution requires each firm to cut its output to force up the market price. The problem for the firms is that the cartel solution is very difficult to obtain. Why? Once an agreement about how much each firm should produce is reached, each firm has an incentive to cheat on that agreement – to take advantage of the higher price and produce more than its quota of output. (Again, think about OPEC, and the problems it has in keeping its members from producing too much oil.) Consequently, output in an oligopolistic market is typically higher than the cartel solution. The firms would all be better off if there were some mechanism to force all of them to reduce their output.

What happens when this industry's output is subjected to a tax? As is the case both for competition and monopoly, the firms contract their output. However, unlike the other market structures, this is not necessarily bad for the oligopolistic firms. To be sure, for any given level of before-tax profits, the firms are worse off, because they have to pay the tax. However, as the firms contract their outputs, they move closer to the cartel solution, so their before, tax profits increase. It is theoretically possible for before- tax profits to increase by so much that

even after paying the tax, the firms are better off (delipalla and Keen, 1002). Of course, it is also possible for the firms to be worse off. One needs more information on just how much the firms cut back their output to obtain a definitive answer.

As economic behavior under oligopoly becomes better understood, improved models of incidence will be developed. In the meantime, most economists feel fairly comfortable in relying on the predictions produced by competitive models, although they realize these are only approximations.

So far we have been discussing taxes based on sales. Firms can also be taxed on their economic profits, defined as the return to owners of the firm in excess of the opportunity costs of the factors used in production. (Economic profits are also referred to as supernormal! Or excess profits). We now show that for profit maximizing firms, a tax on economic profits cannot be shifted-it is borne only by the owners of the firm.

Consider first a perfectly competitive firm in short- run equilibrium. The firm's output is determined by the intersection of its marginal cost and marginal revenue schedules. A proportional tax on economic profits changes neither marginal cost nor marginal revenue. Therefore, no firm has the incentive to change its output decision. Because output does not change, neither does the price paid by consumers, so they are no worse off. The tax is completely absorbed by the firms. Here's another way to get to the same result: if the tax rate on economic profits is t_P, the firm's objective is to maximize after tax profits, $(1-t_P)$ II , where II is

the pretax level of economic profits. But it is just a matter of arithmetic that whatever strategy maximizes Π is identical to the one that maximizes $(1-t_P)\,\Pi$. Hence, output and price faced by consumers stay the same, and the firm bears the whole tax.

In long run competitive equilibrium, a tax on economic profits has no yield, because economic profits are zero – they are all competed away. For a monopolist, there may be economic profits even in the long run. But for the same reasons given in the preceding paragraph, the tax is borne by the owners of the monopoly. If a firm is maximizing profits before tax is imposed tax cannot shifted.

Because they distort no economic decisions, taxes on economic profits might appear to be very attractive policy alternatives. In 1993, for example, certain members of the Clinton administration called for a profits tax on hospitals. However, profits taxes receive very little support from public finance specialists. The main reason is the tremendous problems in making the theoretical notion of economic profits operational. Economic profits are often computed by examining the rate of return that a firm makes on its capital stock and comparing it to some basic rate of return set by the government. Clearly, how the capital stock is measured is important. Should the original cost be used, or the cost of replacing it? And what if the rate of return is high not because of excess profits, but because the enterprise is very risky and investors have to be compensated for this risk? Considerations like these lead to major difficulties in administration and compliance.

Several years ago the coastal city of port, Hueneme, California, levied a special tax on beach properties. The tax was determined in part by how close the properties were to the ocean. For owners close to the water, the extra tax wasa$192 per year. Owners of beach front property complained vociferously.

This episode leads us to consider the special issues that arise when land is taxed. For these purposes, the distinctive characteristics of land are that it is fixed in supply and it is durable. Suppose the annual rental rate on land is $\$R_0$ this year. It is known that the rental will be $\$R_1$ next years $\$R_2$ two years from now, and so on. how much should someone be willing to pay for the land? If the market for land is competitive, its price is just equal to the present discounted value of the stream of the rents. Thus, if the interest rate is r, the price of land (P_R) is

$$P_B = \$R_0 + \frac{\$R_1}{(1+r)} + \frac{\$R_1}{(1+r)^2} + \cdots + \frac{\$R_1}{(1+r)^T} \qquad (3)$$

Where T is the last year the land yields its services,(possibly infinity).

Now it is announced that a tax of $\$u_0$ will be imposed on land now $\$u_1$ next year, $\$u_2$ two years from now, and so forth we know that because land is fixed in supply, the annual rental received by the owner falls by the full amount of the tax. Thus, the landlord's return initially falls to $\$(R_0 - u_0)$, in year 1 to $\$(R_1 - u_1)$, in year 2 to $\$(R_2 - u_2)$, and so on prospective purchasers of the land take into account the fact that if

they purchase the land, they buy a future stream of returns. Therefore, the most a purchaser willing to pay for the land after the tax is announced (P'_R) is

$$P'_R = \$(R_0 - u_0) + \frac{\$(R_1 - u_1)}{(1+r)} + \frac{\$(R_2 - u_2)}{(1+r)^2} + \cdots + \frac{(R_T - u_T)}{(1+r)^T} \quad (4)$$

Comparing Equation we 3,4 see that as a consequence of the tax the price of land falls by

$$u_0 = \frac{\$\ u_1}{(1+r)} + \frac{\$\, u_2}{(1+r)^2} + \cdots + \frac{u_T}{(1+r)^T}$$

Thus at the time the tax is imposed. The price of the and falls by the present value of all future tax payments. This process by which a stream of taxes become incorporated into the price of an asset is referred to as capitalization.

Because of capitalization, the person who beat the full burden of the tax forever is the landlord at the time the tax is levied. To be sure, future landlords writ checks to the tax authorities, but such payments a not really a burden because they just balance the lower price paid at purchase. Capitalization complicated attempts to assess the incidence of a tax on any durable item that is fixed in supply. Knowing the identities of current owners is not sufficient – one must know who the landlords

were at the time the tax was imposed. It's no wonders the owners of beach property in port Hueneme were so upset![16]

A great attraction of partial equilibrium models is their simplicity examining only one market at a time is relatively uncomplicated. In some cases, however, ignoring feedback into other markets leads to an incomplete picture of a tax's incidence. Suppose, for example, that the tax rate on cigarettes is increased to the extent that demand for cigarettes decreases so does the demand for tobacco. Farmers who formerly raised tobacco on their land may turn to other crops, perhaps cotton. as the supply of cotton increases, its price falls, harming the individuals who were already producing cotton. Thus, cotton producers end up bearing part of the burden of a cigarette tax.

More generally, when tax is imposed on a sector that is large relative to the economy. Looking only at that particular market may not be enough. General equilibrium analysis takes into account the ways in which various markets are interrelated.

Another problem with partial equilibrium analysis is that it gives insufficient attention to the question of just who the producers of a taxed commodity and think again of the cigarette tax and the desire of son policymakers to use it as an instrument to punish the tobacco industry. Only people can pay taxes and the producers of tobacco include the shareholder who finance the purchase of machinery, farmers who own the land on which the tobacco is growth, the workers in the factories,

[16] When a land tax is anticipated before it is levied presumably it is borne at least the time the anticipation becomes widespread if so in part by the owner at even finding out the identity of the landowner at the, time the tax was imposed may not be enough.

and so on the division of the tax burden among these groups is often important. General equilibrium analysis provides a framework for investigating it.

Before turning to the specifics of general equilibrium analysis, note that the fundamental lesson from partial equilibrium models still holds: because of relative price adjustments. The statutory incidence of a tax generally tells nothing about who really bear its burden.

The idea of dealing with tax incidence in a general equilibrium framework at first appears dating after all, thousands of different commodities and inputs are traded in the economy. How can we keep track of all their complicated interrelations? Luckily for many purposes. Useful general equilibrium results can be obtained from models in which there are only two commodities, two factors of production, and no savings. for illustration call the two commodities food (F) and manufactures (M). and the two factors capital (k) and labor (L). There are nine possible ad valorem taxes in such a model:

t_{KF} = a tax on capital used in the production of food

t_{KM} = a tax on capital used in the production of manufactures

t_{LF} = a tax on labor used in the production of food

t_{LM} = a tax on labor used in the production of manufactures

t_F = a tax on the consumption of food

t_M = a tax on consumption of manufactures

t_K = a tax on capital in both sectors

t_L = a tax on labor in both sectors

t = a general income tax

The first four taxes which are levied on a factor in only some of its used are referred to as partial factor taxes.

Certain combinations of these taxes are equivalent to others. One of these. One of these equivalences is already familial from the theory of the consumer[17] taxes on food (t_F) and manufactures (t_M) at the same rate are equivalent to an income tax (t).[18] To see this just note that equip proportional taxes on all. Commodities have the same effect on the consumer's budget constraint at a proportional income tax. Both create a parallel shift inward.

Now consider a proportional tax on both capital (t_K) and labor (t_L). Because in this model all income is derived from either capital or labor, it is a simple matter of arithmetic that taxing both factors at the same rate is also equivalent to an income tax (t).

Perhaps not so obvious is the fact that parties' taxes on both capital and labor in the food sector at a given rate $(t_{KF} = t_{LF})$ are equivalent to a tax on food (t_F) at the same rate. Because capital and labor as the only inputs to the production of food, making each of them

[17] The theory the consumer is outlined in the apprendix at the end of the hook.
[18] Note that green the assumption that all income is consumed, an income tax also equivalent to a tax on consumption expenditure

more expensive by a certain proportion equivalent to making the making the food itself more expensive in the same proportion.

Tax Equivalence relations

t_{KF} and	and	t_{KF} and	Equivalent to	t_F and
t_{KM} are	and	t_{LM} are	Equivalent to	t_M are
Equivalent to		Equivalent to		Equivalent to
t_K	and	t_{LM}	Equivalent to	t

Source Charles E .Mclure, Jr., Theory of Tax incidence with imperfect factor Mobility,' Finanzarchiv $30\ (1971)$.P29.

More generally, any two sets of taxes that generate the same changes in relative prices have equivalent incidence effects. All the equivalence relations that can be derived using similar logic are summarized in Table 2. For a given ad valorem tax rate, the equivalences are shown by reading. Across the rows or down the columns. To determine the incidence of all three taxes in any row or column, only two have to be analyzed in detail. The third can be determined by addition or subtraction. For example, from the third row, if we know the incidence of taxes on capital and labor, then we also know the incidence of a tax on income.

In the next section, we discuss the incidence of four taxes: a food tax (t_F), an income tax (t), a general tax on labor (t_L), and a partial tax on capital in manufacturing (t_{KM}). With results on these four taxes in

hand, the incidence of the other five can be determined by using Table 2. Harberger [1974c] pioneered in applying general equilibrium models to tax incidence. The principal assumptions of his model are as follows:

1- **Technology**. Firms in each sector use capital and labor to produce their outputs. In each sector, simultaneous doubling of both inputs leads to doubling of output, constant returns to scale, However the production technologies may differ across sectors.in general, the production technologies differ with respect to the ease with capital can be substituted for labor (the elasticity of substitution) and the ratios in which capital and labor are employed. For example, the capital- labor ratio in the production of food is about twice that used in the production of textile [Congressional Budget Office, 1997d, p. 42] the industry in which the capital- labor ratio in relatively high is characterized as capital intensive; the other is labor intensive.

2- **Behavior of factor suppliers**. Suppliers of both capital and labor maximize total returns. Moreover, capital and labor are perfectly mobile- they can freely move across sectors according to the wishes of their owners. Consequently, the net marginal return to capital must be the same in each sector, and so must the net marginal return to labor. Otherwise, it would be possible to reallocate capital and labor in such a way that total net returns could be increased.

3- **Market structure**. Firms are competitive and maximize profits, and all prices (including the wage rate) are perfectly flexible. Therefore, factors are fully employed, and the return paid to each factor of

production is the value of its marginal product – the value to the firm of the output produced by the last unit of the input.

4-**Total factors supplies**. The total amounts of capital and labor in the economy are fixed. But, as noted above, both factors are perfectly free to move between aggregate

5- **Consumer preferences**. All consumers have identical preferences. A tax therefore cannot general any distributional effects by affecting people uses of income. This assumption allows us concentrate on the effect of taxes on the source of income.

6- **Tax incidence framework**. The framework for the analysis is differential tax incidence: We consider the substitution of one tax for another. Therefore, approximately the same amount of income available before and after the tax, so it unnecessary to consider how changes in aggregate income may change demand and factor prices. Clearly, these assumptions are somewhat restrictive but they simplify the analysis considerably. Later in the chapter, we consider the consequences of dropping some of them. We now employ hamburger's model analyzes several different taxes.

A commodity Tax (t_F) when a tax on food is imposed its relative price increases (although not necessarily by the amount of the tax). Consumers therefore substitute manufactures for food. Consequently, food and more manufactures are produced. As for production falls, some of the capital and labor formed used in food production are forced to find employment in manufacturing. Because the capital – labor ratios

probably differ between the two sectors, the relative prices of capital and labor have to change for manufacturing to be willing to absorb the unemployed factors from food production. For example, assume that food is the capital -intensive sector (US) agriculture does, in fact, use relatively more capital equipment- tractors combines, and so forth- than many types of manufacturing.) Therefore, relatively large amounts of capital must be absorbed in manufacturing. The only way (or all this capital to find employment in the manufacturing sector is for the relative price of capital to fall including capital already in use in the manufacturing sector. in the new equilibrium, then, all capital is relatively worse off, not just capital in the food sector. More generally, a tax on the output of a particular sector induces a decline in the relative price of the input used intensively in that sector.

To go beyond such qualitative statements, additional information is needed. The greater the elasticity of demand for food, the more dramatic will be the change in consumption from food to manufactures, which ultimately induces a greater decline in the return to capital. The greater the difference in factor proportions between food and manufactures, the greater must be the decrease in capital's price for to be absorbed into the manufacturing sector. (If the capital-labor ratios for good and manufactured goods were identical. Neither factor would suffer relative to the other.) Finally, the harder it is to substitute capital for labor in the production of manufactures, the greater the decline in the rate of return to capital needed to absorb the additional capital.

Thus, on the sources side of the budget, the food tax tends to hurt people who receive a proportionately large share of their incomes from capital. Given that all individuals are identical (assumption 5), there are no interesting effects on the uses side. However, were we to drop this assumption, then clearly those people who consumed proportionately large amounts of food would tend to bear relatively larger burdens the total incidence of the food tax then depends on both the sources and uses sides. For example, capitalist who eats a lot of food is worse off on both counts. On the other hand, a laborer who eats a lot of food is better off from the point of view of the source of income, but worse off on the uses side. An income Tax (t). As already noted, an income tax is equivalent to set of taxes on capital and labor at the same rate. Since factor suppliers are completely fixed (assumption 4), this tax cannot be shifted. It is borne in proportion to people's initial incomes. The intuition behind this result is similar to the analogous case in the partial equilibrium model; since the factors cannot escape the tax (by opting out of production), they bear the full burden.

A general tax on labor (t_L). A general tax on labor is a tax on labor in all its uses, in the production of both food and manufactures. As a result, there are no incentives to switch labor use between sectors. Further, the assumption officer factor supplies imply labor must bear the entire burden.

A partial factor Tax (t_{KM}) when capital used in the manufacturing sector only is taxed, there are two initial effects:

1- output effect. The price of manufactures tends to rise, which decreases the quantity demanded by consumers.

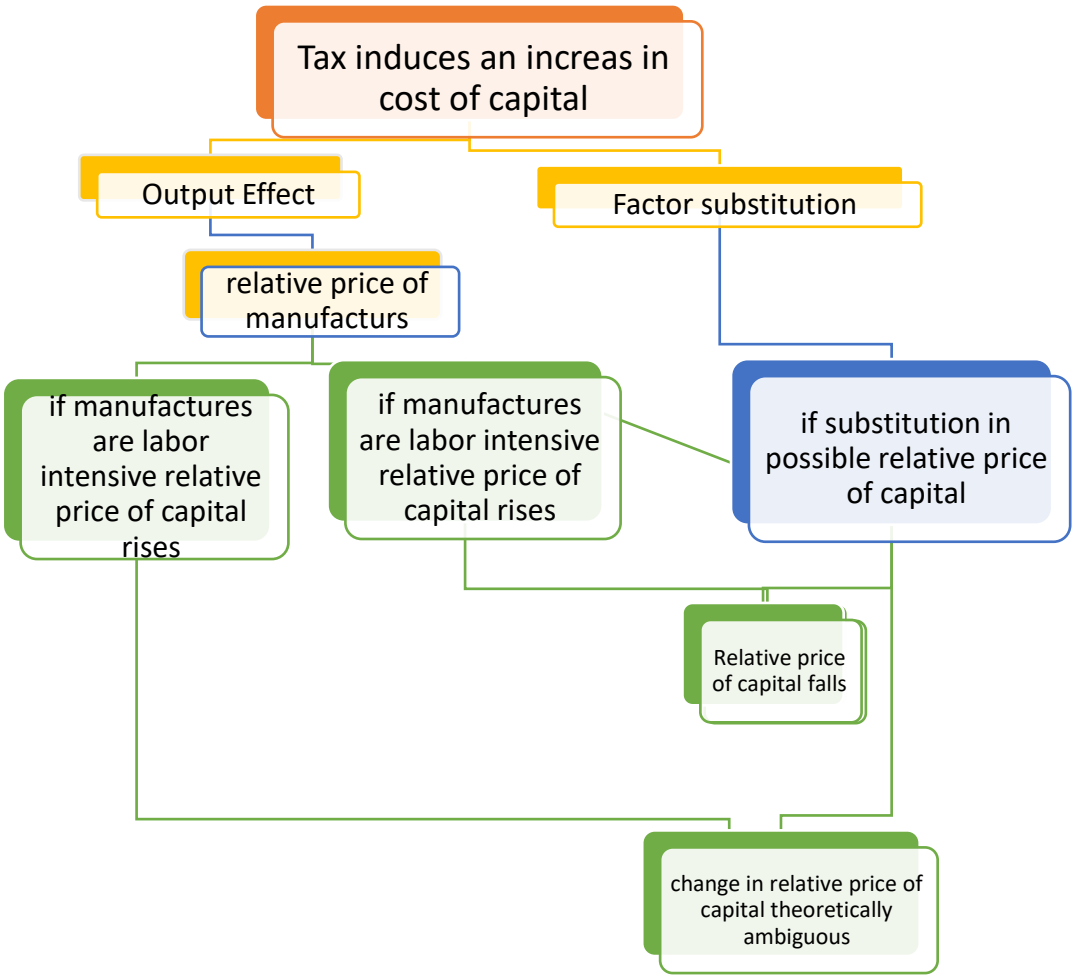
2- factor substitution effect. As capital becomes more expensive in the manufacturing sector. Producers there use less capital and more labor. The flowchart in figure 11 traces the consequences of these two effects.

The output effect is described on the left side as its name suggests, the output effect arises from reducing production in manufacturing. When the price of manufactures increases and demand falls capital and labor are released from manufacturing and must find employment in the production of food, if the manufacturing sector is labor intensive, then (relatively) large amounts of labor have to be absorbed in the food sector, and the relative price of capital increases. If, on the other hand, the manufacturing sector is capital intensive, the relative price of capital falls. Thus, the output effect is ambiguous with respect to the final effect on the relative prices of capital and labor.

This ambiguity is not present with the factor substitution effect, as depicted in the right-hand side of along as substitution between capital and labor is possible, an increase in the price of capital induces manufacturers to use less capital and more labor, tending to decrease the demand for capital and its relative price.

Incidence of a partial factor tax (t_{KM}) in general equilibrium model

Figure (11)



Putting the two effects together, we see that if manufacturing is capital intensive, both effects work in the same direction, and the relative price of capital must fall. But if the manufacturing sector is labor intensive, the final outcome is theoretically ambiguous. Even though the tax is levied on capital, it can make labor worse off! More generally, as long as factors are mobile between uses, a tax on a given factor in a sector ultimately affects the return to both factors in both sectors such

insights cannot be obtained with the partial equilibrium models discussed earlier this chapter.

Much of the applied research on incidence general equilibrium models has focused on the corporation income tax. Such work assumes that the two sectors are corporate and no corporate, a that the corporation income tax is an ad valorem tax on capital only on its use in the corporate sector. Given the theoretical ambiguity of the effect of a part factor tax on the demand for capital, empirical work required to find its incidence. Although different studies have reached different conclusions, the most typical finding is that much of the tax is shifted to the owners of all capital (US of the Treasury, 1992, p. 146) Changing the assumptions underlying the general equilibrium model affects it's for tax incidence in following ways:

Differences in individuals ' Tastes. By assumption all consumers have the same preferences for the goods. When they do not. tax induced changes in the distribution of income change aggregate spending decision and hence relative prices and incomes. Consider, for example, a tax on capital in the corporate sector. As noted above, most analysts suggest that it is shifted to the owners of all capital. And because capital tends to be a relatively important source of income for high-income individuals, the tax would appear to be progressive, However, as noted by Fullerton and Rogers (1997, the tax also raises the relative prices of goods produced in capital intensive industries such as agriculture and petroleum relining whose outputs (food and gasoline) are purchased in high proportions by families at the low end of the

income scale. thus, when we allow for differences in uses between high and low- income families, the tax becomes less progressive than it first appears.

Immobile Factors. By assumption 2, resources are free to flow between sectors, seeking the highest rate of return possible. However, for institutional or technological reasons, some factors may be immobile. For example, if certain land is zoned for residential use, it cannot be used in manufacturing, no matter what the rate of return. Abandoning perfect mobility can dramatically affect the incidence of a tax. For example, earlier we showed that if factors are mobile, the incidence of a partial factor tax is ambiguous depending on the outcome of several conflicting effects. If the factor is immobile. However, the incidence result is clear cut: the taxed factor bears the whole burden. Intuitively, this is because the factor cannot escape taxation by migrating to the other sector. Note also that because the return to the taxed immobile factor falls by just the amount of the tax, the prices of capital and labor in the untaxed sectors are unchanged, as is the price of the good in the taxed sector.

Variable factor supplies. By assumption 4, the total supplies of both factors are fixed. In the long run however. The supplies of both capital and labor the economy are variable. Allowing for growth can turn conclusion from the static model completely of their heads. Consider a general factor tax on capital when the capital stock fixed. This tax is borne entirely by the capital's owners. In the long run, however less

capital may be supplied due to the tax.[19] To the extent this occurs, the economy's capital labor ratio decreases, and the return to labor falls. (the wage falls because labor had less capital with which to work, and hence is less productive, ceteris paribus). Thus, a general tax on capital can hurt labor.

Because the amount of calendar time that must elapse before the long run is reached may be substantial, short-run effects matter, on the other hand, intelligent policy also requires consideration of the long-run consequences of taxation.

The theory or tax incidence has served as a framework for a number of attempts to estimate how the US tax system affects the distribution of income. Table 3 reports the findings of a recent study by Gale and Potter [2002]. The study focuses on federal income, payroll, corporate. estate, and commodity taxes. The average tax rate ranges from 8.4 percent on families in the lowest quintile (under $15,000) to 31.3 percent in the top one percent of the population. This top I percent pays about 25 percent of all federal taxes. These figures suggest that the federal tax system is quite progressive.

However, it should be clear by now that all incidence results depend crucially on the underlying assumptions. This study assumes that there is no shifting of the personal income and payroll taxes and that commodity taxes are borne by consumer in proportion to their consumption of the taxes items. These assumptions help simplify the

[19] However , the supply of capital does not necessarily decrease .

problem considerably. But the theory of tax incidence suggests that they are questionable, especially in the long run.

Another limitation of the analysis is that it is based on individuals annual incomes. Using some measure of lifetime income would be more appropriate and could change the results importantly. To see why we begin by noting that a substantial amount of empirical research suggests people's consumption decisions are more closely related to some lifetime income measure than the value of income in and particular year. Just because a person's income in temporarily high or low in a year does not have that great an impact on how much she consumes.

Assume that the consumption of commodity X proportional to lifetime income. Assume further that the supply curve for X is horizontal, so that consumer bears the entire burden of any tax on X. Then a tax on X would be proportional with respect to lifetime income. However, in any particular year, some people have income that is temporarily higher than their permanent values and some lower. A person with a temporarily high income spends a relatively small proportion of his annual income on X because he does not increase his consumption of X due to the temporary increase in income. Similarly, a person with a temporarily low income devotes a relatively high proportion of her income to good X. In short, based on annual income, good D's budget share appears to fall with income, and a tax on X looks regressive. Consistent with this theory, several investigators have found that incidence results are very sensitive to whether lifetime or annual measures are employed. For example, in his analysis of US state and

local sales taxes. Metcalf (1993) finds that sales taxes are L90 percent of the annual incomes of the lowest income decile, and 1.07 percent in the highest decile. – a decidedly regressive pattern . Using lifetime income, however, the pattern is actually reversed, with sales taxes taking 1.03 percent of lifetime income in the lowest decile, and 1.74 percent in the highest decile. We conclude that even though studies based on annual income are suggestive, the results should be viewed with some caution.

Income category	Average federal tax rare	Shore of federal tax
Lowest quintile	8.4%	1.1%
Second quintile	14.0	4.1
Third quintile	18.8	9.2
fourth quintile	22.3	17.9
Top 1%	31.3	24.9

Source Gale and potter (2002) these figures include the tax changes embodied in the economic growth and tax relief reconciliation Act of 2001.

Discussion questions

1- For commodity X. average cost is equal to marginal cost at every level of output. Assuming that the market for X is competitive and the demand curve is linear, analyze the effects when a unit tax of u dollars is imposed. Now analyze the effects of the same tax assuming that the market for X is a monopoly. Discuss the differences.

2- Use a general equilibrium framework to discuss the possible incidence of a tax on cigarettes.

3- Suppose that the demand for cigarettes in a hypothetical country is given by Q^Dc = $2000 . 200\ P_C$, where Q^Dc is the number of packs demanded and P_C the price per pack. The supply of cigarettes is Q^sc = $P_C \times 200$

a- find the price and quantity of cigarettes assuming the market is competitive.

b- in an effort to reduce smoking, the government levies a tax of $\$2$ per pack. Compute the quantity of cigarettes after the tax. The price paid by consumers, and the price received by producers. How much revenue does the tax raise for the government?

4- suppose that the demand curve for a particular commodity is Q^D = a - bP, where Q^D is the quantity demanded, P is the price, and a and b at constants. The supply curve for the commodity Q^S = C + dP where Q^S is quantity supplied and C and d are constants. Find the

equilibrium price and output as functions of the constant a, b, c, and d.

Suppose now that a unit tax of u dollars imposed on the commodity. Show that the new equilibrium is the same regardless of whether the tax is imposed on producers or buyers of the commodity

5- In 2003, Senate Democrats proposed a tax reform that would reduce taxes for all workers by $\$300$ for simplicity, assume that there is one earner family, so each family would get a $\$300$. Reduction in its taxes. Use equations (1) and (2) to discuss how this proposal would affect the progressiveness of the tax system.

6- Assume that in a given country, tax revenues T depend on income, 1, according to the formula

$$T = -4.000 + 0.21$$

Thus, for example, when a household has an income of $\$50.000$ its tax burden is $- 4.000 + 0.2 \times 50.000$ or $\$6.000$. Is this a progressive tax schedule? (Hint: compute average tax rates at several different levels of income.)

7- Now let's generalize the tax schedule from the last problem

$$T = a + tI$$

Where a and t are numbers. (For example, in the previous problem a = $- 4.000$ and t = 0.2) write down a formula for the average tax rate as a function of the level of income. Show that the tax system is

progressive if a is negative. And regressive if a is positive. (Hint: the average tax rate is T/I.)

Exercises

Chapter two

Taxation and income distribution

Part A True – false questions

Circle whether the following statements are true (T) or false (F)

1- Consumers pay the entire tax in the form of higher prices.

2- If after the tax is imposed, the consumer is no worse off, means that the seller bears the full burden of the tax.

3- If the average tax rate increases with income, the system is progressive; if it falls, the tax is regressive.

4- There is appositive relationship between income and average tax rate.

5- The greater the increase in ones rates as income increases, the more progressive the system.

6- Tax system is more progressive than another if it's elasticity of tax is higher.

7- A unit tax is levied as a fixed amount per unit of a commodity sold.

8- The more elastic the demand curve, the less the tax borne by consumers, ceteris paribus.

9- The more elastic the supply curve, the less the tax borne by producers, ceteris paribus.

10- The more elastic the demands, the easier it is for consumers to turn to other products when the price goes up.

11- If consumers purchase the same amount regardless of price, the whole burden can be shifted to them.

12- When supply is perfectly inelastic, producers bear the entire burden.

13- When supply is perfectly elastic, consumers bear the entire burden.

14- If the elasticity of the total supply of hours of work is about zero, labor probably bears most of the payroll tax.

15- The share of the burden borne by consumers depends on the elasticity of the demand schedule.

16- A cartel is just a group of producers that act together to maximize profits.

17- The international oil cartel OPEC is the most famous of cartel.

Part B: multiple – choice questions

Circle the appropriate answer:

1- Is a straightforward; it describes a situation in which the ratio of taxes paid to income is constant regardless of income level this is means

a) proportional tax
b) regressive tax
c)progressive tax
d) Not of the above

2- If the average tax rate increases with income, the system is ……; if it falls, the tax is……

a) regressive, progressive. b) progressive, regressive

c)proportional, regressive d) progressive, proportional

3- The change in taxes paid with respect to a change in income this refer to ……

a) average tax rate b) marginal tax rate

c) tax revenue d) tax liability

4-Average tax rate…….. With income, however the marginal tax rate is…….

a) decreases, constant b) increases, constant

c) increases, negative d) decreases, positive

5- The percentage change in tax revenues divided by percentage change in income this refer to

a) average tax rate b) marginal tax rate

c) tax revenue d)elasticity of tax

part C:- problems: (Graph if possible)

Suppose that the demand for cigarettes in a hypothetical country is given by Qdc = $1000 - 100$ Pc where Qdc is the number of packs demanded and Pc the price per pack. The supply of cigarettes is Qsc = Pc* 100

a) Find the price and quantity of cigarettes assuming the market is competitive

b) In an effort to reduce smoking, the government levies a tax of a $1 per pack. Compute the quantity of cigarettes after the tax the price paid by consumers, and the price received by producers. How much revenue does the tax raise for the government?

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Chapter Three

Taxation and efficiency

Chapter 3.

Taxation and efficiency

We need to illustrate and understand the following topics in this chapter

1- The theory and measurement of excess burden

2- Measurement of excess burden by using the theory of welfare economics

3- Measurement of excess burden with commodity subsidies is important components of the fiscal system

4- The theory of excess burden applies just as well factors of production

Chapter Three

Taxation and Efficiency[20]

Taxes impose a cost on the taxpayer. It is tempting to view the cost as simply the amount of money that he or she hands over to the tax collector. However, an example indicates that this is just part of the store, Consider Breuer Dazs, a citizen who typically consumer 10 ice. Ream each week, at a price of $1 per cone. The government levies 25 percent tax on his consumption of ice cream cones so now Dazs faces a price of $1.25. In response to the price hike, Dazs reduces his ice cream cone consumption to zero, and he spends the $10 per week on other goods and services. Obviously because Dazs consumes no ice cream cones, the ice cream tax yields zero revenue. Do we want to say that Dazs in unaffected by the tax? The answer is no. Dazs is worse off because the tax has induced him to consumer less desirable bundle of goods than previously. We knd that the after-tax bundle is less desirable because before tax, Dazs had the option of consuming no ice cream cones. Since he chose to buy 10 cones weekly.[21]

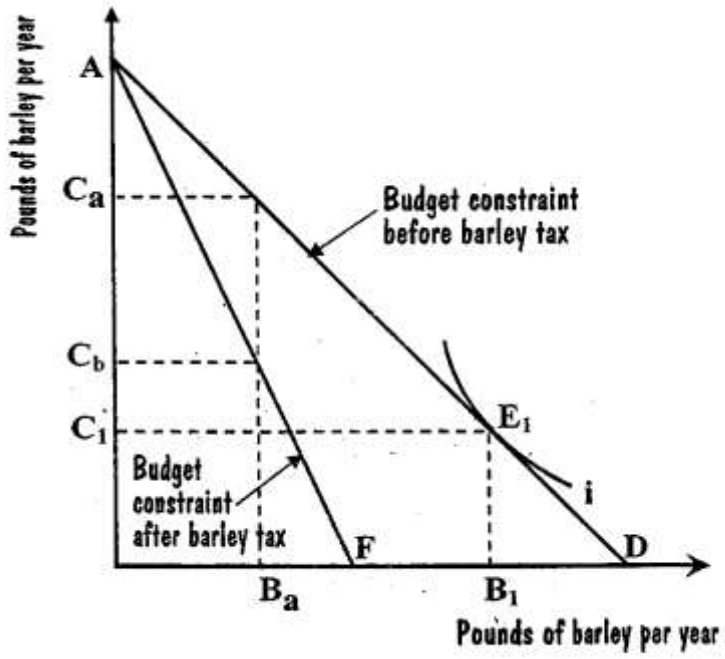
This must have been preferred to spending the money on other items. Thus, despite the fact that the tax raised zero revenue, it made Dazs worse off.

[20] Harvey S, Rosen, "Public Finance", mcgraw- Hill new York. USA. 2005

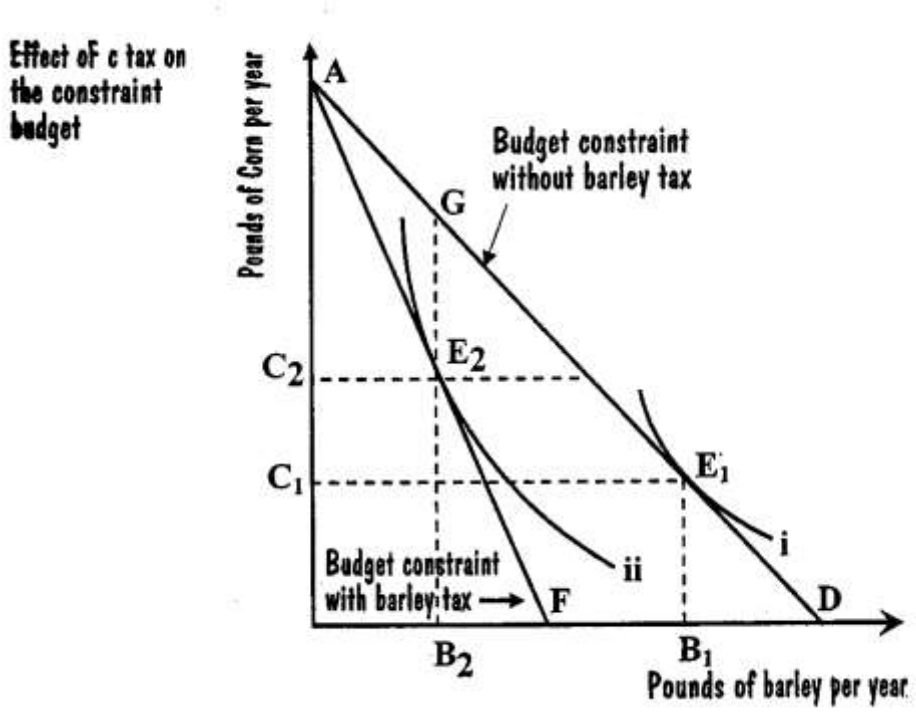
[21] As emphasized in the price paid by the consumer generally does not rises by the full amount of the tax. This assumption, which is correct it the supply curve is horizontal, is made here only for convenience,

This example is a extreme. Normally, we expect that an increase in price to diminish the quantity demander but not drive it all the way to zero. Nevertheless, the basic result holds: because a tax distorts economic decisions, it creates an excess burden a of welfare above and beyond the tax revenues collected. Excess burden is sometimes referred to as welfare cost– deadweight Loss. In this chapter we discuss the theory and measurement of excess burden. And explain its importance for evaluating actual tax systems.

Effect of C tax on the budget constraint



Ruth has a fixed income of / dollars, which she spends on only two commodities: barley and corn. The price per pound of barley is P_b and the price per pound of corn is P_C. There are no taxes or distortions, such as externalities or monopoly in the economy, so the prices of the goods reflect their social marginal costs. For convenience, these social marginal costs are assumed to be constant with respect to output.in Figure 1 Ruth's consumption of barley is measured on horizontal axis and AD, which has slope− P_b/P_C and horizontal intercept I/P_b . Assuming Ruth wants to maximize her utility, she chooses a point like E_1 on indifference curve i, where she consumes B_1 pounds of barley and C_1 pounds of corn.

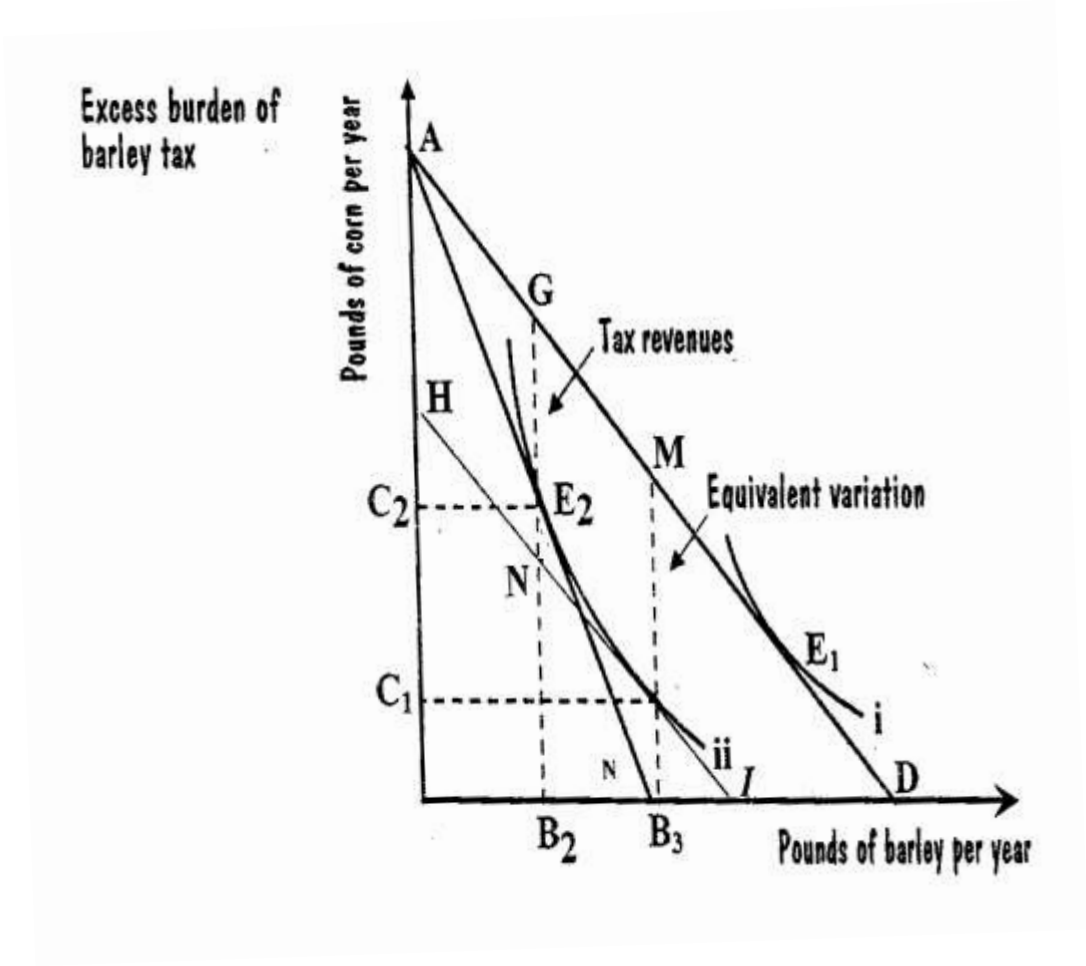


Now suppose the government levies a tax at a percentage rate of P_b on barley so the price Ruth faces becomes $(1 + t_b)\ P_b$ (the before-tax price is unchanged because of our assumption of constant marginal social costs). Imposition of the tax changes Ruth's budget constraint, it now has a slope of $[(1 + t_b)\ P_b\ /P_C]$ and horizontal intercept I/$[(1 + t_b)\ P_b]$. This is represented in as line AF (Because the price of corn is stillP_C, lines AF and AD have the same vertical intercept.)

Note that at each consumption level of barley the vertical distance between AD and AF shows Ruth's tax payments measured in corn. To see this, consider an arbitrary quantity of barley B_a on the horizontal axis before the tax was imposed; Ruth could have both Ba pounds of barley and C_a pounds of corn. After the tax however, if she consumed B_a pounds of barley the most corn she could afford would be C_b pounds. The difference (distance) between C_a and C_b must therefore represent the amount of tax collected the government measured in pounds of corn. We can convert tax receipts to dollars by multiplying distance $C_a\ C_b$ by the price per pound of corn P_C. For convenience, we measure corn in units such the P_C = I. In this case, the distance $C_a\ C_b$ measure the receipts in corn or dollars.

So far, we have not indicated Ruth's choice on her new budget constraint. AF Figure 2 shows that her most preferred bundle is at E_2 on indifference curve ii, where her consumption of barley is B_2, her consumption of corn is C_2, and her tax bill is the associated vertical distance between AD and AF, GE_2. Clearly, Ruth is worse off at E_2 than she was at E_1. However, any tax would have put her on a lower

indifference curve.[22] The important question is whether the barley tax inflicts a greater utility loss than is necessary to raise revenue GE_2. Alternatively, is there some other way of raising revenue GE_2 that would cause a smaller utility loss to Ruth? If so, the barley tax has an excess burden.



To investigate this issue, we need to find a dollar equivalent of the loss that Ruth suffers by having the move from indifference curve i to ii. One way to measure this is the equivalent variations – the amount of income we would have to take away from Ruth (before the barley tax was levied) to induce her to move from I and ii. The equivalent variation

[22] This ignores benefits that be obtained from the expenditures financed

measures the loss inflicted by the tax as the size of the reduction in income that would cause the same decrease in utility as the tax.

To depict the equivalent variation graphically recalls that taking away income from an individual leads to a parallel movement inward of her budget lines. Hence, To find the equivalent variation, all we have to do is shift AD inward, until it is tangent to indifference curve ii the amount by which we have to shift AD is the equivalent variation. In budget line HI is parallel to AD and tangent to indifference curve ii. Hence, the vertical distance between AD and HI, ME_3, is the equivalent variation. Ruth is indifferent between losing ME_3 dollars and facing the barley tax.

Note that the equivalent variation ME_3 exceeds the barley tax revenues of GE_2. To see why, just observe that ME_3 equals GN, because, because both measure the distance between the parallel lines AD and HI. Hence, ME_3 exceeds GE_2. by distance E_2N. this is really quite a remarkable result. It means that the barley tax makes Ruth worse off by an amount that actually exceeds the revenues it generates. In the amount by which the loss in welfare (measured by the equivalent variation) exceeds the taxes collected – the excess burden is distance E_2N.

Does every tax entail an excess burden? Define a lump sum tax as a certain amount that must be laid regardless of the taxpayer's behavior if the government levies a $\$100$ lump sum tax on Ruth, there is nothing she can do to avoid paying the $\$100$, other than to leave the country or

die . In contrast, the barley tax is not a lump sum tax, because the revenue yield depends on Ruth's barley consumption.

Let us analyze a lump tax that leaves Ruth as well off as the barley tax. To begin, we must sketch the associated budget line. It must have two characteristics. First, it must be parallel to AD. (Because a lump sum tax simply takes away money from Ruth, it does not change the relative prices of barley and corn; two budget lines embodying the same price ratio must be parallel.) Second, because of the stipulation that Ruth attain the same utility level as under the barley tax, the budget line must be tangent to indifference curve ii.

Budget line HI in Figure 3 which is tangent to indifference curve ii at point E_3, satisfies both these criteria. If confronted with this budget line, Ruth would consume B_3 pounds of barley and C_3 pounds of com.the revenue yield of the lump sum tax is the vertical distance between E_3 and the before tax budget constraint, distance ME_3. But we showed earlier that ME_3. is also the equivalent variation of the move from indifference curve I to ii. This comes as no surprise, since a lump sum tax is just a parallel shift of the budget line. Because the revenue yield of a lump sum tax equals it equivalent variation, a lump sum tax has no excess burden

In short a lump sum tax that leaves Ruth on the same indifference curve as the barley tax generated more revenue for government. Alternatively. If we compared a lump sum tax and a barley tax that raised the same revenue, the lump sum tax would leave Ruth on a higher indifference curve.

The skeptical reader may suspect that this result merely an artifact of the particular way the indifferent curves are drawn in Figure 4 this is not the case one can prove that as long as the indifference curve have the usual shape, a tax that that changes relative price generates an excess burden.[23] Alternatively, a tax that changes relative prices is inefficient in the sense that it lowers individual utility more than is necessary to raise a given amount of revenue.

The previous section's discussion of excess burden raises some important questions.

If lump sum taxes are so efficient. Why aren't they widely used? Lump sum taxation is an unattractive policy tool for several reasons. Suppose the government announced that every person's tax liability was $2,000 per year. This is a lump sum tax, but most people would consider it unfair because the loss of $2.000 presumably hulls a poor family more than a rich family. In 1990, the government of British Prime Minister Margaret Thatcher implemented a tax that in some ways resembled a lump sum tax. The property tax that had financed local government was replaced by a head tax; in each local jurisdiction the amount depended on that jurisdiction's per capita revenue needs. The tax was lump sum in the sense that a person's tax liability did not vary with the amount of income earned or property owned; it did vary, however, with a person's choice of where to live. The perceived unfairness of that tax was one of the factors that led to Mrs. Thatcher's

[23] As noted this assumes there are no other distortions in the economy. For a proof , see Hines (1999).

downfall in 1990, and it was repealed in 1991 by her successor, John Major.

As a way of producing more equitable results one might consider making people pay different lump sum taxes based on their incomes. A rich person might be required to pay $\$20{,}000$ annually, independent of his or her economic decisions, while a poor person would pay only $\$500$. The problem is that people entering the work force would soon realize that their eventual burden depended on their incomes, and adjust the work and savings decisions accordingly. In short because the amount of income individuals earn is the least in part under their control, the income- based tax is not a lump tax.

Ultimately, to achieve an equitable system of lump sum taxes, it would be necessary to base the tax some underlying ability characteristic that measure individuals' potential to earn income. In this way high and low - potential people could be taxed different because the base is potential, an individual's tax burden would not depend on behavior. Even if such an ability measure existed, however, it could not possibly observed by the taxing authority. Thus, individual lump sum taxes are best viewed as standards of efficiency not as major policy options in a modern economy. Are there any results from welfare economics that would help us understand why excess burden arise? Recall from chapter 3 that a necessary condition for a Pareto efficient allocation of resources is that the marginal rate of substitution of barley for corn in consumption (MRS_{bc}) equals the marginal rate of

transformation of barley for corn in production (MRT_{bc}) Under the barley tax, consumers face a price of barley of $(1 + t_b)P_b$. Therefore, they set

$$MRS_{bc} = \frac{(1+ t_b)P_b}{P_C}$$

Equation (1) is the algebraic representation of the equilibrium point E_2 in Figure 3

Producers make their decisions by setting the marginal rate of transformation equal to the ratio of the prices they receive. Even though Ruth pays $(1 + t_b)P_b$ per pound of barley. The barley producers receive only P_b the difference goes to the tax collector. Hence, profit maximizing producers set

$$MRT_{bc} = \frac{P_b}{P_C}$$

Clearly, as long as t_b is not zero, MRS_{bc}. Exceeds MRT_{bc}. and the necessary condition for an efficient allocation of resources is violated.

Intuitively, when MRS_{bc} is greater than MRT_{bc} the marginal utility of substituting barley consumption for corn consumption exceeds the change in production costs necessary to do so. Thus, utility would be raised if such an adjustment were made. However, in the presence of the barley tax there is no financial incentive to do so. The excess burden is just a measure of the utility loss. The loss arises because the barley tax creates a wedge between what the consumer pays and what the producer receives. Contrast, under a lump sum tax, the price ratios

faces by consumers and producers are equal. There is no wedge, so the necessary conditions for pareto efficiency are satisfied.

Does an income tax entail an excess burden? The answer is, generally yes, but it takes a little thinking to see why. showed the imposition of a lump sum tax as a downward parallel movement from AD to HI. The movement could just as well have arisen via a tax that took some proportion of Ruth's income. Like the lump sum tax, an income reduction moves the intercepts of the budget constraint closer to the origin but leaf its slope unchanged. Perhaps, then, lump sum taxation and income taxation are equivalent. In fact, if income were fixed, an income tax would be a lump sum tax. However, when people's choices affect their incomes. An income tax is not generally equivalent to a lump sum tax.

Think of Ruth as consuming three commodities, barley, corn, and leisure time, 1. Ruth gives up leisure (supplies labor) to earn income that she spends on barley and corn. In the production sector, Ruth's leisure is an input to the production of the two goods. The rate at which her leisure time can be transformed into barely is MRT_{lb} and into corn MRt_{Ic}. Just as a utility maximizing individual sets the marginal rate of substitution between two commodities equal to their price ratio, the MRS between leisure and a given commodity is set equal to the ratio of the wage (the price of leisure) and the price of that commodity.

Again appealing to the theory of welfare economics, the necessary conditions for a Pareto efficient allocation of resources in this three commodity case are

$\mathbf{MRS_{lb}} = \mathbf{MRT_{lb}}$

$\mathbf{MRS_{lc}} = \mathbf{MRT_{lc}}$

$\mathbf{MRS_{bc}} = \mathbf{MRT_{bc}}$

A proportional income tax, which is equivalently a tax at the same rate on barley and corn, leaves the third equality unchanged. Because producers and consumers still face the same relative prices for barley and corn. (The tax increases both prices by the same proportion, so their ratio is unchanged) however it introduces a tax wedge in the first two conditions. To see why, suppose that Ruth's employer pays her before-tax wage of W, and the income tax rate is Ruth's decisions depend on her after-tax wage, $(1-$ w$/P_b$. On the other hand, the producer's decisions as based on the wage rate he or she pays, the before tax wage, w. Hence, the producer sets MRT_{Ib} = w$/P_b$. Consequently, $MRS_{Ib} \neq MRT_{Ib}$. Similarly, $MRS_{IC}. \neq MRT_{IC}$.In contrast, a lump sum tax leaves all three equalities intact. Thus, income and lump sum taxation are generally not equivalent.

The fact that the income tax breaks up two equalities while taxes on barley and corn at different rates break up all three is irrelevant for determining which system is more efficient. Once any of the equalities fails to hold, a loss of efficiency results, and the sizes of the welfare losses cannot be compared merely by counting wedges. Rather, the excess burden associated with each tax regime must be computed and

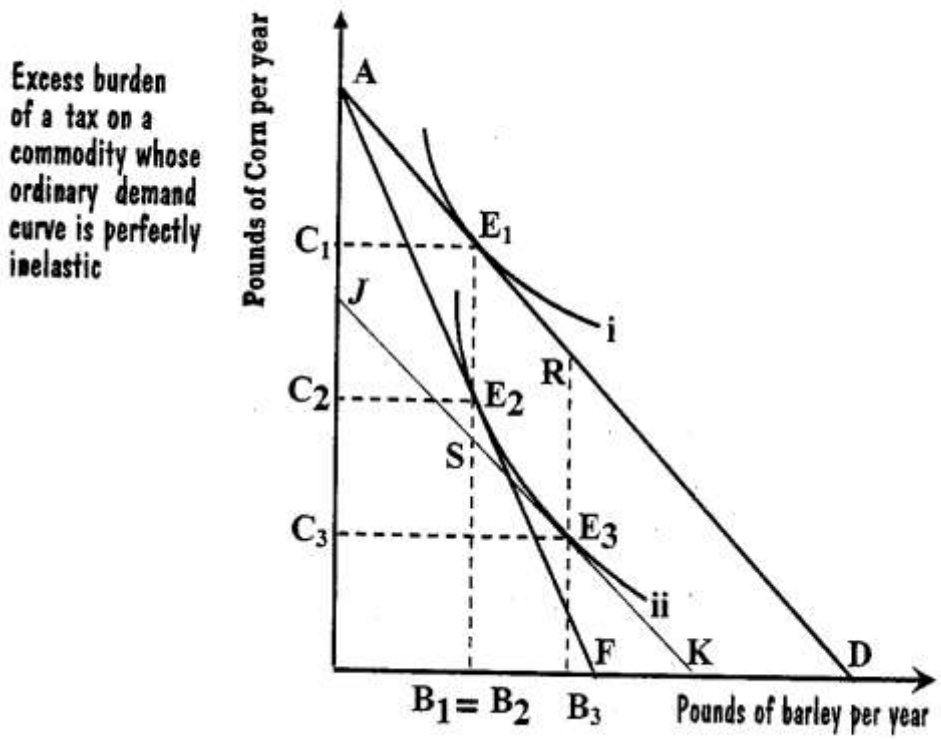
then compared. There is no presumption that income taxation is more efficient than a system of commodity taxes at different rates, which is referred to as differential commodity taxation. It may be true, but this is an empirical question that cannot be answered on the basis of theory alone

If the demand for a commodity does not change when it is taxed does this mean that there is no excess burden? The intuition behind excess burden is that it results from distorted decisions. If there is no change in the demand for the good being taxed, one might conclude there is no excess burden. This conjecture is examined in Naomi, the individual under consideration, begins with the same income as Ruth and faces the same prices and taxes. Hence, her initial budget constraint is AD, and after the barley tax, it is AF. However, unlike Ruth, Naomi foes not change her barley consumption after the barley tax; that is, $B_1 = B_2$. The barley tax revenues are E_1E_2. Is there an excess burden? The equivalent variation of the barley tax is RE_3 . This exceeds the barley tax revenues of E_1E_2 by E_2S. Hence, even though Naomi's barley consumption is unchanged by the barley tax, it still creates an excess burden of E_2S.

The explanation of this paradox begins with the observation that even though Naomi's barley consumption doesn't change, her corn consumption does (from C_1 to C_2) when the barley tax changes barley's relative price, the marginal rate of substitution is affected, at the composition of the commodity bundle is distorted.

A more rigorous explanation requires that distinguish between two types of responses to the barley tax. The movement from E_1 to E_2 is the uncompensated response. It shows how consumption changes because of the tax and incorporates effects due to both losing income and the tax induced change in relative prices. Now, we can imagine decomposing the move from E_1 to E_2 into a move from E_1 to E_3 and then from E_3 to E_2 the movement from E_1 to E_3 shows the effect consumption of a lump sum tax. This change, called the income effect, is clue solely to the loss of income because relative prices are unaffected. In effect, that the movement from E_3 to E_2 is strictly due to change in relative prices. It is generated by given Naomi enough income to remain on indifference curve ii even as barley's price rises due to the tax. Because Naomi is compensated for the rising price of barley with additional income, the movement from E_3 to E_2 called the compensated response also sometimes referred to as the substitution effect.

The compensated response is the important one for calculating excess burden Why? By construction, the computation of excess burden involves comparting tax collections at point E_2 and E_3 on indifference curve ii. But the movement from E_3 to E_2 along indifference curve ii is precisely the compensated response. Note also that it is only in moving from E_3 to E_2 that the marginal rate of substitution is affected. As shown earlier, this change violates the necessary conditions for a pareto efficient allocation of commodities.



An ordinary demand curve depicts the uncompensated change in the quantity of a commodity demanded when price changes. A compensated demand curve shows how the quantity demanded changes when price changes and simultaneously income is compensation so that the individual's commodity bundle stays on the same indifference curve. A way of summarizing this discussion is to say that excess burden depends on movement along the compensated rather than the ordinary demand curve.

Although these observations may seem like theoretical nitpicking. May are actually quite important policy discussion often focus on whether or not a given tax influences observed behavior, with the assumption that if it does not, no serious efficiency problem is present. For example, some argue that if hours of work do not change when an income tax is imposed then the tax has no adverse efficiency consequences. We have shown that such a notion is fallacious. A substantial excess burden may be incurred even the uncompensated response of the taxed commodity is zero.

The concept of excess burden can be reinterpreted using (compensated) demand curves. This interpretation relies heavily on the notion of consumer surplus – the difference between what people would be willing to pay for a commodity and the amount they actually have to pay. As show in the appendix at the end of the book, consumer surplus is measured by the area between the demand curve and the horizontal line at the market price. Assume that the compensated demand curve for barley is straight line D_b in for convenience, we continue to assume that the social marginal cost of barley is constant at P_b so that the supply curve is the horizontal line marked S_b. In equilibrium , q_1 pounds of barley are consumed. Consumer surplus, the area between the price and the demand curve, is aih.

Again suppose that a tax at percentage rate t_b is levied on barley, so the now price $(1 + t_b)\ P_b$, is associated with supply curve S'_b. Supply and demand new intersect at output q_2. Observe the following characteristics of the new equilibrium:

- Consumer surplus falls to the area between the demand curve and S'_b. agf.
- The revenue yield of the barley tax is rectangle gfdh. This is because tax revenues are equal to the product of the number of units purchases (hd) and the tax paid on each unit: $(1 + t_b)P_b - P_b$ = gh. But hd and gh are just the base an height respectively, of rectangle gfdh, and hence their product is its area.
- The sum of posttax consumer surplus and tax revenues collected (area hafd) is less than the original consumer surplus (ahi) by area fid. In effect, if we returned the tax revenues to barley consumers as a lump sum, they would still be worse off by triangle fid. The triangle, there is the excess burden of the tax.

This analysis provides a convenient framework for computing an actual dollar measure of excess burden. The area of triangle fid is one-half the product of its base (the tax-induced change in the quantity of barley) and height (the tax per pounds. Some simple algebra shows that this product is equivalent to

$$^1/_2 \ \pi P_b q_1 t_b^2$$

Where π (Greek eta) is the absolute value of the compensated price elasticity of demanded for barley.[24] (A proof is provided in Appendix A at the end of the chapter.)

A high (absolute) value of π indicates that the compensated quantity demanded is quite sensitive to (3) changes in price. Thus, the presence of π in equation makes intuitive sense- the more the tax distorts the (compensated) consumption decision, the higher the excess burden. P_b X q_1 is the total revenue expended on barley initially. Its inclusion in the formula shows that the greater the initial expenditure on the taxed commodity, the greater the excess burden.

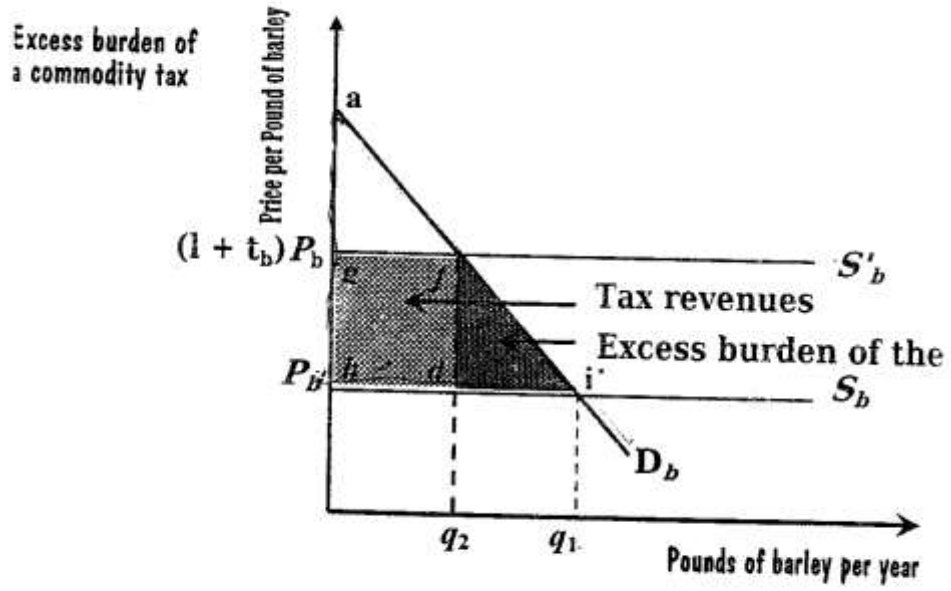
Finally, the presence of t_b^2 suggests that as the tax rate increases, excess burden goes up with its square. Doubling a tax quadrupeds its excess burden. Other things being the same. Because excess burden increases with square of the tax rate, the marginal excess burden from raising one more dollar of revenue excess the average excess burden. That is, the incremental excess burden of raising one more dollar of revenue exceeded the ratio of total excess burden to total revenue. This fact has important implications for cost benefit analysis. Suppose, for example that the average excess burden per dollar of tax revenue is 12 cents, but the marginal excess burden per additional dollar of tax

[24] The formula is an approximation that holds strictly only for an infinitesimally tax levied in the absence of any other distortions. When the supply curve is upward sloping rather than horizontal the excess burden triangle contains burden producer surplus as well as consumer surplus, the formula for excess then depends on the elasticity supply as well as the elasticity of demand in this case, the excess burden is

$$1/2 \frac{P_b q}{\frac{1}{\pi}+\frac{1}{t}} t_b^2$$

Where E is the elasticity of supply, note that as approaches infinity, this expression Equation. This is because an of infinity corresponds to horizontal collapses to a horizontal supply curve as in.

revenue is 27 cents the social cost of each dollar raised for a given public project is the dollar plus the incremental excess burden of 27 cents. Thus a public project must produce marginal benefits of more than $1.27 per dollar of explicit cost if it is to improved welfare.



Airline- Ticket taxation. let's illustrate equation with a real -world example. Airplane tickets are taxed by the federal government at a rate of 10 percent. What is the excess burden of this tax? The equation tells us that we have to know the price elasticity of demand. According to the survey of Oum, Waters, and Yong (1992), a reasonable estimate is about 1.0, we also need the product of price per ticket and number of tickets sold - airline, ticket revenues. This figure is roughly $94 billion annually (US Bureau of the Census, 2002, p.661). Substituting all of

this information into equation tells us that the airline ticket tax imposes an annual excess billion of $\frac{1}{2} \times 94 \times (0.10)^2$ billion or $\$470$ million.

This analysis has assumed no distortions in the economy other than the tax under consideration. In reality, when a new tax is introduced, there are already other distortions: monopolies, externalities, and preexisting taxes this complicates the analysis of excess burden.

Suppose that consumers regard gin and rum as substitutes. Suppose further that rum is currently being taxed creating an excess burden triangle like that in figure 5. Now the government decides to impose a tax on gin. What is the excess burden of the gin tax .in the gin market, the gin tax creates a wedge between what gin consumers pay and gin producers receive. As usual, this creates an excess burden. But the store is not over. If gin and rum are substitutes, the rise in the consumers' price of gin induced by the gin tax increase the demand for rum. Consequently, the quantity of rum demand increases. Now, because rum was tax under the status quo, too little or it was being consumed. The increase in rum consumption inducted by the gin tax helps move rum consumption back toward its efficient level. there is thus an efficiency gain in the rum market that helps offset the excess burden imposed in the gin market. In theory, the gin tax could actually lower the overall excess burden (Appendix B at the end of the chapter has a graphical demonstration of this phenomenon.)

We have shown, then, that the efficiency impact of a tax or subsidy can not be considered in isolation. To the extent that there are other markets with distortions, and the goods in these markets are related

(either substitutes or complements), the overall efficiency impact depends on what is going on in all the markets. To compute the overall efficiency impact of a set of taxes and subsidies, it is generally incorrect to calculate separately the excess burden in each market and then add them up. The aggregate efficiency loss is not equal to the sum of its parts.

This result can be quite discomfiting because strictly speaking, it means that every market in the economy must be studied to assess the efficiency implications of any tax or subsidy. In most cases, practitioners simply assume that the amount of interrelatedness between the market of their concern and other markets is sufficiently small that cross effects can safely be ignored.[25] Although this is clearly a convenient assumption, its reasonableness must be evaluated in each particular case.

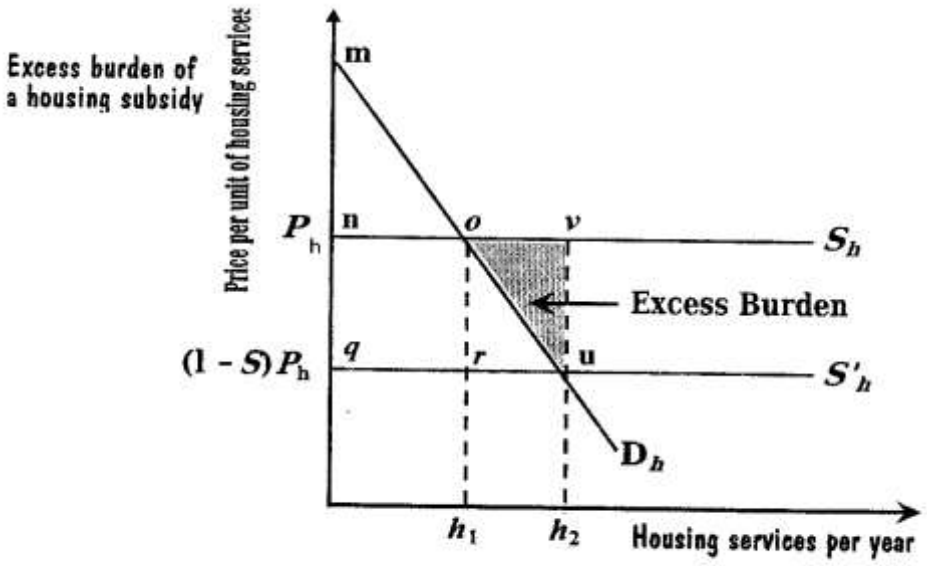
A controversy from the field of environmental economics provides an instance where accounting for preexisting distortions is important. Recall from chapter 5 that in the presence of an externality, a tax can enhance efficiency. A Pigouvian tax in effect forces a polluter to take into account the costs that he imposes on other people and induces him to reduce output now, recall also that the US income tax system is highly inefficient. By distorting labor supply and other decision the income tax creates large excess burdens. Linking these two observations together, some have proposed that we increase reliance on environmental taxes and use the revenues to reduce income tax rates.

[25] For an exception see Fullerton and Rogers (1997)

The idea is called the double-dividend hypothesis because tax scheme increases efficiency both in the market with the polluter and in the markets that are distorted the income tax.

However , there is a possible flaw in this log to see why, note that the pollution taxes drive up the prices of the goods that are produced using pollution technology. However, when commodity prices go upon effect this is a decrease in the real wage rate- a given dollar amount of wages buys you fewer goods and services. Put another way, the environmental taxes to some extent, also taxes on earnings. So if the labor market is already distorted because of an income tax the environmental tax exacerbates the problem. It turn out that the added excess burden in the labor market can actually outweigh the efficiency gains from correcting the externality (parry and Oates, 2000) PA other way, the efficient pollution tax can be low than in a situation in which there is not a preexisting income tax. This is not to say that Pigouvian taxation is a bad idea , only that its consequences for efficiency depend on the extent to which existing taxes already distort the labor market.

Commodity subsidies are important components of the fiscal systems of many countries. In effect, a subsidy is just a negative tax, and like a tax, it is associated with an excess burden. To illustrate the calculation of the excess burden of a subsidy, we consider the subsidy for owner,-occupied housing provided by the federal government via certain provisions of the personal income tax.



Assume that the demand for owner occupied housing services is the straight line D_h in Figure supply is horizontal at price P_h, which measures the marginal social cost of producing housing services. Initially, the equilibrium quantity is h_1. Now suppose that the government provides a subsidy of s percent to housing producers. The new price for housing services is then $(1 - S)\ P_h$ and the associated supply curve is S'_h. The subsidy increases the quantity of housing services consumed to h_2. If the purpose of the subsidy was to increase housing consumption. then it his succeeded. But if its goal was to maximize social welfare is it an appropriate policy?

Before the subsidy, consumer surplus was area mqu. After the subsidy, consumer surplus is mqu. The benefit to housing consumers is the increase in their surplus area nouq. But at what cost is this benefit obtained. The cost of the subsidy program is the quantity housing services consumed, qu, times the subsidy p unit, nq, or rectangle nvuq. Thus, the cost of the subsidy actually exceeds the benefit–there is an

excess burden equal to the difference between areas nvuq and nouq which is the shaded area ovu. Estimates by Poter (1992) imply that for someone who owns a $\$200{,}00$ home, the excess burden is about $\$1{,}200$ annually.

How can subsidizing a good think like housing be inefficient? Recall that any point on the demand curve for housing services measures how much people value that particular level of consumption. To the right ofh_1, although individuals do derive utility from consuming more housing, its value is less than P_h, the marginal cost to society of providing it . in other words, the subsidy induces people to consume housing services that are valued at less than their cost– hence , the inefficiency.[26]

A very important policy implication follows from this analysis. One often hears proposals to help some group of individuals by subsidizing a commodity that they consume heavily. we have shown that this is an inefficient way to aid people. Less money could make them as well off if it were given to them as a direct grant. In people would be indifference between a housing subsidy program costing nvuq and a direct grant of nouq, even though the subsidy program costs the government more money.[27] This is one of the reasons many economists prefer direct income transfers to commodity subsidies.

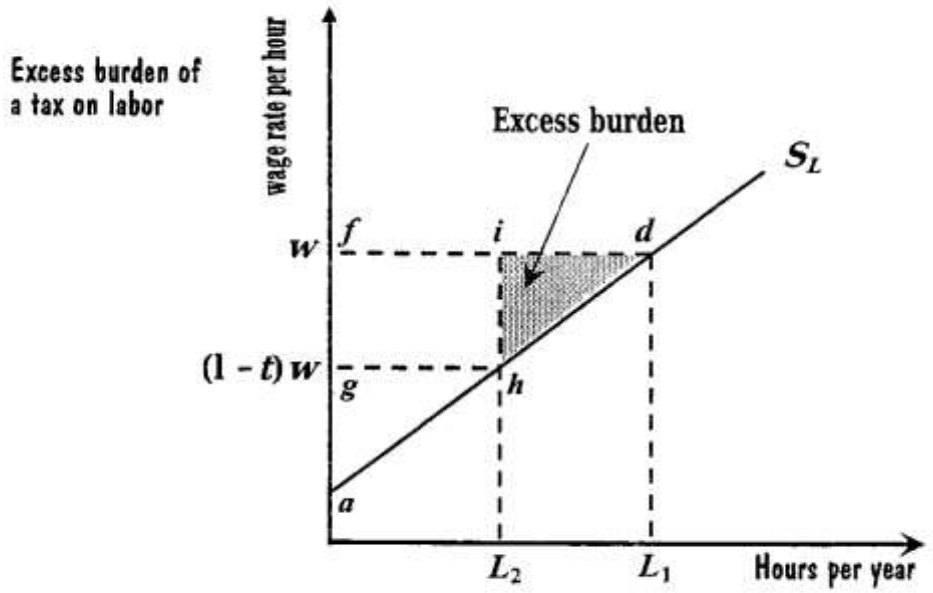
[26] Alternatively, after the subsidy the marginal rate of substitution in consumption depends on (I*S)P_h, while the marginal rate of transformation in production depends on P_{ir}, Hence the marginal rate of transformation is not equal to the marginal rate of substitution and the allocation of resources cannot be efficient

[27] This result is very similar to that obtained when examined in – kind subsidy programs. That chapter also discusses why commodity subsidies nevertheless remain politically popular

The theory of excess burden applies just as well as factors of production as it does to commodities. Figure1 Jacob's hours of work are plotted on the horizontal axis and his hourly wage on the vertical. Jacob compensated labor supply curve, which shows the smallest wage that would be required to induce how to work each additional hour, is labeled S_L initial. Jacob's wage is w and the associated hours of work L_1. In the same way that consumer surplus is the area between the demand curve and the market price worker surplus is the area between the supply curve and the market wage rate. When the wage is w Jacob's surplus is therefore area adf.

Now assume that an income tax at a rate t imposed. The tax wage is then $(1 - t)w$, and given supply curve S_L, the quantity of labor supplied to L_2 hours. Jacob's surplus after the tax is agh at the government collects revenues equal to fihg. The excess burden due to the tax induced distortion the work choice is the amount by which Jacob's l. Of welfare (fdhg) exceeds the tax collected: area (=fdhg − fihg). In analogy to Equation area hiding approximately.

$$\mathbf{^1/_2\ \varepsilon\, w L_1 t^2}$$

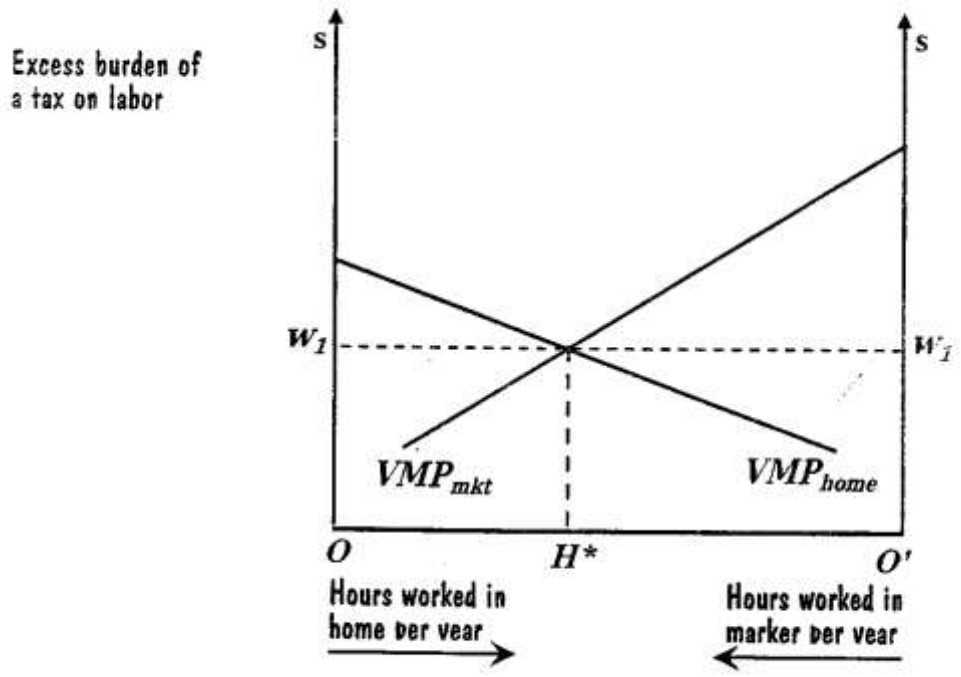


Where e is the compensated elasticity of hours of work with respect to the wage.

A reasonable estimate of e for an American male is about 0.2. For illustrative purposes, suppose that before taxation, Jacob works 2.000 hours per year at a wage of $\$20$ per hour. A tax on earnings of 40 percent is then imposed. Substituting these figures into Equation, (4) the excess burden of the tax is about $\$640$ annually. One way to put this figure into perspective is to note that it is approximately 4 percent of tax revenues. Thus, on average, each dollar of tax collected creates an excess burden of 4 cents.

Of course, wage rates, tax rates, and elasticities vary across members of the population, so different people are subject to different excess burdens. Moreover, the excess burden of taxing labor also depends on tax rates levied on other factors of production. Jorgenson

and Yun (2001) estimated that for plausible values of the relevant elasticities, the excess burden of labor income taxation in the United States is about 27 percent of the revenues raised. There is considerable uncertainty about the values of some of the key elasticities. Hence, this particular estimate must be regarded cautiously. Still, it probably provides good sense of the magnitudes involved.



In the income tax-example just discussed, we assumed that labor income was taxed at the same rate regardless of where the labor was supplied. But sometimes the tax on an input depends on where it is employed. For instance, because of the corporate income tax, capital employed in the corporate sector faces a higher rate than capital in the noncorporporate sector. Another example is the differential taxation of labor in the household and market sectors. If an individual does

housework, valuable services are produced but not taxed.[28] On the other hand, if the same individual works in the market, the services are subject to the income and payroll taxes. The fact that labor is taxed in one sector and untaxed in another distorts people's choices between them.

To measure the efficiency cost, consider the horizontal distance $00'$ measures the total amount of labor available in society. The amount of labor devoted to work in the home is measured by the distance to the right of point O'. Thus, any point along 00t represents allocation of labor between the home and the market.

Now, define the value of marginal product (VMP) hours worked in the household sector as the dollar value of the additional output produced for each how worked the schedule (VMP_{hame}) In Figure 7 represent the value of the marginal product of household work.

It is drawn sloping downward, reflecting the reasonable assumption that as more hours are spent in the hon the incremental value of those hours decreases. that is just a manifestation of the law of diminishing marginal returns. Similarly VMP_{mkt} shows the value of the marginal product of hours worked in the market sector. (Remember that movements to the left on the horizontal axis represent increases in the amount of labor allocated to market work). Although we expect both schedules to be decreasing with respect to the amount of labor

[28] The value of housework was expressed nicely by a biblical author who wrote at a time when it was assumed homes were managed only by females. In proverbs 31, he discusses in detail the many tasks performed by the woman who looketh well to the ways of her household (v,27). His general conclusion is that her price is far above rubies (v,10) unfortunately price data on rubies during the biblical era are unavailable.

employed in the respective sector there is no reason to expect the schedules to have the same shapes, so they are not drawn as minor images of each other.

How is the allocation of labor between the t sectors determined? Assume that individuals allocated their time between housework and market working maximize their total incomes. It follows that the value of the marginal product of labor is the same in both sectors. if it were not, it would be possible for people to reallocate labor between the sectors to increase their incomes.[29] In Figure 8 the equilibrium occurs where OH* hours are devoted to housework and O'H* hours to market work. The value of the marginal product of labor in both sectors is w_1 dollars. Competitive pricing ensures that the wage in the market sector is equal to the value of the marginal product.

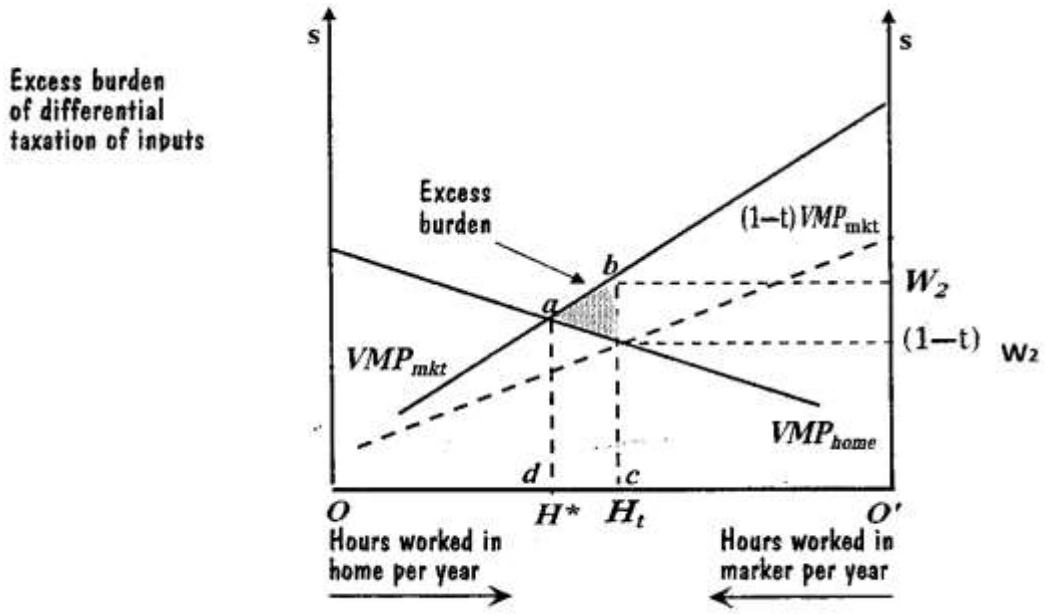
Now assume that a tax of t is levied on income from market work, but the return to housework is untaxed. At any amount of labor employed in the market, the tax creates a wedge between the VMP and the associated wage rate. For example, if the value of the marginal product is $\$10$ and the tax rate is 25 percent. Then the wage rate will only be $\$7.50$. More generally, the imposition of a tax on market wages at rate t lowers the wage rate from VMP_{mkt} to $(1 - \text{t})VMP_{mkt}$. Geometrically, this amounts to moving every point on VMP_{mkt} down by tpercent, as illustrated in clearly, the original allocation is no longer an equilibrium, because at H* the return to working in the household exceeds the rate in the market, that is, at H*, VMP_{hame} is greater than

[29] For further discussion of why thi be true. We the appendix the end of the book.

$(1 - t)\ VMP_{mkt}$. As a result, people begin working less in the market and more at home, which moves the economy rightward from H* equilibrium is reached when the after tax value of marginal product in the market sector equals the value of marginal product in the household sector. In this occurs when people work OH_1 hours in the home and $O'H_t$ hours in market.

At the new equilibrium the after- tax VMPs in the two sectors are both equal to $(1 - t)W_2$. However, the before tax VMP in the market sector W_2. Is greater that the VMP in the household sector, $(1 - t)W_2$. To this means that if more labor were supplied to the market sector, the increase in income there (w_2) would exceed the loss of income in the household sector $(1 - t)$ W. But there is no incentive for this reallocation to occur because individuals are sensitive to the returns that receive after tax, and these are already equal. The tax thus creates a situation in which there is too much housework and not enough work in the market. In short the tax leads to an inefficient allocation of resources the sense that it distorts incentives to employ input in their most productive uses. The resulting decrease in real income is the excess burden of the tax.

Figure (9)



To measure the excess burden, we must analyze Figure 9 closely begin by observing that as a result of the exodus of labor from the market the value of output there goes down by abed, the area under VMP_{mkt} between H* and H_t.[30] On the other hand, as labor enters the household sector. The value of output increases by abed, the area under the VMP home curve between H* and Ht. Therefore, society comes out behind by area abed minus area abed, or triangle abe, which is the excess burden of the tax. The base of this triangle is just the size of the tax wedge W2 − [(1 − t)W_2] or tw_2. Its height is the increase the amount of time devoted to work at home, distance H* H_r, which we denote ΔH. Taking advantage of the formula for the area of a triangle. we then represent greater the excess burden as

[30] The vertical distance between VMP and the horizontal axis at any level of input gives the value of marginal product for that level of input adding up all these distances gives the value of the total product thus, the area under VMP gives the value of total product

$$^{1}/_{2}\ (\Delta H)tw_2$$

The greater the change in the allocation of labor (ΔH) and the greater the tax wedge (tw_2), the greater the excess burden.

In general, whenever a factor is taxed different in different uses. It leads to a misallocation of factor between sectors and hence an excess burden. In the case of our housework versus market work example Bodkin (1975) estimated the cost of the distortion a between 6 and 13 percent of tax revenues.

Discussion Questions

1- Which of the following is likely to impose a large excess burden?

a- a tax on land

b- A tax of 24 percent on the use of cellular phones. (this is the approximate sum of federal and state tax rates in California, New York, and Florida.)

C- A subsidy for investment in high-tech companies

d- A tax on economic profits.

e- A 10 percent tax on all computer software.

f- A 10 percent tax only on the Excel spreadsheet program.

2- Under legislation passed in 2001, the marginal tax rate on the wages of individuals in the highest income category (over a million dollars annually). Will decrease from 39.9 percent 34.0 percent. Use Equation (4) to approximate the proportion by which this change will reduce the excess burden on individuals in this income group.

3- In the formula for excess burden given in Equation (3) the tax is less than one. When it is squared. The result is smaller, not bigger, Thus having t_2 instead of t in the formula makes the tax less important. Comment.

4- Some countries rely relatively heavily on taxes that distort economic behavior, and other do not, a recent econometric study found that countries in the latter category tend to grow faster than countries in

the former (Knelled, Bleaney, and Gemmell, 1999). Use the discussion surrounding Figure 9 to explain this phenomenon.

5- In the United Kingdom, each household that owns a television pays a compulsory levy that is equivalent to $160 per year Do you think that such a tax is likely to have a substantial excess burden relative to the revenues collected?

6- Because of federal subsidies, the price of core ($2.25 a bushel) is 50 cents less than the cost of growing it (Pollan, 2002p. 50). Use a mode along the lines of Figure 6 to model this situation and show the excess burden of the subsidy.

7- Under the US tax system, capital that is employed in the corporate sector is taxed at a higher rate than capital in the no corporate sector. The problem will analyze the excess burden of the differential taxation of capital.

Assume that there are two sectors, corporate and no corporate. The value of marginal product of capital in the corporate sector, VMP_c, is given by $VMP_c = 100 - K_c$, where K_c is the amount capital in the corporate sector, and the value of the marginal product of capital in the noncorporate sector, K_n is given by $VMP_n = 80 - 2K_n$, where is the amount of capital in the noncorporate sector. Altogether there are 50 units of capital in society.

a- in the absence of any taxes, how much capital is in the corporate sector and how much in the noncorporate sector? (Hint: Draw a sketch along the lines of to organize your thoughts).

b- Suppose that a unit tax of 6 is levied on capital employed in the corporate sector. After the tax. How much capital is employed in each sector? What is the excess burden of the tax?

8- consider a conventional supply and demand model in which the supply curve slopes up and the demand curve slopes clown. Show graphically the excess burden when a unit tax is imposed. (Hint: Compare the losses of both consumer and producer surplus to tax revenues).

Appendix Formula for Burden

This appendix shows how the excess burden triangle fdi of may be written in terms of the compensated demand elasticity. The triangle's area, A, is given by the formula

A = $^1/_2$ X base X height (A.1)

A = $^1/_2$ X (di) X (fd)

fd is just the difference between the gross and net prices (ΔP_b)

fd = ΔP_b = $(1 + t_b)$ X $P_b - P_b = t_b \times P_b$ (A.2)

di = Δq

Now note that the definition of the price elasticity, π, is

$$\pi \quad \frac{\Delta q \; P_b}{\Delta \; P_b q}$$

So that

$$\Delta q = \pi \left(\frac{q}{P_b}\right) \Delta P_b$$

We saw in (A.2) that $\Delta P_b = t_b \times P_b = t_b$ so that (A.40 yield

$$\Delta q = \pi \left(\frac{q}{P_b}\right) \times (t_b P_b) = \pi \times q \times t_b$$

Finally recall that di = $\Delta q \; and \; substitute \; both$ (A.3) and (A.2) into (A.1)

A = $^1/_2$ X (di) X (fd)

=$^1/_2$ $(\pi q t_b)$ X$(t_b P_b)$

=$^1/_2$ Xπ XP_b X $(t_b)^2$

As in the text

Appendix B

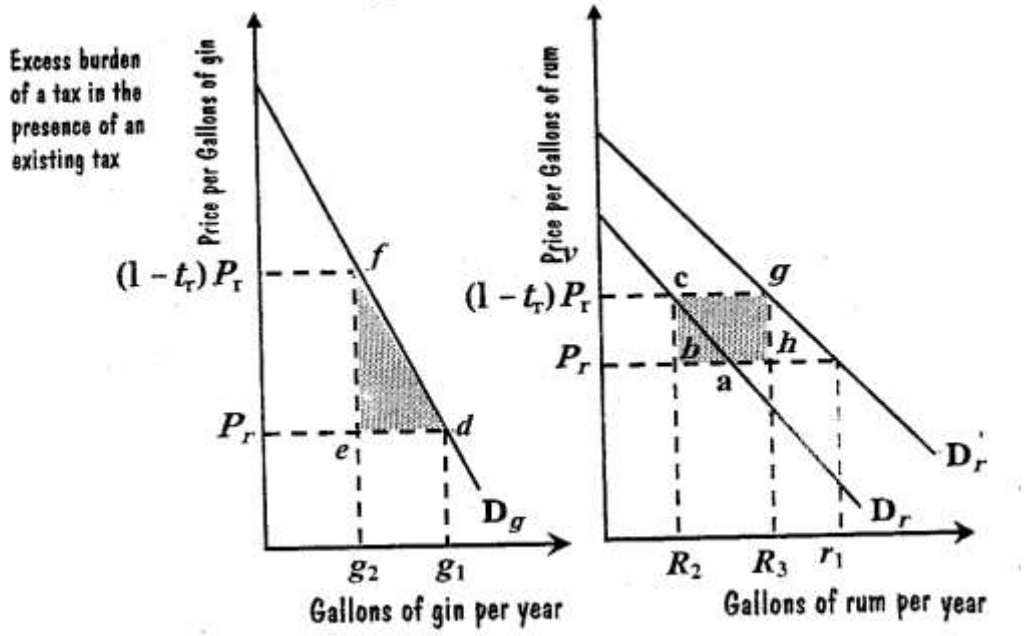
Appendix B multiple taxes and the theory of the second Best

The appendix discusses the measurement of excess burden when a tax is imposed in the presence of preexisting distortion.

In figure 8 we consider two goods, gin and rum whose demand schedules are D_g and D_r, and who before-tax prices are DG and Dr, respectively. (The prices represent marginal social costs and a tax

assumed to be constant) Rum is currently taxed at percentage rate tr, so its price $(\mathrm{I} + t_r)\, P_r$.

Figure 10



This creates an excess burden in the rum market triangle ahc. Now suppose that a tax on gin at rate t_g is introduced, creating a wedge between what gin consumers pay and gin producers receive. This creates an excess burden in the gin market of efd. But this is not the end of the story. If gin and rum are substitutes, the increase in the consumers' price of gin induced by the gin tax shifts the demand curve for rum to the right, say to D'_r. Consequently, the quantity of rum demanded increases from r_2 to r_3. Distance C_g. For each bottle of rum purchased between r2 and r3. The amount that people pay $[(1 + t_g)\, P_r]$ exceeds the social cost (P_r) by distance C_b. Hence. There is a social gain of C_b per bottle of rum times C_g bottles, or area cbhg.

To summarize: Given that the tax on rum was already in place, the tax on gin creates an excess burden of efd in the gin market and simultaneously decreases excess burden by cbhg in the rum market if cbhg is efficiency large, the tax can actually reduce overall excess burden. This is an example of the theory or the second best: in the presence of existing distortions, policies that in isolation would increase efficiency can decrease it and vice versa.

This discussion is a special case of the result that the excess burden of a set of taxes generally depend on the whole set of tax rates, as well as on the degree of substitutability and complementarity among the various commodities. Specifically, suppose that n commodities are subject to taxation. Let P_i be the before − tax price of the jth commodity; the ad valorem tax on the jth commodity; t_i the ad valorem tax on the jth commodity and S_{ij} the compensated response in the demand of the jth good with respect to a change in the price of jth good. Then the overall excess burden is.

$$-{}^{1}/_{2}\sum_{i=1}^{n}\sum_{j=1}^{n} t_1 P_1 t_j\, P_j S_i j$$

For example, in the two good case just discussed, when the goods are g and r, the overall excess burden is

$$-{}^{1}/_{2}\,(t_r^2 P_r^2 S_{rr} + 2t_r P_r t_g P_g S_{gr} + t_g^2 P_g^2 S_{gg})$$

Exercises

Chapter three

Taxation and efficiency

Part A True – false questions

Circle whether the following statements are true (T) or false (F)

1- Excess burden means also welfare cost or deadweight loss.

2- Any tax would have put consumer on lower indifference curve.

3- Equivalent variation "find dollar equivalent of the loss that consumer suffers by having the move to lower utility.

4- The equivalent variation measure the loss inflicted by the tax.

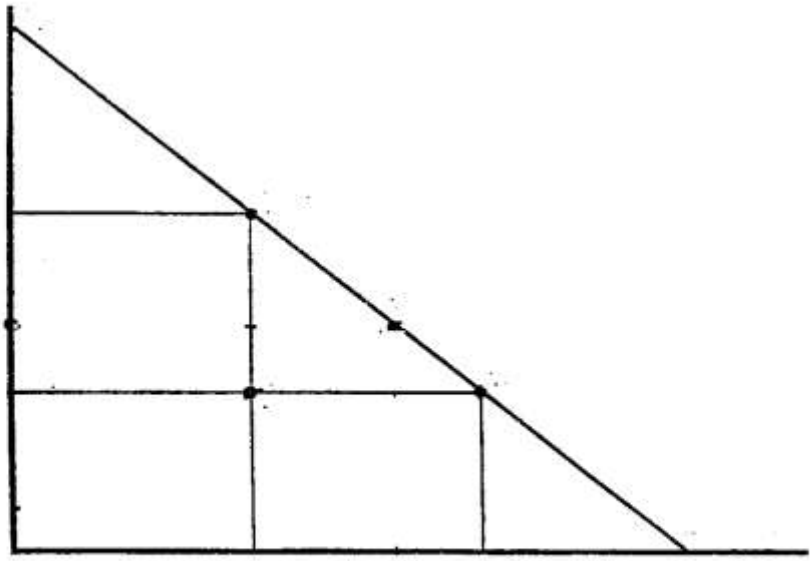
5- More elasticity od demand, the more excess burden exists.

6- If the marginal cost is greater than the average cost, the excess burden exists.

Part B: multiple – choice questions

Circle the appropriate answer:

1- From the below figure, answer the following questions:



- Refer to the graph shown. When the price is P, consumer surplus is

a- A b- A +B c- A + B + C d- A +B +D

- Refer to the graph shown. When the price rises from P To $(1+t)$P, consumer surplus

a- increases by an amount equal to A.

b- decreases by an amount equal to B + C

c- increases by an amount equal to B + C

d- decreases by an amount equal to C

– Refer to the graph shown. At $(1+t)P$, the government revenue is ……

a– B + D b – B +C c– D + E d– B e– C

– Refer to the graph shown. At $(1+t)P$, Excess burden is

a– B + D b– B+C c– D + E d– B e– C

2– A regulated natural monopolist practicing average cost pricing

a– makes zero economic profit

b– produces an allocative inefficient level of output

c– produces the largest quantity possible while still enabling the firm to cover its total costs.

d– all of the above

e– none of the above

3– Equivalent variation means

a– finding an equivalent change in income that puts a person on the same utility as a change in price would.

b– finding equal tax rates that insure quantity demanded does not change

c– equalizing excess burden across all markets.

d– moving the same distance in either direction from a starting point on an indifference curve

e- price variations that ensure quantity demanded does not change

4- The compensated demand curve

a- shows how the quantity demanded changes when the price changes.

b- shows how income is compensated, so that the individual's commodity bundle stays on the same indifference curve

c- is sometimes referred to as the Hicksian demand curve

d- is all of the above

e- is none of the above

5- Points on the same utility curve are

a- points where the person is indifferent between bundles on the line

b- points where utility is maximized

c- never possible

d- known as points of light

e- all of the above

6- A tax that causes the price that producers receive for a commodity to deviate from the buyer's price is

a- a unit tax

b- a compensated tax

c- an income tax

d- a price distorting tax

7- The equivalent variation cause a shift in AD inward as it is tangent to curves……. , ……

a- new utility, new budget line b- new utility, old budget line

c- old utility, new budget line d- old utility, old budget line

Part C:- problems: (Graph if possible) (a

Problem 1

1- Suppose the utility function is $U_{(x,Y)}$ = XY, P_X = 4, P_Y = 1 and I = 72

2- If the government impose tax on the good X 125%

3- Required

4- (1) determine the government revenue in terms of Y, X, and dollars.

5- (2) determine the excess burden in terms of dollars.

Problem2

Suppose the utility function is $U_{(x,Y)}$ = XY, P_X = 10, P_Y =1 and I = 960 If the government impose tax on the good X 50%

Required:

1- Determine the government revenue in terms of Y, X and dollars

2- Determine the excess burden in terms of dollars.

Problem 3:

Suppose that the utility function is $U_{(X, Y)}$, P_X = 2.5, P_Y = 1 , and I = 100 If the government imposed tax on the good X 60%

Required:

1- Determine the government revenue in terms of Y, X, and dollars.

2- Determine the excess burden in terms of dollars.

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Chapter Four

Efficient and equitable taxation

Chapter 4

Efficient and equitable taxation

We need to illustrate and understand the following topics in this chapter

1- At what rates should various goods and services be taxed?

2- What is meaning of the marginal excess burden

3- Reinterpretation of the Ramsey Rule

4- Criterion of efficiency and fairness for evaluating a tax system

5- Vertical equity and horizontal equity

Chapter Four

Efficient and equitable taxation

In Florida wireless phone bills are taxed at a rate of 17.8 percent; most other commodities (except for food, which is exempt) are taxed at a rate of 6 percent. Should wireless phone service be taxed at a higher rate than other things? This is just one example of a very general and very important economic policy question: at what rates should various goods and services be taxed? The purpose of the theory of optimal commodity taxation is to provide a framework for answering this question.

Of course, we can't find the right set of taxes without knowing the government's goal. At the outset, we assume that the only goal is to finance the state's expenditures with a minimum of excess burden and without using as well as efficiency matters.

To begin, consider the situation of Stella, a representative citizen who consumes only two commodities, X and Y, as well as leisure, l. The price of X is P_X, the price of Y is P_y, and the wage rate (which is the price of leisure) is w. The maximum number of hours per year that Stella can work– her time endowment – is fixed at $\bar{\bar{T}}$. (think of $\bar{\bar{T}}$ as the amount of time left over after sleep) it follows that hours of work are ($\bar{\bar{T}}$ – l) all time not spent on leisure is devoted to work. Income is the product of the wage rate and hours of work – w($\bar{\bar{T}}$–l,). Assuming that Stella spends her entire income on commodities X and Y (there is no saving), her budget constraint is

$$W(\bar{\bar{T}} - l) \; P_x X + P_y Y \qquad (1)$$

The left-hand side gives total earnings, and the right- hand side shows how the earnings are spent.

Equation (1) can be rewritten as

$$w\bar{\bar{T}} = P_x X + P_y Y + wL. \qquad (2)$$

The left hand side of (2) is the value of the time endowment. It shows the income that Stella could earn if she worked every waking hour.

Now suppose that it is possible to tax X,Y, and / at the same ad valorem rate, t. The tax raises the effective price of X to $(1 + t) \; P_x$, of Y to $(1 + t) \; P_y$, and of/ to $(1 + t)$ w.

Thus , Stella 's after - tax budget constraint is

$$w\bar{\bar{T}} = (1 + t) \; P_x X + (1 + t) \; P_y Y + (1 + t) \; wL. \qquad (3)$$

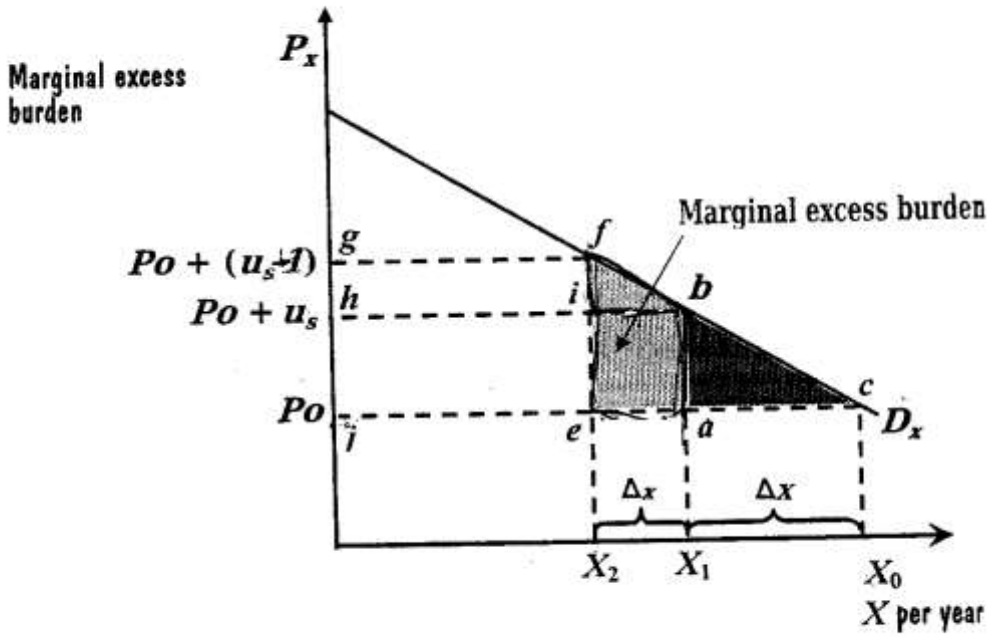
Dividing through Equation (3) by $(1 + t)$, we have

$$\frac{1}{1+t} w\bar{\bar{T}} = P_x X + P_y Y + wL. \qquad (4)$$

Comparison of (3) and (4) points out following fact: A tax on all commodities including leisure, at the same percentage rate, t, is equivalent to reducing the value of the time endowment from wT to $[1/(1$ + t) x $w\bar{\bar{T}}$. for example a 25 percent tax on XY and L equivalent to a reduction of the value of the time endowment by 20 percent- However, because and we are fixed, their product, wT is also fixed; for any value of the wage rate, an individual cannot change the value of her time

endowment. Therefore, a proportional tax on the time endowment is in effect a lump sum tax. We know that lump sum taxes has no excess burden. We conclude that a tax at the same rate on all commodities, including leisure, is equivalent to lump sum tax and has no excess burden.

It sounds good, but there is a problem – putting a tax on leisure time is impossible. The only available tax instruments are taxes on commodities X and Y. Therefore, some excess burden generally is impossible. The only of optimal commodity taxation is to select tax rates on X and Y in such a way that the excess burden of raising the required tax revenue is as long as possible. It might seem that the solution to the problem is to tax X and Y at the same rate– so called neutral taxation. We will see that, in general, neutral taxation is not efficient.



To raise the revenue with the least excess burden possible, how should the tax rates on X and Y be set? To minimize overall excess burden, the marginal excess burden of the last dollar of revenue raised from each commodity must be the same. Otherwise, it would be possible to lower overall excess burden by raising the rate on the commodity with the smaller marginal excess burden, and vice versa.

To explore the consequences of this typical example of marginal analysis, suppose for simplicity that for our representative consumer X and Y are unrelated commodities- they are neither substitutes nor complements for each other. Hence, a change in the price of either commodity affects its own demand and not the demand for the other good. Shows Stella compensated demand for X, D_X. Assume that she can buy all the X she wants at the price Po, so the supply curve of X is horizontal.

Suppose that a unit tax of ux is levied on X, which lowers quantity demanded from X_0 to X_1, ΔX in the figure as proven in the last chapter, the excess burden of the tax is the area of triangle abc. Now suppose we raised the tax by 1, so it becomes $(U_x + 1)$. the total price is Po + $(U_x + 1)$; quantity demanded falls by, Δx to , X_2 and the associated excess burden is triangle fed. The marginal excess burden is the difference between the two triangles, trapezoid fbase. the area of the trapezoid is one-half its height (Δx) times the sum of its based [U_X + (U_X + l)] thus , the marginal excess burden is $1/2\Delta \times[U_X + (U_X + l)]$.

With a bit of algebra,[31] we can simplify this expression to obtain that the marginal excess burden is approximately ΔX:

ΔX = marginal excess burden

Recall that excess burden minimization requires information on the marginal excess burden on the last dollar of revenue collected. Now that we know the marginal excess burden induced by the tax increase, we must compute the associated increase in revenues. Then all we have to do is divide the marginal excess burden by the change in revenues. By definition, this quotient is the marginal excess burden per incremental dollar of revenue collected.

To compute the change in tax revenues associated with raising the rate from U_X to $(U_X$ + l). Note that when the tax rate is U_X. Tax revenues are $U_X\ X_1$ (the tax per unit times number of unit sold). In figure 1, this is rectangle hbaj. Similarly, When the tax rate is $(U_X$ + l) , tax revenues are gfej. Comparing these two rectangles, we see that when the tax goes up, the government gains area gfih but loses ibae. Thus, the change in revenues is gfih−ibae. using algebra, this is X_2 − $(X_1$ − $X_2)\,U_X$. A bit of mathematical manipulation[32] leads us to the following approximation to the change in tax revenue:

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[31] The area of the trapezoid is $^1/_2\,\Delta X(2U_X + 1)$ or $XU_X + (^1/_2)\,\Delta X$, which we can approximate isΔXU_X because the second term, which corresponds to triangle fibh relatively small and can be ignored. Now note that $^1/_{\Delta X}$ and $^{U_X}/_{\Delta X}$are eual because both measure the slope (in absolute value) of D_X Hence $\Delta XU_X = \Delta X$ which is the marginal excess burden

[32] Note that expression for marginal tax revenue is equivalent to$\mathrm{X_2(U_X + I) - X_1U_X = X_2 + U_X\ (X_2 - X_1)}$. From figure 1 $\mathrm{X_2 = X_1 - \Delta X}$. Substituting gives us $\mathrm{X_1 - \Delta X - U_X\Delta X}$. But $\Delta X = \Delta X/\mathrm{U_X}$ (see previous footnote. Giving us $\mathrm{X_1 - X\ (1 + U_X)/U_X}$ providing that $\mathrm{U_X}$ is large relative to 1, this can he approximated us $\mathrm{X_1 - \Delta X}$ the expression the text for marginal tax revenue.

$X_1 - \Delta X$ = marginal tax revenue (6)

Marginal excess burden per additional dollar of tax revenue is Equation (6) divided by (5) or

$$\frac{\Delta X}{X_1 - \Delta X}$$

Exactly the same reasoning indicates that if unit tax of is levied on Y, the marginal excess burden per last dollar of revenue is

$$\frac{\Delta Y}{Y_1 - \Delta Y}$$

Because the condition for minimizing overall excess burden is that marginal excess burden per last dollar of revenue be the same for each commodity we must set

$$\frac{\Delta X}{X_1 - \Delta X} = \frac{\Delta Y}{Y_1 - \Delta Y}$$

This implies

$$\frac{\Delta X}{X_1} = \frac{\Delta Y}{Y_1}$$

To interpret Equation (7), note that the change in variable divided by its total value is just the percentage change in the variable. Hence, equation (7) says that the minimize total excess burden, tax rates should he set so that the percentage reduction in the quantity demanded of each commodity is the same. This result, called the Ramsey rule. (after its discoverer, Bank Ramsey [1927l], also holds even for cases when X, Y, and I are related goods – substitutes or complements.

But why should efficient taxation induce equip proportional changes in quantities demanded rather than equiproportional changes in prices? Because excess burden is a consequence of distortions in quantities. To minimize total excess burden requires that all these changes be in the same proportion.

A reinterpretation of the Ramsey Rule. It is useful to explore the relationship between the Ramsey rule and demand elasticities. Let π_X be the compensated elasticity of demand for. Let tx be the tax rate on X, this time expressed as an ad valorem rate rather than a unit tax.[33] now, by definition of an ad valorem tax. Hence, $t_X \pi_X$ is the percentage change in the price times the percentage change in quantity demanded when the price increases by I percent. This is just the percentage reduction in the demand for X induced by the tax. Defining ty and π_y analogously, $t_y \pi_y$ is the proportional reduction in Y. The Ramsey rule says that to minimize excess burden, these percentage reductions in quantities demanded must be equal:

$$t_2 \ \pi_y = t_y \ \pi_y \qquad (8)$$

Now divide both sides of the equation by tx πx to obtain

$$\frac{t_x}{t_y} = \frac{\pi_y}{\pi_X} \qquad (9)$$

[33] In a competitive market any unit tax can be represented by a suitably chosen ad valorem tax , and vice versa. For example suppose a commodity is subject to a unit tax of 5 cents, and the price paid by consumer is 50 cents. Then the resulting excess burden is the same as that associated with an ad valorem tax equal to 10 percent of the after tax price

Equation (9) is the inverse elasticity rule: as long as goods are unrelated in consumption, tax rates should be inversely proportional to elasticities. That is, the higher π_y is relative to π_x. The lower should be t_x relative to π_x. Efficiency[34] does not require that all rates be set uniformly.

The intuition behind the inverse elasticity rule straightforward. Efficient taxes distort decisions as little as possible. The potential for distortion is greater the more elastic the demand for commodity. Therefore, efficient taxation requires that relatively high rates of taxation be levied on relatively inelastic goods.

The Corlett–Hague Rule. Corlett and Hague [1953] proved an interesting implication of the Ramsey rule: when there are two commodities, efficient taxation requires taxing the commodity, that is complementary to leisure at a relatively high rate. To understand this result intuitively, recall that if it were possible to tax leisure, a first best result would be obtainable–revenues could be raised with no excess burden. Although the tax authorities cannot tax leisure, they can tax goods that tend to be consumed jointly with leisure. Indirectly lowering the demand for leisure. Indirectly lowering the demand for leisure. If computer games are taxed at a very high rate, people buy fewer of them

[34] A more careful demonstration requires a little calculus recall from Equation (3) that the excess burden on commodities X and Y are $^1/_2\,\pi_x P_X\, Xt_t^2$ and $^1/_2\,\pi_y P$, Yt_t^2 respectively. Then the total excess burden is $^1/_2\,\pi_x P_X Xt_t^2$ + Yt_t^2 (we can add up the two expressions because by assumption. X and Y are unrelated no suppose the required tax revenue is R. then t_X and t_y must satisfy the relation$\pi_x P_X Xt_X$ + $P_y\, Xt_y$ = R our problem is to choose t_x and t_y to minimize $^1/_2\,\pi_x P_X\, Xt_t^2$+$^1/_2\,\pi_y P$, Yt_t^2, subject to R - $P_X Xt_X$ - $P_y Yt_y = 0$ set up the lagrangian expression= $^1/_2\,\pi_x P_X\, Xt_t^2\ + {}^1/_2\,\pi_y P$, Yt_t^2,+λ $[R - P_X\, Xt_t^2$ - $P_y Yt_y]$

Where λ is the lagrange multiplier. (the method of largrangian multipliers is cover in any intermediate calculus book). $\partial/\partial t_x$ Yields $\pi_y t_X = \lambda$ yield $\partial\ /\ \partial t_x$hence and$\pi_x t_X = \pi_y t_X$ eاكتب المعادلة هنا.quation (9)

and spend less time at leisure. In effect, then, high taxes on complements to leisure provide an indirect way to get at leisure, and hence, move closer to the perfectly efficient outcome that would be possible if leisure were taxable.

At this point you may suspect that efficient tax theory has unpleasant policy implications. For example, the inverse elasticity rule says inelastically demanded goods. Should be taxed at relatively high rates. is this fairly. Do we really want a tax system that collects the bullet of its revenue from taxes on insulin?

Of course not. Efficiency is only one criterion for evaluation a tax system; fairness is also important. In particular, it is widely agreed that a tax system should have vertical equity: it should distribute burdens fairly across people with different abilities to pay. The Ramsey rule has been modified to account for the distributional. consequences of taxation. Suppose, for example, that the poor spend a greater proportion of their income on commodity X than do the rich, and vice versa for commodity Y. X might be bread, and Y caviar. Suppose further that the social welfare function puts a higher weight on the utilities of the poor than on those of the rich. Then even if X is more inelastically demanded than Y, optimal taxation may require a higher rate of tax on Y than X [Stern, 1987]. True, a high tax rate on Y creates a relatively large excess burden, but it also tends to redistribute income toward the poor. Society may be willing to pay the price of a higher excess burden in return for a more equal distribution of income.

In general, the optimal departure from the Ramsey rule depends on two considerations. First, is how much social cares about equality. If society cares only about efficiency – a dollar to one person is the same as a dollar to another, rich or poor – then it may as well strictly follow the Ramsey rule. Second is the extent to which the consumption patterns of the rich and poor differ if the rich and the poor consume both goods in the same proportion. Taxing the goods at different rates cannot affect the distribution of income. Even if society has a distributional goal, it cannot be achieved by differential commodity taxation.

If lump sum taxation were available, taxes could be raised without any excess burden at all. Optimal taxation would need to focus only on distributional issues. lump sum taxes are not available, however, so the problem is how to raise tax revenue with as small an excess burden as possible. In general, minimizing excess burden requires that taxes be set so that the (compensated) demands for all commodities are reduced in the same proportion. For unrelated goods, this implies that tax rates should be set in inverse proportion to the demand elasticities. However, if society has distributional goals, departures from efficient taxation rules may be appropriate.

Under current federal income tax law, the fundamental unit of income taxation is the family.[35] A husband and wife are taxed on the sum of their incomes. Regardless of whether the wife or the husband earns an extra dollar, it is taxed at the same rate. Is this efficient. In

[35] This section is based on and Sheshinski (1983).

other words, is the family's excess burden minimize by taxing each spouse 's income at the same rate?

Imagine the family as a unit whose utility depends on the quantities of three “commodities”. Total family consumption, husband's hours of work, and wife's hours of work. Family utility increases with family consumption but decreases with each spouse's hours of work. Each spouse's hours of work depend on his or her wage rate among other variables. A tax on earnings distorts the work decision creating an excess burden. How should tax rates be set so the family's excess burden is small as possible?

Assume for simplicity that the husband's and wife hours of work are approximately unrelated goods- increase in the husband's wage rate has very little impact on the wife's work decision, and vice Veda. The assumption is consistent with much empirical research then application of the inverse elasticity rule suggests that a higher tax should be levied on the commodity that is relatively inelastically supplied. To enhance efficiency whoever's labor supply is relatively inelastic should bear a relatively high tax rate. Numerous econometric studies suggest that the husband's labor supplies are considerably less elastic than wives. Efficiency could therefore be gained if the current tax law were modified to give husbands higher marginal tax rates than wives.[36]

Again, we emphasize that efficiency is only one consideration in tax design. However, it is interesting that this result is consistent with the

[36] The important distinction here is not between and wife but between primary earner and secondary earner. In families where the wife has the lower supply elasticity requires that she have higher tax rate

claims of some who have argued that on equity grounds, the relative tax rate on the earnings of working wives should be lowered. The next chapter contains a discussion of the actual tax treatment of married couples under US law.

So far we have assumed that all production occurs in the private sector. The government's only problem is to set the tax rates that determine consumer prices. Sometimes, the government itself is the producer of a good or service. in such cases, the government must directly choose a user fee- a price paid by users of a good or service provided by the government. As usual, we would like to determine the best possible user fee. Analytically, the optimal tax and user fee problems are closely related. In both cases, government sets the final price paid by consumers. In the optimal tax problem this is done indirectly by choice of the tax rate, while in the optimal user fee problem, it is done directly.

When should the government choose to produce good instead of purchasing if from the private sector, we argued that government production may be appropriate when the use of some good or service subject to continually decreasing average costs-the greater the level of output, the lower the cost per unit. Under such circumstances, it is unlikely that the market for the service is competitive. A single firm can take advantage of economies of scale and supply the entire industry output, at least for a sizable region this phenomenon is often called natural monopoly. Examples are bridges, electricity, and cable television. In some cases, these commodities are produced the private

sector and regulated by the government (electricity); and in others they are produced by the public sector (bridges). Although we study public production here, many of the important insights apply to regulation of private monopolies

Figure 2

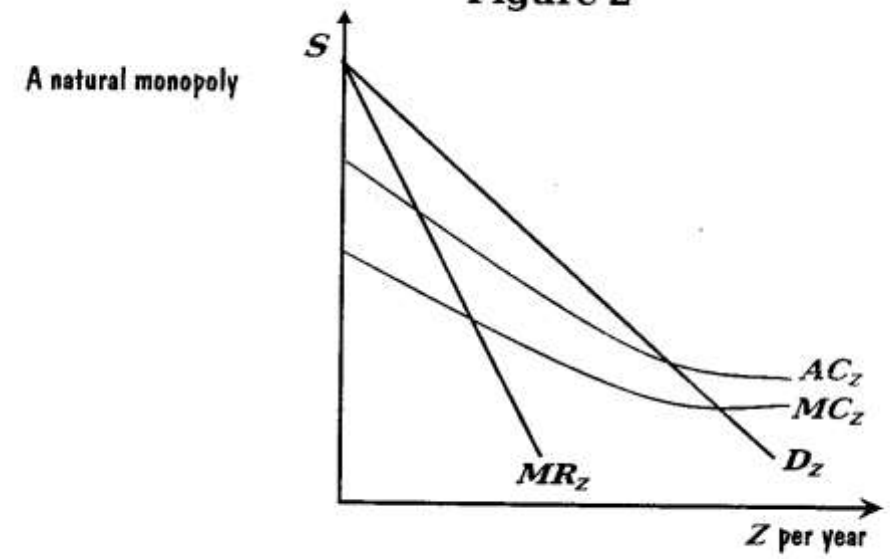
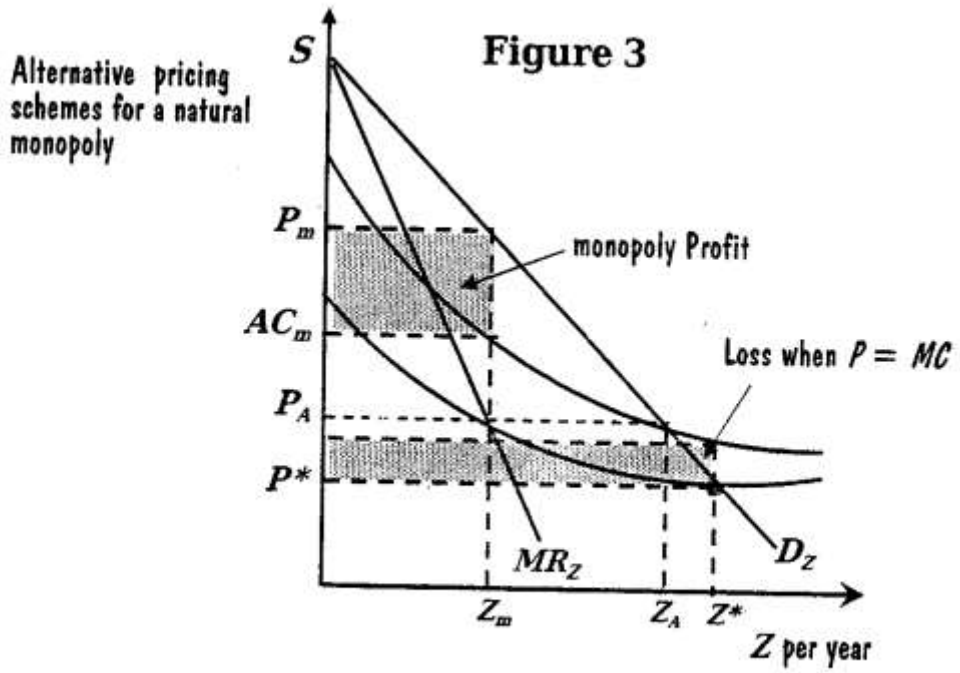


Figure 2 measures the output of the natural monopoly, z on the horizontal axis, and dollars on the vertical. The average cost schedule is denoted AC_Z, by assumption, it decreases continuously over all relevant ranges of output. Because average cost is decreasing, marginal cost must be less than average. Therefore, the marginal cost (MC_Z) curve, which shows the incremental cost of providing each unit of Z, lies below

AC_Z. The demand curve for Z is represented by D_Z. The associated marginal revenue curve is MR_Z.it shows the incremental revenue associated with each level of output of Z.

To illustrate why decreasing average costs often lead to public sector production or regulated private sector production, consider what would happen if Z were produced by an unregulated monopoly. A monopolist seeking to maximize profits produced up to the point that marginal revenue equal marginal cost, output level Z_m in the associated price P_m, is found by going up to the demand curve D_Z. Monopolies profits are equal to the product of number of units sold times the profit per unit and are represented geometrically by the light colors rectangle.

Is output Z_m efficient? According to the theory of welfare economics, efficiency requires that price equal Marginal cost–the value that people place of the good must equal the incremental cost to society of producing it. At Z_m price is greater than marginal cost. Hence, Z_m is inefficient. This inefficiency the fact that society may not approve of the existence of the monopoly profits provide a possible justification for government taxing over the production of Z.



The obvious policy prescription seems to be for the government to produce up to the point where price equals marginal cost. in the output at which P = MC is denoted Z* and the associated price is P* There is a problem, however: at output Z*, the price is less than the average cost. price P* is so low that the operation cannot cover its costs, and it suffers losses. the total loss is equal to the product of the number of unit sold Z*, time the loss per unit, measured as the vertical distance between the demand curve and AC_Z at Z*. Geometrically, the loss is the darker colored rectangle in figure3.

How should the government confront this dilemma? Several solutions have been proposed.

Average cost pricing. By definition, when price equals average cost, there are neither profits no losses – the enterprise just breaks

even. The operation no longer had to worry about a deficit. Geometrically, this corresponds to the intersection of the demand and average cost schedules in where output is Z_A and price is P_A. However, note that Z_A is less than Z*. Although average cost pricing leads to more output than at the profit-maximizing level, it still falls show of the efficient amount.

Marginal Cost pricing with lump sum taxes. Charging P = MC, and make up the deficit by levying lump sum taxes. changing P = MC ensures efficiency in the market for Z; financing the deficit with lump sum taxes on the rest of society guarantees that no new inefficiencies are generated by meeting the deficit. However, there are two problems with this solution:

First as previously noted, lump sum taxes as generally unavailable. The deficit has to be financed by distorting taxes. Such as income or commodity taxes. If so, the distortion due to the tax may more than outweigh the efficiency gain in the market for Z.

Second, there is a widespread belief that fairness requires consumers of a publicly provided service to pay for it- the so called benefits received principle. If this principle is taken seriously, it is unfair to make up the deficit by general taxation. If the coast guard rescues me from a stormy sea, why should you pay for it?

A Ramsey solution, so far we have been looking at one government enterprise in isolation. Suppose that the government is running several enterprises, and as a group they cannot lose money, but

any individual enterprise can suppose further that the government wants the financing to come from Users of the services produced by the enterprises. By how much should the user fee for each service exceed its marginal cost?

Does this question sound familiar? It should, because it essentially the same as the optimal tax problem. In effect, the difference between the marginal cost and the user fee is just the tax that the government levies on the commodity. And just as in the optimal tax problem, the government had to raise a certain amount of revenue-in this case, enough for the group of enterprises to break even. The Ramsey rule gives the answer- set the user fees so that demands for each commodity are reduced proportionately. This analysis, by the way, illustrates one of the nice features of economy theory. Often a framework that is developed to study one problem can be fruitfully applied to another problem that seems to be quite different.

Of the various possibilities for dealing with decreasing costs, which has the United States chosen? In most cases both publicly owned and regulated private enterprise have selected average cost pricing. Although average cost pricing is inefficient, it is probably a reasonable compromise. It has virtue of being fairly simple and adheres to the popular benefits-received principles, some economists; however, argue that more reliant on Ramsey pricing would be desirable.

Thus far, we have assumed that a government can taxes on all commodities and inputs. We now turn to the question of how to design systems in which liabilities are based on people's incomes. Specifically,

how progressive should the income tax be? There are hardly a more contentious issue in public financial Nineteenth century economist John McCulloch who opposed progressive taxation, argued that once you abandon proportional taxation, you are at sea without rudder or compass, and there is no amount of injustice and folly you may not commit. The goal of the theory of optimal income taxation is to provide a rudder, that is, to provide a systematic way for thinking about the right S amount of tax progressivity.

At the end of the 19th century, Edgeworth [1959/1897] examined the question of optimal income taxation using a simple model based on the following assumptions.

1- Subject to the revenues required, the goal is to make the sum of individuals' utilities as high as possible. Algebraically, if U1 is the utility of the with individual and W is social welfare, the tax system should maximize.

$$W = U_1 + U_2 + \ldots\ldots + U_m. \qquad (10)$$

Where n is the number of people in the society.

2_ individuals have identical utility functions that depend only on their incomes. These utility functions exhibit diminishing marginal utility of income; as income increases, an individual becomes better off but at a decreasing rate.

3- the total amount of income available is fixed.

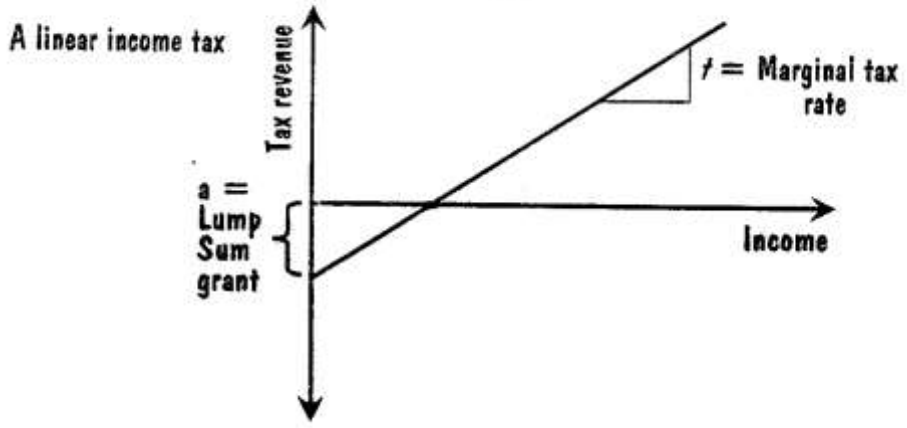
Edgeworth's assumptions are virtually identical to the assumptions behind the optimal income distribution model presented in under Rational for income redistribution. There we showed that with these assumptions, maximization of social welfare requires that each person's marginal utility of income be the same. When utility functions are identical, marginal utilities are equal only if incomes are equal. The implications for tax policy are clear: Taxes should be set so that the after tax distribution of income is as equal as possible. In particular, income should be taken. First from the rich because the marginal utility loss is smaller than that of the poor. If the government requires more revenue even after obtaining complete equality, the additional tax burden should be evenly distributed.

Edgeworth's model, then, implies a radically progressive tax structure–incomes are leveled off from the top until complete equality is reached. In effect marginal tax rates on high income individual are 100 percent, However, as stressed in each of the assumptions underlying this analysis is subject question. In recent decades, economists have investigated how Edgeworth's results change when certain of the assumptions are relaxed.

One of the most vexing problems with Edgeworth's analysis is the assumption that the total amount of income available to society is fixed. Confiscatory tax rates have no effect on the amount of output produced More realistically, suppose the individuals' utilities depend not only on income but on ensure as well. then income taxes distort work decisions and create excess burden A society with a utilitarian social welfare

function thus faces an inescapable dilemma. On the one hand, it desires to allocate the tax burden to equalize the after-tax distribution of income. However, in the process of doing so, it reduces the total amount of real income available. An optimal income tax system must account for the costs (in excess burden) of achieving more equality. In Edgeworth's model, the cost of obtaining more equality is zero, which explains the prescription for a perfectly egalitarian outcome.

Figure 4



How does Edgeworth's result change when work incentives are taken into account? Stern [1987] studies a model similar to Edgeworth's, except that individual choose between income and leisure. To simplify the analysis, Stern assumed that the tax revenues collected from a person are given by.

$$\text{Revenues} = -a + t \times \text{income}. \qquad (11)$$

Where a and t are positive numbers. For example, suppose that a = $3,000 and t = .25. Then a person with income of $20,000 would

have a tax liability of $2,000 (= −$3,000 + .25 × $20,000). A person with an income of $6,000 would have a tax liability of minus $1,500 (= − $3,000 + .25 × $6,000) Such a person would receive a $1,500 grant from the government.

In Figure 4 we graph Equation (11) in a diagram with income measured on the horizontal axis and tax revenues on the vertical. When income is zero, the tax burden is negative − the individual receives a lump sum grant from the government of a dollars. Then, for each dollar of income, the individual must pay t dollar to the government. Thus, t is the marginal tax rate the proportion of an additional dollar that must be laid in tax. Because the geometric interpretation of (11) is a straight line, it is referred to as a linear income tax schedule. in popular discussions, a linear income tax schedule is often called a flat income tax. note that even though the marginal tax rate for a linear tax schedule is constant, the schedule is progressive in the sense that the higher an individual's income, the higher the proportion of income paid in taxes. Just how progressive depends on the precise values of a and t. Greater values of t are associated with more progressive tax systems. However, at the same time that high values of t lead to more progressiveness, they create larger excess burden. The optimal income tax problem is to find the best combination a of and t − the values that maximize social welfare [Equation (10)] subject to the constraint that a given amount of revenue (above the required transfers) be collected.

Stern [1987] finds that allowing for a modest amount of between leisure and income, and with required government revenues equal to

about 20 percent of income, a value of t of about 19 percent maximizes social welfare.[37] This is considerably less than the value of 100 percent implied by Edgeworth's analysis. Even quite modest incentive effects appear to have important implications for optimal marginal tax rates. Incidentally, Stern's calculated rate is also much smaller than the actual marginal tax rates found in many Western Countries. For example, under the US federal person income tax, the highest statutory marginal income tax rate in 2003 was 38.6 percent at times it has been 90 percent.

More generally, Stern showed that the more elastic the supply of labor. The lower the optimal value of other things being the same. Intuitively, the cost to redistribution is the excess burden it creates. the more elastic the supply of labor, the greater the excess burden from taxing it. [see Equation] more elastic labor supply therefore means a higher cost to redistribution, so the less should be undertaken.

Stern also investigated how alternative social welfare functions affect the results, focusing on the impact of giving different social weights to the utilities of the rich and the poor. In Equation (10) more egalitarian preferences are represented by assigning the utilities of poor people higher weights than utilities of the rich. An interesting extreme case is the maximum criterion according to which the only individual who received any weight in the social welfare function is the person with the minimum utility Stern found that the maximum criterion calls for a

[37] Specifically, the result reported here assumes the elasticity of substitution between leisure and income is 0,6. In Stern's model, this correspond to a small positive elasticity of labor supply with respect to the net wage.

marginal tax rate of about 80 percent. Not surprisingly, if society has extremely egalitarian objectives, high tax rates are called for. Even here, though, the rates fall short of 100 percent.

One limitation of Stern's analysis is that if constrains the income tax system to have only a single marginal tax rate. Gruber and Saez (2000) investigated a more general model that allowed for four marginal tax rates. The most interesting finding to emerge from their analysis is that people in higher income brackets should face a lower marginal tax rate than people in the lower brackets. The intuition behind the result is that, by lowering the marginal tax rate on high-income people, they are induced to supply more labor, and the increased tax revenue can be used to lower the tax burdens on low-income individuals. Importantly, although marginal tax rates fall with income, a age tax rates with income, so the optimal tax system is still progressive:

This cataloging of results may convey a somewhat false sense of precision as to what economists really know about the optimal tax system. After all, there are many controversial value judgments behind the utilitarian social welfare that the optimal tax system seeks to maximize. Moreover, as explained in there is substantial uncertainty about the behavioral elasticities that are crucial to analyzing then trade-off between efficiency and equity. Nevertheless, explicit calculation of optimal tax rates under alternative sets of assumption are extremely informative. The contribution of the literature on optimal taxation is systematically drab out the implications of alternative ethical and behavior assumptions, thus facilitating coherent discussion of tax policy.

Optimal taxation is a purely normative theory. It does not purport to predict what real-world tax systems look like, or to explain how these tax systems emerge. The theory pays little attention to the institutional and political setting in which tax policy is made. Holcomb (2002) argues that in the presence of real work political institutions, policy recommendations base on optimal tax logic may actually reduce welfare.

Assume that in a certain society, there are three commodities, X, Y, and leisure. Labor is totally fixed supply, and therefore, income is fixed. Currently, the society levies a tax on X, but its constitution forbids taxing Y. Viewing this situation. A student of optimal tax theory might say something like: you are running an inefficient tax system. Because labor is totally fixed in supply, you could have no excess burden if you taxed X and Y at equal rates – an income tax. I recommend that you lower the tax on X and impose a tax at the same rate on Y set the rates so that the same amount of revenue is collected as before.

Suppose, however, that the citizens suspect that if they allow taxation of Y, their politician will not lower the tax rate on X. Rather, they will simply take advantage of the opportunity to tax something new to make tax revenues as large as possible. Certain theories of the public sector suggest that those who run the government can and will maximize tax revenues despite the wishes of the citizenry. Therefore, by constitutionally precluding the taxation of Y, the citizens may be rationally protecting themselves against an inefficiently large public sector. In other words, if citizens do not trust the government, what looks inefficient from the point of view of optimal commodity taxation

may be efficient in a larger setting.[38] There is, in fact, some evidence that government with tax systems that generate large excess burden tend to grow more slowly than governments with efficient tax systems (Becker and Mulligan, 1991), although research on this matter is at a preliminary stage.

Issues relating to these considerations may help explain. In part, the current controversy over the tax treatment of purchases made on the internet proponents of internet taxation argue that a good purchased in a store is essentially the same commodity as the same good purchased on the internet. Taxing the former but not the latter distorts consumer's choices between the two modes of purchase, and hence creates an excess burden. Opponents argue that taxing internet sales would simply fuel increases in the size of the public sector, which is already inefficiently larger

This discussion is related to a more general phenomenon called the time inconsistency of optimal policy. Consider a proposal made by the government of Colombia in 2002. To put down a rebellion, a tax of 1.2 percent of the value of their capital would be levied on all individuals and businesses whose assets exceeded the equivalent of $60,000. Importantly, the tax was to be imposed only one time; it would not be repeated in the future. While capitalists presumably would not be pleased to pay the tax, it would appear to have no impact on their

[38] Holcombe (1998) provides further comparisons between optimal tax theory and an approach that takes politics into account.;

current incentives to save for the future. Such a tax is in effect a lump sum levied and therefore fully efficient.

There is a problem, however the Colombian government has an incentive to renege on its promise that the tax would only be levied once and pull exactly the same trick next year, raising yet more revenue without an excess burden. Thus, the stated tax policy is inconsistent with the government's incentives over time. Even worse, the capitalists realize the government has an incentive to renege. They will change their saving behavior to reflect the expectation that the more they save now, the more they will be taxed next year, because the expected tax changes behavior, it introduces an inefficiency.

In short, unless the government can credibly promise not to renege, it cannot conduct the fully efficient tax policy. To avoid this time inconsistency problem, the government must be able to commit itself to behave in certain ways in the future. How can this be done? One possible approach is to enact constitutional provisions forbidding the government to go back on, its promises. However, as long as the government has an underlying incentive to renege suspicions will remain, frustrating attempts to run an efficient policy. These considerations suggest that the credibility of the political system must be considered before making recommendations based on optimal tax theory. As we have seen, optimal taxation depends on trade-off between efficiency and fairness. However, the use of these concepts in optimal tax theory do not always correspond closely to lay usage. In context of optimal tax theory, a fair tax is one time guarantees a socially

desirable distribution of the tax burden; an efficient tax is one with a small excess burden. In public discussion, on the other hand a tax is often one that imposes equal liabilities on people who have the same ability to pay. and an efficient tax system is one that keeps down administrative and compliance expenses. These alternative notions fairness and efficiency in taxation are subject this section.

The American Humorist Will Rogers one said, people want just taxes more than they want lower taxes. There want to know that every man is paying his proportion share according to his wealth. This criterion evaluating a tax system is embodied in the economist notion of horizontal equity people in equal position should be treated equally. To make horizontal equity an operational idea, one must define equal position Rogers suggests wealth as an index of ability to pay, income and expenditure might also be used.

Unfortunately, all of these measures represent the outcomes of people's decisions and are not really suitable measures of equal position. Consider two individuals, both of whom can earn S10 per hour. Mr. A chooses to work 1,500 hours each years, while Ms. B works 2,200 hours each year. A's income is $15,000 and B's is $22,000, so that in terms of income, A and B are not in equal positions. In an important sense, however, A and B are the same, because their earning capacities are identical- B just happens to work harder. Thus, because work effort is at least to some extent under people's control, two individuals with different incomes may actually be equal positions.

Similar criticism would apply to expenditure or wealth as a criterion for measuring equal positions.

These arguments suggest that the individual's wage rate rather than income be considered as a candidate for measuring equal positions but this idea has problems too. first, investments in human capital education, on the - job training, and health care-can influence the wage rate. if Mr. A had to go to college to earn the same wage that Ms. B is able to earn with only a high school degree, is it fair to treat them the same? Second, computing the wage rate requires division of total earning by hours of work, but the latter is not easy to measure. (How should time spent on coffee break be counted?) Indeed, for a given income, it would be worthwhile for a worker to exaggerate hours of work be able to report a lower wage rate and pay fewer taxes presumably, bosses could be induced to collaborate with their employees in return for a share of tax savings.

As an alternative to measuring equal position either in incomes or wage rates, Feldstein (1976a) suggests it be defined in utilities. Hence, the utility definition horizontal equity. (a) if two individuals would be equal well off (have the same utility level) in the absence of taxation, they should also be equally well off if there is taxation; and (b) taxes should not alter the utility ordering-if A is better off than B before taxation he should be better off after.

To assess the implications of Feldstein 's definition first assume all individuals have some preferences that is, identical utility functions. In this case, individual who consume the same commodities (including

leisure should pay the same tax or equivalently, all individual should face the same tax schedule. Otherwise, individual with equal before-tax utility level would have different after-tax utilities.

Now assume that people have diverse tastes. For example, let there be two types of individuals, gourmets and Sunbathers. Both groups consume food (which is purchased using income) and leisure, but Gourmets put a relatively high value on food, as do sunbathers on leisure time. Assume further that before any taxation, Gourmets and sunbathers have identical utility levels if the same proportional income tax is imposed on everybody, Gourmets are necessarily made worse off than Sunbathers, because the former need relatively large amounts of income to support their food habits, Thus, even though this income tax is perfectly fair judged by the traditional definition of horizontal equity, it is not fair according to the utility definition. Indeed, as long as tastes for leisure differ, any income tax violates the utility definition of horizontal equity.

Of course, the practical difficulties involved in measuring individuals' utilities preclude the possibility of having a utility tax, Nevertheless, the utility definition of horizontal equity has some provocative policy implications. Assume again that all individuals have the same preferences. Then it can be shown that any existing tax structure does not violate the utility definition of horizontal equity if individuals are free to choose their activities and expenditures.

To see why, suppose that in one type of job a larger part of compensation consists of amenities that are not taxable- pleasant

offices, access to a swimming point and so forth. In another occupation, compensation exclusively monetary, all of which is subject to income tax. According to the traditional definition, this situation is a violation of horizontal equity, because a person the job with a lot of amenities has too small a tax burdens, but, if both arrangements coexist and individual are free to choose, then net after- tax reward (including amenities) must be the same in both jobs. Who suppose that the net after reward is greater in the jobs with amenities. Then individuals migrate to the jobs to take advantage of them, but the increased supply of workers in these jobs depresses their wage. The process continues until the net returns are equal. In short, although people in the different occupation pay unequal taxes, there is no horizontal inequity because of adjustments in before tax wage.

Some suggest that certain tax advantages available only to the rich are sources of horizontal inequity, according to the utility definition, this notion is wrong, if these advantages are open to everyone with high income. And all high-income people have identical tastes, then the advantages may indeed reduce tax progressiveness but they have no effect whatsoever on horizontal equity

We are led to a striking conclusion: given common tastes, a preexisting tax structure cannot involve horizontal inequity. Rather, all horizontal inequities arise from changes in tax laws. This is because individuals make commitments based on the existing tax laws that are difficult or impossible to reverse. For example, people may buy larger houses because of the preferred tax treatment for owner-occupied

housing. When the tax laws are changed, their welfare goes down, and horizontal equity is violated. As one congressman put it, it seems unfair to people who have done something in good faith to change the law on them.[39] These observations give new meaning to the dictum; the only good tax is an old tax.

The fact that tax changes may generate horizontal inequities does not necessarily imply that they should not be undertaken. After all, tax changes may improve efficiency and/ or vertical equity. However, the arguments suggest that it might be appropriate to ease the transition to the new tax system. For example, if it is announced that a given tax reform is not to go into effect until a few years subsequent to its passage, people who have based their behavior on the old tax structure will be able to make at least some adjustments to the new equity The problem of finding fair processes for changing to regimes (transitional equity) is very difficult, and many result are available on the subject.

The very conservative implications of the utility definition of horizontal equity should come as no great surprise, because implicit in the definition is the notion that the pretax status quo has special ethical validity (otherwise, why be concerned about changes in tax ordering of utilities?) However, it is not at all obvious why the status quo deserves to be defended. A more general feature of the utility definition is its focus the outcomes of taxation. In contrast, some have suggested that the essence of horizontal equity is to put constraint on the rules that govern the selection of taxes, rather than to provide criteria for judging

[39] Change ill tax bill York times. May 26. 1986.P.31

their effects. Thus horizontal equity excludes capricious taxes, or taxes based on irrelevant characteristics. For example, we can imagine the government levying special lump sum tax on people with red hair, or putting very different tax on angel food and chocolate cakes. The rule definition of horizontal equity would presumably exclude such tax from consideration, even if they had desirable efficient or distributional effects. In this sense, provision in the US constitution that rule out certain kinds of taxes can be interpreted as an attempt to guarantee horizontal equity.

However, identifying the permissible set of characteristics on which to base taxation is a problem. Most people would agree that religion and race should be irrelevant for purposes of determining tax liability. On the other hand, there is considerable disagreement as to whether or not marital status should influence tax burdens. And even with agreement that certain characteristics are legitimate bases for discrimination, the problem of how much discrimination is appropriate still remains. Everyone agrees that serious physical impairment should be taken into account in determining personal tax liability. But how bad must your vision be to qualify for special tax treatment as blind? And by what amount should your tax bill be reduced?

We are forced to conclude that horizontal equity, however defined, is a rather amorphous concept. Yet it has enormous appeal as a principal of tax design. Notions of fairness among equals, regardless of their vagueness, will continue to play an important role in the development of tax policy. An implicit assumption in the models we have been studying is that collecting taxes involves no costs. This is clearly

false. The tax authorities require resources to do their job. Tax payers incur costs as well; including outlays for accountants and tax lawyers, as well as the value of time spent tilling out tax returns and keeping records.

The costs of administering the income tax in the United States are fairly. For example, the internet revenue service spends only about 39 cents to raise each $100 in taxes. However, the compliance costs of personal income taxation are quite substantial on the basis of survey evidence, Slemrod (1996) estimates that in 1995, US households devoted 2.8 billion hours to federal tax preparation. If the value of time is approximated $15 per hour, then the time cost of federal tax compliance is $42 billion. Further, Slemrod assesses the monetary expenditures for tax compliance (fees for professional advice, tax preparation manuals, etc.) At about $8 billion giving a total resource cost of $50 billion, about percent of federal income tax revenue. An updates estimate of compliance costs for the year 2000, including corporate as well as personal taxes, is about $115 billion.

Clearly, the choice of tax and subsidy systems should take account of administrative and compliance costs. Even systems that appear fair and efficient (in the excess burden sense) might be undesirable because they are excessively complicated and expensive to administers.

Consider the possibility of taxing output produced in the home- housecleaning, child care, and so on. As suggested in the fact that

market work is taxed but housework is not creating a sizable distortion in the allocation of labor. Moreover, taxing differentially on the basis of choice of workplace violates some notions of horizontal equity. Nevertheless, the difficulties involved in valuing household production would create such huge administrative costs that the idea is infeasible.

Unfortunately, administrative problems often receive insufficient attention. A classic case was the federal luxury tax on new jewelry enacted in 1990 the tax applied only to the portion of the price that exceeded $10,000. And only items worn for adornment were subject to the tax. As one commentator noted, the tax was an administrative nightmare: loose gems and repairs aren't taxed; market value after a major modification is. Thus.... you may be taxed if you have gems from your grandma's brooch put in a new setting. But you won't be if you replace a $30,000 diamond lost form a ring; that's a repair (Schmede, 1991, P. All). The costs to the internal revenue service of collecting the luxury tax may have exceeded the revenues collected! The tax was finally repealed in 1993.

Obviously, no tax system is costless to administers the trick is to find the best trade-off between excess burden and administrative costs. For example, administering a sales tax system in which each commodity has its own rate might be very cumbersome, despite the fact that this is the general tack prescribed by the Ramsey rule. Any reductions in excess burden that arise from differentiating the tax rates must be compared to the incremental administrative costs.

We now turn to one of the most important problem facing any tax administration-cheating. To begin, or must distinguish between tax avoidance and tax evasion tax avoidance, which john Maynard Keynes once called the only intellectual pursuit that carries any reward is changing your behavior so as to reduce your tax liability. There is nothing illegal about tax avoidance

Over and over again courts have said that there is nothing sinister in so arranging one's affairs so as to keep taxes as low as possible. Everybody does so. Rich or poor; and all do right, for nobody owes any public duty to pay more than the demands.... To demand more in the name morals is mere can't. (Judge Learned Hand) (commissioner v. Newman.1947)

In contrast, tax evasion is failing to pay legally due taxes. If a tax on mushrooms is levied and you sell fewer mushrooms, it is tax avoidance. If you fail to report your sales of mushrooms to the government, it is tax evasion. Tax evasion is not a new problem. centuries ago Plato observed, when there is an income tax, the just man will pay more and the unjust less on the same amount of income. in recent years, however, tax evasion has received an especially large amount of public attention. A case that received international notice was that of tennis star Steffi Graf. Several years ago, the German authorities accused her of evading as much as $50 million in taxes over a 12- year period. From 1989 to 1992, she did not even file a tax return.

Tax cheating is extremely difficult to measure. The internal revenue service estimates that taxpayers voluntarily pay only about 80 percent of

their actual income tax liability. if this estimate is even roughly accurate, it suggests that evasion is a very important issue.

People commit tax fraud in a variety of ways

- Keep two sets of books to record business transactions, one record the actual business and the other is shown to the tax authorities some evaders use two cash registers.
- Moonlight for cash. Of course, working an extra job is perfectly legal. However, the income received on such jobs is often paid in case rather than by check. Hence, no legal record exists, and the income is not reported to the tax authorities.
- Barter. I'll fix your car if you bake me five loaves of bread when you receive payment in kind instead of money, it is legally a taxable transaction. However, such income is seldom reported.
- Deal in cash. Paying for goods and service with cash and checks made out to cast makes it very difficult for the internal revenue service to trace transactions.

At one time, tax evasion was associated with millionaires who hid their capital in Swiss bank accounts the current image of a tax evader may well be a repair whose income comes from unofficial work not reported for tax purposes. or a parent who evades taxes on wag paid to a babysitter. Indeed, people who pay maid nannies, and other household employees more that roughly $1,300 per year are obligated to pay social security taxes for them, yet fewer than 0.25 percent of all households pay this nanny tax (Herman, 2001, p.A1.) The feeling that everyone is doing it is widespread.

We first discuss the positive theory of tax evasion, and then turn to the normative question of how public policy should deal with it.

Positive analysis of tax evasion. Assume A1 cares only about maximizing his expected income. He has a given amount of earnings and is trying to choose R, the amount that he hides from the tax authorities. Suppose A1's marginal income tax rate is 0.3; for each dollar shielded from taxable income, his tax bill falls by 30 cents. This is the marginal benefit to him of hiding a dollar of income from the tax authorities. More generally. when A1 faces a marginal income tax rate t, the marginal benefit of each dollar concealed is t.

The tax authorities do not know A1's true income, but it randomly audits all tax payers returns. As a result, there is some probability, P, that A1 will be audited. (In the United States, only about $0,49$ percent of federal income tax returns are audited). If he is caught cheating, A1 pays a penalty that increases with R at an increasing rate. Note that if it were costless to monitor A1 every second of every day, opportunities for evasion would not exist. The fact that such monitoring is infeasible is the fundamental source of the problem.

Assuming that A1 knows the value of P and the penalty schedule, he makes his decision by comparing the marginal costs and benefits of cheating. In the amount of income not reported is measured on the horizontal axis, and dollars on the vertical. The marginal benefit (MB) for each dollar not reported is t, the amount of tax saved. The expected

marginal cost (MB) is the amount by which the penalty goes up for each dollar of cheating (the marginal penalty) time the probability of detection. For example, if the additional penalty for hiding the thousandth dollar is $1.50 and the probability of detection 1 in 3, then the expected marginal penalty is 50 cents the optimal amount of cheating is where the two schedules cross, at R*. R* is optimal in the sense the on average it is the policy that maximizes A1's income in a world of uncertainty, finding the best policy this expected value sense is a reasonable way proceed. It is possible, of course, that not cheating at all will be optimal. for the individual in the marginal cost of cheating exceeds the marginal benefit for all positive values of R, so the optimum equal to zero.

Figure 5

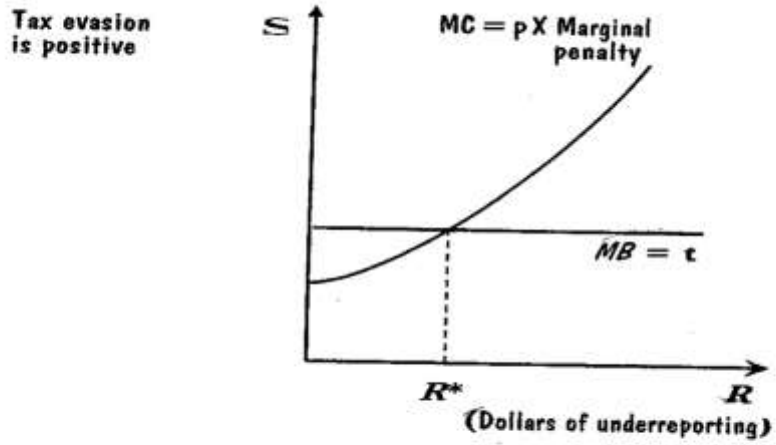
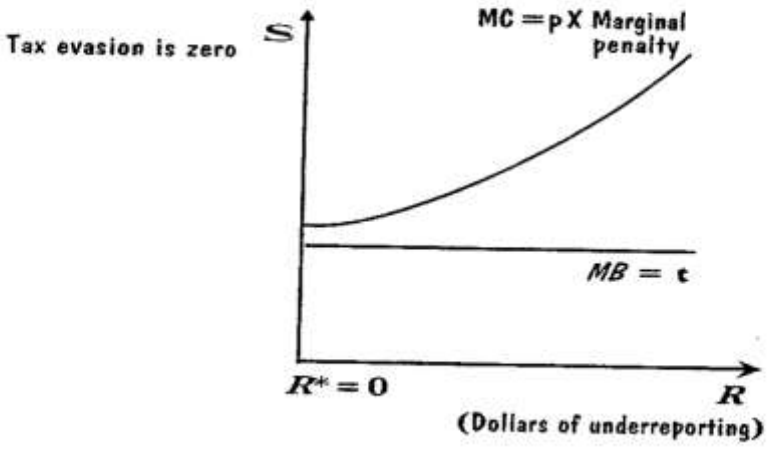


Figure 6



The model predicts that cheating increases when marginal tax rates go up. This is because a higher value of t increases the marginal benefit of evasion, shifting up the marginal benefit schedule so the intersection with marginal cost occurs at a higher value of R. this prediction is consistent with anecdote evidence. Consider, for example, the Russian politician Alexander Lebed's description of the situation in her country: The Russian tax policy is making everyone every single entrepreneur, every single businessman a criminal. On every ruble earned, out of 100 kopecks if you're lucky you pay 92 Kopecks as tax.[40] The model's prediction is also home out by the econometrist work of Feinstein (1991), who found that the amount of underreporting of income increases with marginal tax rates. A further implication is that cheating decreases when the probability of detection goes and when the marginal penalty rate increases both these steps raise the expected marginal cost of cheating.

Although this model yields useful insights, it ignores some potentially important considerations.

Psychic costs of cheating. Simply put, lax evasion may make people feel guilty. One way to model this phenomenon is by adding psychic costs to the marginal cost schedule for very honest people, the psychic costs are so high they would not cheat even if the expected marginal penalty were zero.

[40] Wall sneer journal. November 20,1996

Risk aversion. Assume people care only about expected income, and that risk per se does not bother them. To the extent that individuals are risk averse, their decisions to engage in what is essentially a gamble may be modified. (the appendix to discusses choice under uncertainty.

Work choices. The model assumes the only decision is how much income to report. The type of job and the amount of before tax income are taken as given. In reality, the tax system may affect hours of work and job choices. For example, high marginal tax rates might induce people to choose occupations that provide substantial opportunities for evading taxation, the so-called underground economy. This includes economic activities that are legal but easy to hide from the tax authorities (home repairs) as well as work that is criminal per se (prostitution, selling drugs). The size of the underground economy is inherently very difficult to measure. The estimates reported by Friedman, Johnson, Kaufmann, and Lobaton (2000) place it at 14 percent of gross domestic product in the United States. For Britain, the figure is & percent, and for Russia 42 percent. One of the few econometric analyses of an underground economy is a study by Fortin, Lemieux, and Frechette (1994) of data from a random survey carried out in the region of Quebec City, Canada. They found that when marginal tax rates increase, does the probability of participating in the underground sector. This finding is consistent with journalist reports of what transpired in New York City after cigarette taxes there raised the price per pack about $7.50. the tax increase fueled a thriving market in low tax cigarettes

from other states and the sellers included not only veteran marketer, but also amateurs seeking extra income (Fairclough, 2002, p. BI)

Changing probabilities of audit. In our simple analysis the probability of an audit is independent of the amount evaded and the size of income reported. However, in the United States, audit probabilities depend on occupation and the size of repotted income. This complicates the model but does not change essential aspects

Clearly, cheating is a more complicated phenomenon than suggest. Nevertheless, the model provides us a useful framework for thinking about the factors the influence evasion decision. As already suggested it is difficult to do empirical work on tax evasion.

Consequently, it is not known whether high fines or frequent audits are more effective ways of deterring cheating. One tentative result that emerges from several econometric studies is that for most groups a heightened threat of audit increases reported income, but the magnitude of the effect is small (Blumenthal, Christian, and Slemrod, 1998).

Normative analysis of tax Evasion. Most public discussions of the underground economy assume that it is a bad thing and that policy should be designed to reduce its size. Although possibly correct, this proposition is worth scrutiny.

An important question in this context is whether or not we care about the welfare of tax evaders. In the jargon of welfare economics, do the utilities of participants in the underground economy belong in the social welfare function? Assume for the moment that they do. Then

under certain conditions, the existence of an underground economy raises social welfare. For example, if the supply of labor is more elastic to the underground economy than to the regular economy, optimal tax theory suggests that the former be taxed at a relatively low rate. This is simple an application of the inverse elasticity rule Equation 9.

Alternatively, suppose that participants in the underground economy tend to be poorer than those in the regular economy. In fact, many observers believe in the underground economy is a crucial part of life in American inner cities [Templin, 1995]. To the extent society has egalitarian income redistribution objectives, leaving the underground economy intake might be desirable.

Consider now the policy implications when evaded are given no weight in the social welfare function , and the goal is simply to eliminate cheating at the lowest administrative cost possible. Figure 5, suggest a straibhtforward way to accomplish this objective. The expected marginal cost of cheating is the production the penalty rate and the probability of detection. The probability of detection depends on the amount resources devoted to tax administration; if the interne revenue services has a big budget, it can catch a lot cheaters, however, even if the tax authorities have small budget so that the probability of dection low, the marginal cost of cheating can still be make arbitrarily high if the penalty is large enough. If on one tax evader were caught each year, but he or she were publicly hanged for the crime, the expected of tax evasion would deter many people. The fact the such a draconian policy has never been serious proposed in the United states indicates that existing

penalty systems try to incorporate just retribution. Contrary to the assumptions of the utilitarian framework, society cares not only about the end result (getting rid of cheaters) but also the processes by which the result is achieved.

Discussion Questions.

1- according to estimates by Goolsbee and petrin [2001]. The elasticity of demand for basic cable service is 0.51, and the elasticity of demand for direct broadcast satellites is – 7,40. Suppose that a community wants to raise a given amount of revenue by taxing cable service and the use of direct broadcast satellites, if the community's goal is to raise the money as efficiently as possible what should be the ratio of the cable tax to the satellite tax? Discuss briefly the assumptions behind your calculation.

2- In 2002, the US federal government levied a tax of 3 percent on that part of a car's price exceeding $40,000. (For example, the tax liability on a $50,000 car would be 0.03 X ($50,000 - $40,000, or $300.) discuss the efficiency, equity, and administrability.

3- Peter the Great at one time levied a tax upon beards; he held that the beard was a superfluous and useless ornament. The tax is said to have been proportional according to the length of the beard and progressive according to the social position of its possessor. [Groves, 1946, P.51 Evaluate Peter's beard tax from the standpoint of optimal tax theory and from the standpoint of horizontal equity.

4- In recent years, farmers in China have been protesting their tax treatment by the government. They have many complaints, including a fee that is collected for production of especial producer like nuts, even when none are growth [Eckholm, 1999, P. A10). Evaluate this

nut tax from the viewpoints of both optimal tax theory and horizontal equity.

5- According to Fisman and Wei [2001], imported in china respond to high tariffs by evasive behavior. For example, when they are importin a commodity with a high tariff rate they make lie and claim that it is a different commodity with a lower tariff. They estimate that a1 percent increase in the tax rate results in a 3 percent increase in evasion. Modify the model from illustrate this phenomenon,

6- Suppose that Shariene faces a marginal income tax rate of 36 percent, and if she cheats on her taxes, there is a percent change that she will be caught. Use the logic surrounding to compute the smallest fine that will induce sharlene not to cheat.

7- Real estate marginal Donald Trump once proposed a onetime tax of 14.25 percent on the net wealth of every American with more than $10 million, would this be an efficient way to raise tax revenue? Include in your answer the concept of the time inconsistency of optimal policy.

Indicate whether each of the following statements is true, false or uncertain and explain why:

a- A proportional tax on all commodities including leisure is equivalent to a Lump-sum tax

b- Efficiency is maximized when all commodities are taxed at the same rate.

c- Average cost pricing for a natural monopoly allows the enterprise to break even, but the outcome is inefficient.

d- Tom's workplace provides free access to a fitness room; Jerry's does not, Horizontal equity require that Tom he taxed on the value of having access to the fitness room.

Exercises

Chapter four

Efficient and equitable Taxation

1- According to fairness higher tax rates must be imposed on the goods that the rich people tend to consume it and vice versa.

2- The social welfare function put a higher weight on the utilities of the rich than on those of the poor.

3- The efficient taxation requires that relatively high rates of taxation BE levied on relatively elastic demand.

4- The tax creates an excess burden- a loss of welfare above and beyond the tax revenues collected.

5- An income tax decrease employment

6- If the demand for labor is perfectly inelastic, workers pay the entire amount of the social security tax.

7- If the supply for labor is perfectly inelastic, employers pay the entire amount of the social security tax.

8- If the supply for labor is perfectly inelastic and the demand is perfectly elastic, workers pay the entire amount of the social security tax.

9- The more inelastic demand for a good, the larger is the deadweight loss created by an excise tax levied on it.

10- The more elastic demand for a good, the larger is the deadweight loss created by an excise tax levied on it.

11-Excess burden is sometimes referred to as welfare cost or deadweight loss.

12- If there are no taxes or distortions in the prices of the goods reflect their social marginal costs.

13- Proportional tax is a certain amount that must be paid regardless of the payer's behavior.

14- The revenue yield of lump sum tax equals the equivalent variation.

15- The lump sum tax results in excess burden.

16- The lump-sum tax that leave consumer on the same indifference curve as the proportional tax generate the same revenue for government.

17- The lump sum tax and the proportional tax that raised the same revenue, the lump sum tax would leave the consumer on a higher indifference curve.

18- The tax that changes relative prices generates an excess burden.

19- The tax that changes relative prices is efficient.

20- The lump sum tax is considered fairness tax.

21- With a progressive tax, the decrease in employment and deadweight loss are greater for low – wage workers than high-wage workers.

22- Provision of local public goods usually is financed with excise taxes.

23- The theory of optimal commodity taxation helps determining the optimal rates of taxes on various goods and services.

24- There are negative relation between the marginal excess burden and efficiency.

25- A tax on all commodities including leisure at the same percentage rate, is equivalent to reducing the value of time endowment from WT to $(1/1+t)$ WT.

26- The lump sum tax has no excess burden.

27- Imposing the same rate of tax on all commodities is called neutral taxation.

28- The neutral taxation is efficient.

29- To minimize overall excess burden the marginal excess burden of the last dollar of revenue raised from each commodity must be the same

30- There are negative relation between the tax rate and elasticity according to the efficiency and vice versa in case the fairness

31- Vertical equity means that tax payers in similar financial condition should pay similar amounts in taxes.

32- If lump sum taxation were available, taxes could be raised without any excess burden at all, but there is inefficiency taxation

33- a higher tax should be levied on the commodity that is relatively in elastically supplied

34- Nature monopoly can take advantage of economies of scale and supply the entire industry output

35- Average cost pricing puts the enterprise in break – even point

36- To ensure efficiency, marginal cost pricing should be applied

Part B : multiple – choice questions

Circle the appropriate answer:

1- The income taxes……the employment and…….A deadweight loss

a- increase, do not create b- increase, create

c- decrease, do not create d- decrease, create

2-When the income increases, regressive tax's average tax rate……and an example of a regressive tax is……

a- increase, the income tax b- decrease, the income tax

c- decrease, a sales tax d- increase, a sales tax

3- Suppose that the demand for wine is not perfectly inelastic and that initially 5 million bottles of wine are produced and consumed in the United States. If the government imposes an excise tax of 1$ per bottles of wine the government will collect:

a- more than $5 million in tax revenue

b- $5 million in tax revenue

c- less than$5 million in tax revenue

d- an amount that might be more than, equal, or less than $5 million in tax revenue, depending on the elasticity of demand

4- The products with elastic demands often are lightly because:

a- they usually are goods consumed largely by the poor

b- the amount of the deadweight loss created is large

c- free riders ensure that the government's tax revenue is small.

d- the promise of the question is wrong because products with elastic demands usually are taxed heavily

5- Suppose that Jon consume 12 unit of X and 10 unit of Y, PX = 10 and PY = 8, if the government impose tax 10% on X that jon now consume 5 unit of X, the government revenue is……

a- $4 b- $10 c- $40 d- $32

6- Suppose that the government impose tax on good X, that result in Equivalent variation 100$ and tax revenue 70$, then the excess burden is ……

a- 30 b- 170 c- 100 d- 70

7- Suppose that the government impose tax on good X, that result in tax revenue 120$, and excess burden 30$, then the excess equivalent variation is …….

a- $90 b- 120 c- 30 d- 150

8- If the government impose tax t = 56.25% on all goods, this is equivalent to a reduction of the value of the time endowment by

a- 30% b- 64% c- 36% d- 80%

9- If the government impose tax t = 100% on all goods, this refer to the value of time endowment become……

a- 30% b- 50% c- 70% d- 80%

10- Suppose that the government reduce the tax rate of 56.25% to 25%, this is Equivalent to a change in the value of the time endowment by…….

a- increase by 36% b- decrease by 20%

c- decrease by 56% d- increase by 16%

11- Suppose that there are two goods X and Y in market, the elasticity is 2 and 5 respectively and TX = 10%, the efficient tax on the good Y is

a- 10% b- 20% c- 30% d- 40%

12- Suppose that there are only two goods X and Y and the government impose tax = 20% on them, if the percentage reduction in good X was greater than reduction in good Y this refer to that……

a- X's demand is more elastic than Y's demand

b- X's demand is less elastic than Y's demand

c- X and Y's demand have the same elasticity

d- none of the above

13- Suppose that the efficient that minimize the excess burden is the same rate on X and Y this refer to that……

a- X's demand is more elastic than Y's demand

b- X's demand is less elastic than Y's demand

c- X and Y's demand have the same elasticity

d- none of the above

14- Suppose that there are only two goods X and Y the supply elasticity of X is greater than Y, then to enhance the efficiency

a- higher tax rate should be levied on X and lower tax rate should be levied on Y

b- higher tax rate should be levied on X and higher tax rate should be levied on Y

c- lower tax rate should be levied on X and lower tax rate should be levied on Y

d- lower tax rate should be levied on X and higher tax rate should be levied on Y

15- Suppose that the marginal benefit from anther unit of a public good exceeds the marginal cost of producing it. Then

a- the net benefit from the product is at its maximum, and its provision is at the efficient level

b- the net benefit from the product is at its maximum, but the provision of the product is not at its efficient level.

c- less of the product should be produced because its provision exceeds the efficient level

d- more of the product should be produced because its provision is less than the efficient level.

16- Another term sometimes used for excess burden is

a- welfare cost b- deadweight loss

c- efficiency cost d- all of the above

17- Which of the following is a unit excise tax?

a- a tax of 15%

b- an admissions fee of $2.00 on each ticket purchased

c- an ad valorem tax of $3.00

d- an income tax of $3.00

e- all of the above

18- Taxes

a- are compulsory payments

b- are necessary for financing government expenditures

c- do not directly relate to the benefit of government goods and services received

d- are all of the above

19- A demand curve that is perfectly inelastic is

a- horizontal b- vertical

c- at a 45 degree angle d- parallel to the X – axis

20- In the following which is the characteristic of a tax

a- compulsory b- optional

c- forced d- nationality

21- Which is the main objective of a tax

a- increase in consumption b- increase in production

c- raising public revenue d- reduction in capital formation

Part C: Problem: (Graph if possible)

Problem1

Suppose that the demand equation is QD = 300 – 2P and average cost is AC = 10

Required

1- Determine the profit before tax

2- Determine the tax rate that maximize the revenue for government

3- Determine profit after tax

4- Determine the government revenue

5- Determine the excess burden

Problem2

Suppose that the demand equation is QD = $200 - 2P$ and average cost is AC = 5

Required

1- Determine the profit before tax

2- Determine the tax rate that maximize the revenue for government

3- Determine profit after tax

4- Determine the government revenue

5- Determine the excess burden

Problem3

Suppose that you have the following information QD = $200 - 2P$ AC =10

Required

1- Determine the profit before tax

2- Determine the tax rate that maximize the revenue for government

3- Determine profit after tax

4- Determine the government revenue

5- Determine the excess burden

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Chapter Five

Taxation Prices Efficiency

And Distribution of Income

Chapter five

Taxation, prices, efficiency and the distribution of income

We need to study and understand the following topics in this chapter

1- **Using indifference curve analysis to compare the effects of a lump-sum tax and a price distorting tax**

2- **The impact of taxes on market prices and efficiency**

3- **Excess burden of a unit tax**

4- **Excess burden, unit taxes, and price elasticities**

5- **The efficiency-loss ratio of a tax**

6-**General equilibrium analysis of the excess burden and incidence of taxes.**

Chapter Five

Taxation, Prices, Efficiency and the Distribution of Income

Taxes affect the decision to buy and sell products and inputs. By shifting market supplies or demands of goods and services, taxes inevitably change the prices and thereby influence the pattern of resource use. However, the effects of taxes on prices are often quite misunderstood. For example, many motorists line up at the gas pumps to fill up their tanks benefit a new gasoline tax increase goes into effect. A go understanding of the economics of taxation would be these people that it is unlikely that a gasoline tax increase would increase the price of gasoline by the amount of the tax. Some of the tax would be absorbed by sellers as a reduction in the net price received after paying the tax. For example, luxury car makers, such jaguar, subjected to increased competition because the introduction of new luxury car brands, such as Lexus, by Japanese sellers in the U.S. market, actual ran advertisement saying that they would abase all of a luxury tax on their cars and not increase the price to cover the tax. The demand for Jaguars very simply too elastic to risk a rise in price to covers the cost of the luxury tax.

Taxes can cause a loss in efficiency in private use of income and resources. When taxes influents the prices of goods and services traded in competition markets with no externalities, losses in efficiency likely to result, this is because, as demonstrated in the chapter, prices that are distorted by taxes no long simultaneously reflect the marginal social costs a benefits of goods and services, simple technique are developed in this chapter to measure the loss in wellbeing when taxes prevent the attainment efficiency through market interaction.

No person enjoys paying taxes. Taxes, however do provide revenues to finance government-supplies goods and services, which, in turn, benefit taxpayer. Although this is true, the impact of taxes on the well-being of those who pay them can be analyze independently of the benefits received from the use of tax revenues. this is the approach that is usually pursued in the economic analysis of taxes.

Finally, to evaluate the fairness of taxation, it is necessary to determine the actual impact of taxes of the incomes of citizens. This is no easy task. The people from whom taxes are collected are not necessary those whose income are reduced by taxation, because the impact of taxes on prices can result in a transfer of the payment of a tax

from those groups from which the tax is collected. For example, an excise tax on gasoline is commonly collected from distributors of that product. However, if the tax has the effect of decreasing the supply of gasoline, it will increase the market price of the product. By doing so, the tax will make consumers of gasoline worse off by decreasing their real incomes. the analysis in this chapter shows how changes in prices caused by taxes can be considered to determine the distribution of taxes paid among buyers and sellers of goods. The techniques and terminology developed here are used to discuss important current issues in tax policy in part IV.

Lump-Sum Taxes: A Benchmark Standard for Comparison

A lump-sum tax is a fixed sum that a person would pay per year, independent of that person's income, consumption of goods and services, or wealth. The fixed annual payments by people to government authorities do not depend on any controllable variable. Lump-sum taxes do not prevent prices from equaling the marginal social cost and benefit of any goods and services. Imposition of these taxes would reduce the ability of consumers to purchase market goods and services and to save. But these taxes influence choices only through income effects. As

shown in this chapter, no substitution effects result from a lump-sum tax. therefore, a lump-sum tax does not provide any opportunity or incentive to substitute one activity for another.

Lump-sum taxes, however, do force those bearing the burden of taxation to reduce consumption, saving or investment. Yet they accomplish this objective without distorting prices in ways that prevent marginal social costs of goods and services from being set equal to their marginal social benefits. for this reason, the lump-sum tax is used as the benchmark against which the effects of price distorting taxes are compared lump-sum taxes do not prevent the attainment efficiency in markets.

Lump-sum taxes are likely to affect the distribution of income: therefore, they move the economy to a no efficient allocation of resources consistent with the pattern of demand that result from the income distribution. A head tax is an example of a lump sum tax that would require all adult to pay an equal amount each year to governing authorities. In no way could taxpayers rearrange their economic affairs to avoid or reduce the tax burden,[41] a head tax would not distort any

[41] This assumes that migrations to another country to avoid the tax is impossible or that person migrating would have to pay the discounted present value of future tax liabilities under the head tax before being permitted to migrate

prices in ways that prevent markets from achieving efficiency. Nevertheless, when a head tax is used, the after – tax distribution of income will be less equal than the before –tax distribution of income. Such a tax would necessarily be regressive with respect to income, because the tax, as a percentage of income, would fall as income rose.

For example, total revenues raised by the federal government in the United States in 2000 were $\$2$ trillion. If there are 200 million adults, raising that amount with a head tax would have required each of them, without exception, to pay a tax of $\$10{,}000$ per year. The average tax rates (ATRs) would amount to 50 percent for a person whose annual income was $\$20{,}000$ but only 10 percent for a person whose annual income was $\$100{,}000$. The ATR would decline with a person's annual income. The marginal tax rate (MTR) associated with a lump-sum tax is always zero. Regardless of any change in a person's income, consumption, or wealth, a lump-sum tax causes no change in the tax due.

Lump-Sum Price-Distorting Taxes: Indifference Curve Analysis.

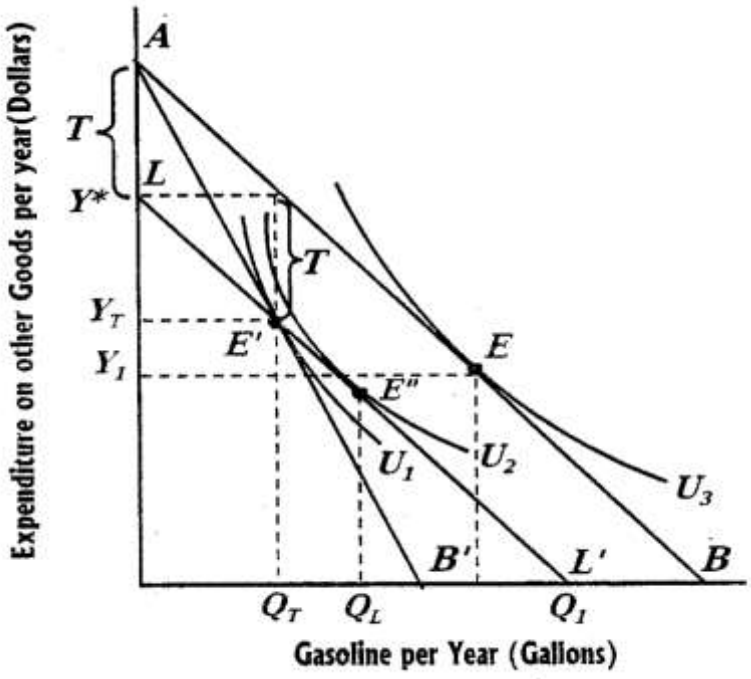
A price – distorting tax is one that causes the net price received by sellers of a good or service to diverge from the gross price paid by

buyers. Indifference curve analysis can be used to compare the effects of a lump-sum tax and a price –distorting tax, each collecting the same amount from a person. Suppose a price distorting tax imposed on some good, say gasoline, the proceeds which are used to finance government – supplied service in figure 1 the tax is assumed to increase the curve market price of gasoline, which swivels the consumers budget constraint line from AB to AB'. The amount of tax paid by the person whose indifference curves a drawn in figure 1 is influenced by the quantity of gasoline purchased per year. The gross price paid by the buyers includes the tax. The net price received by sellers is the gross price minus the tax. The tax – induced price increase affects the consumer's choice of consuming gasoline or spending available income on other goods. The consumer enjoys an annual income represented by the distance OA. This gives the dollar amount of expenditure on goods other than gasoline that the consumer could buy if she purchases on gasoline in one year.

The consumer is initially in equilibrium at point consuming Q_1 gallons of gasoline per year and spending Y_1 on all other goods per year. The amount spent on gasoline per year prior to the tax is AY_1 . this is the difference between her total annual income and her annual

expenditure on other goods. The tax – induced price increase causes her to move to a new equilibrium at E', where she reduces annual consumption of gasoline to Q_T gallons. The person now spends AY_T on gasoline each year at the price including the tax, leaving Y_T to spend on other goods each year. If the tax were not present, she would have to give up only AY* expenditure.

A Price –Distorting Tax Versus A Lump-Sum Tax



A lump –sum tax that collects T in taxes from a person allows that person to attain a higher level of well-being than a price distorting tax that collects the same amount. The loss in well-being due to the substitution effect of the price distorting tax is its excess burden

On other goods to obtain the same amount of gasoline per year. Of her total expenditure on gasoline, the distance Y_TY* = T represents the annual gasoline tax payments. This equals the difference between the amount of income she must give up to buy Q_T gallons of gasoline per year when the price includes the tax and the amount that she would give up for Q_T gallon in the absence of the tax. T is also the difference between the amount sellers receive for the Q_T gallons AY*, and the amount the consumer actually spends AY_{T**} the effect of the tax is to reduce the consumer's utility from U_3 to U_1, reduce her consumption of gasoline from Q_1 to Q_T gallons per year, and reduce her annual after – tax income from QA to (OA T)

If T per year were collected from this person as lump-sum tax, neither the price of gasoline nor the price of any other good would be distorted. No difference would result between the gross price paid by buy and the net price received by the seller. The lump-sum tax merely would reduce the income of the taxpayers shifting her budget constraint line down, parallel itself, from to LL'. All points along LL' collect the tax by reducing the consumer's income by that amount independent of the amount of gasoline per year she purchases.

Figure 1 shows that the person is better off under the lump-sum tax than under the price distorting tax if both collect T per year. With the lump-sum tax, the taxpayer attains an equilibrium at point E", where she achieves utility level U_2 and consumers Q_1. Gallons of gasoline per year. Provided that gasoline is a normal good, the decrease in income caused by the lump-sum tax results in a decline in its consumption. However, because $Q_1 > Q_T$, she consumes more gasoline per year than when she paid the price distorting tax. Although the lump-sum tax reduces the taxpayer's income, it causes no substitution effects, because it does not affect the relative price of gasoline or any other good service. The taxpayer consumes more gasoline than she did under the price distorting tax, because the price she pays is lower under the lump-sum tax, because the consumer has the same disposable income under the two taxes but consumes more gasoline per year under the lump-sum tax, it follows that she must be better off when paying T in annual taxes under the lump sum tax. This is shown in figure 1 in that the level of well-being at E" under the lump-sum tax is $U_2 > U_1$. Thus, provided both taxes collect the same amount from the taxpayer, the lump-sum tax will be preferred by the taxpayer.

The loss in well-being of the taxpayer when she pays T in taxes under the price –distorting tax instead of under the lump-sum tax is the individual excess burden of a tax the excess burden measures the loss in well-being to a taxpayer caused by the substitution effect of a price –distorting tax. The excess burden of the price –distorting tax is the reduction in well –being the taxpayers from U_2 to U_1 when the price distorting tax is used instead of the lump-sum tax.

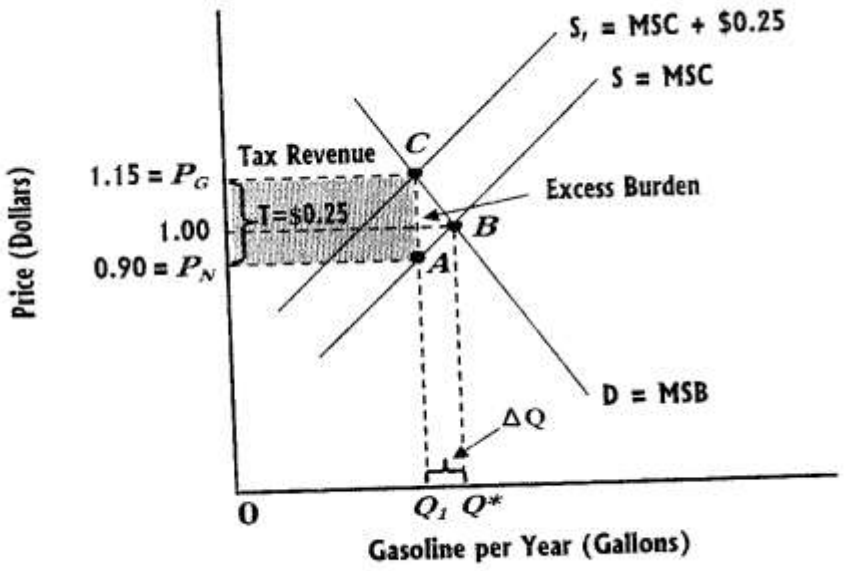
The Impact of Taxes on Market Prices and Efficiency a Unit

Excise Tax: Impact on Market Equilibrium

Suppose a good such as gasoline is traded is trade in a competitive market and that no externalities and associated with market exchange of gasoline. Under these conditions, markets exchange of gasoline results in the efficient output of this good. This is illustrated in figure 11.2, with a market price of gasoline at $\$1$ per gallon. the demand curve, D reflects the marginal social benefit of the good, while the supply curve, S, reflect, its marginal social cost. The market equilibrium at point B corresponds to the efficient amount of gasoline per year. At the output Q*, the marginal social benefit of gasoline is equal to its marginal social cost. The $\$1$ price of gasoline equals both the

marginal social cost and marginal social benefit of gasoline (P = MSB = MSC). Seller of gasoline. This fixed tax due on each gallon sold independent of the price of gasoline. If the price of gasoline were to rise, the tax would not collect any more revenue per gallon. taxes that are a percentage of the price of a good or service are analyzed later in this chapter.

Impact of A Unit On Market Equilibrium



A unit tax of 25 cents on gasoline collected from sellers decreases the market supply of the good and increases the price. The market price, P_C paid by buyers increases from $\$1.00$ to $\$1.15$. After payment of the tax, the net price received by sellers falls to 90 cents. If ΔQ is the reduction in output due to the substitution effect of the tax, then the area ABC measure the excess burden of the tax.

When the tax is imposed, the marginal cost of selling gasoline increases by 25 cents per gallon because of the tax. In addition to covering all other variable costs of production, sellers also must cover the tax to avoid losses when selling gasoline this shifts the supply curve (which is the marginal cost curve under perfect competition)upward, from S = MSC to S_T = MSC + 25 cents at each level of annual output. The effect of the tax is equivalent to an increase in the marginal cost to sellers that decreases the market supply of gasoline.

The decrease in supply results in a new post tax equilibrium at C, implying that the quantity sold decreases to Q_1 and that the equilibrium price rises to P_G = $\$1.15$. The price P_G is the new market price paid by consumers of gasoline. This is the gross price received by sellers, however, must pay 25 cents of the gross price received as a tax. Their net price, P_N , is only 90 cents per gallon after payment of the tax. In general, if T is the unit tax, the relationship between the gross price and the net price P_n , received by sellers is.

$$P_n = P_G - \mathrm{T}. \qquad (1)$$

the amount of revenue collected from the tax y the government is the amount of gasoline sold after the tax multiplied by the tax per unit, TQ_1. This is represented by the rectangle $P_N P_G$CA in figure 2. The total

revenue of producers is simply $P_N Q_1$. For example , if Q_1 is 10 million gallon of gasoline per year, the tax would collect $\$2.5$ million annually. Total revenue taken in by sellers after paying the tax would be $\$9$ million per year.

Excess Burden of a Unit Tax

When the excise tax of $\$0.25$ is imposed, buyers and sellers than base their decision on their differing views of the price of gasoline. Buyers decide how much to buy by comparing P_G the gross price with their marginal benefit sellers, however, decide how much to sell by comparing their net price P_N, with marginal cost. in the absence of any externality the marginal cost and benefit reflect marginal social cost and benefit. The tax prevents markets interaction among buyers and sellers from automatically equating marginal social cost and marginal social benefit, as is required to attain efficiency. because P_G > P_N after the tax, it follows that MSB > MSC at Q_1 as shown in figure 2. As a result of the tax less than the efficient annual output, Q*, of gasoline will be sold in the market.

The total excess burden of a tax is an additional cost to society over and above the amount of dollars that citizens pay in a tax, the

excess burden measures the loss in net benefits from private use of resources that results when a price-distorting tax prevents markets for taxed goods and services from attaining efficient output levels.

The total excess burden of a unit tax is the loss in well-being to buyers and sellers in a market over that which they would suffer if a lump-sum tax were used to collect the revenues. A lump-sum tax would not prevent the attainment of efficiency in markets because it causes no substitution effects, if this benchmark type of tax were, no difference would result between the price paid by buyers and that received by sellers.

Figure 2 shows how the excess burden of the unit tax can be measured. Assume the income effect of the tax –induced price increase on the consumption of gasoline is negligible. This implies that the observed reduction in the quantity of gasoline consumed entirely reflects the substitution effect of the tax- induced price increase. The efficient output is Q*. This means that increasing output from Q_1 to Q* would allow increments in well-being that exceed the incremental social costs. The price-distorting excise tax prevents the achievement of net gains, represented by the difference between the marginal social benefits and the marginal social costs of $\Delta Q = Q^* - Q_1$ gallons of gasoline. The

total excess burden of the price distorting tax can be represented by the area of the triangle ABC in figure 2. This area represents the net loss in well-being to buyers and sellers of gasoline due to the substitution effect of the tax.[42] It is a measure of the loss in efficiency in the gasoline market attributable to the price distorting gasoline tax.

When the excess burden is positive, the total burden of tax on buyers and sellers in a market exceeds the tax revenues collected. even if the total tax revenues collected were returned to buyers and sellers of gasoline as a lump –sum payment of TQ_1 (represented by the area $P_N P_G$CA figure 11.2), the ecess burden would not be recovered . for this reason, the total excess burden of a tax sometimes is called a deadweight loss. It is a loss in efficiency that cannot be regained even if tax revenues collected provide benefits equal in dollar amount to the amount paid by citizen in taxes.

Call W the area of triangle ABC. The area W is

$$W = \frac{1}{2} T\, T\Delta Q_1 \qquad (2)$$

Where T, the tax per unit, is the base of triangle ABC, and ΔQ, measuring the decrease in the consumption of gasoline because of the

[42] When the income effects of tax induced price changes cannot be ignored ΔQ must e estimated along a compensated demand curve. The relationship between price and quantity demanded for which the income effect of price changes has been how removed is the compensated demand curve. The appredix to this chapter shows compensated demand curves are derived.

substitution effect of the tax – induced price increase, is its height. For example, if ΔQ is 2 million gallons per year, the excess burden of the tax would be $\$250{,}000$ per year.

The Excess Burden, Unit Taxes, and Price Elasticities

The excess burden actually varies more than proportionately with the unit tax T, because ΔQ depends on increase in price, ΔP, caused by tax because ΔP depends on the amount of the tax per unit, ΔQ also depends on T . The higher the unit tax other things being equal, the greater is the annual reduction in gasoline (or any taxed good) sold. The reduction in output that results from the substitution effect of a price-distorting tax can be predicted with estimates of the price elasticities of demand and supply of taxed goods.

A bit of algebraic manipulation (see the appendix to this chapter) can show the excess burden of a tax depends on the unit tax, initial prices and quantities traded, and price elasticities of supply and demand. As derived in the appendix, the resulting formula for the excess burden of a unit tax is.

$$W = \frac{1}{2}\, T^2\, \frac{Q*}{P*}.\, \frac{E_S E_S}{E_S E_S} \qquad (3)$$

Where $E_S$is the price elasticity of supply, E_D is the price elasticity of demand, Q* is the pretax quantity, and P* is the pretax market price of the taxed good. Because the price elasticity of demand is a negative number, the change in well-being that results from the excess burden will be equal to or less than zero, indicating a loss.[43]

According to Equation 3, the excess burden of a tax varies quadratically with the unit tax. If the unit tax on a good, such as gasoline, were to double from 25 cents to 50 cents, the loss in well-being from the excess burden of a tax could be expected to increase fourfold other things being equal, the losses due to the excess burden of a tax increase at a faster rate than the rate of increase of a tax. the formula for the excess burden also indicates that, other things being equal, the loss in well–being due to the excess burden of a tax is greater the more elastic the demand for good. Similarly, other things being equal, the greater the price elasticity of supply, the greater is the loss due to the excess burden of a tax. Assuming that income effects are negligible, any commodity for which either $E_S = 0$ or $E_D = 0$ has a zero efficiency loss. The most efficient taxes are those levied on commodities or inputs that are in inelastic supply, demand, or both. In

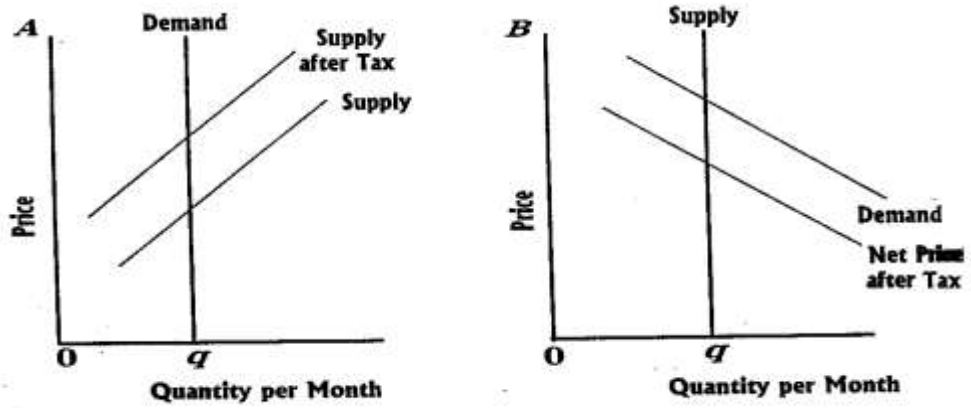
[43] The elasticities must be based on changes in output due only to the substitutions effects of tax-induced price increases in cases for which income effects of the price increases are not negligible.

general, to minimize the excess burden of a tax, goods and services for which minimal substitution effects are likely should be taxed.

The algebraic result is in accord with commonsense reasoning. The less the opportunity or willingness to substitute other goods and services for those that are taxed, the less is the distortion introduced into the economy with respect to resource allocation. On efficiency grounds, the best taxes are those levied on goods that have few substitutes in either production or consumption.

The graphs in Figure 3 show that the excess burden of a tax would be zero if either the demand or supply of a tax product were perfectly inelastic. in the case of a perfectly inelastic demand shown in Figure 3A, the tax causes the price to rise, but because quantity demanded is not reduced, the change in output is zero and the excess burden is also zero. The more inelastic the demand for a taxed good or service, the smaller the area of the triangle that represents the excess burden of the tax.

Excess Burden When Demand or Supply Is Perfectly Inelastic



The more inelastic the demand or the supply of a taxed item, the lower the excess burden. As either the price elasticity of demand or the price elasticity of supply approaches zero, the excess burden of the tax approaches zero because the reduction in quantity sold as a result of the tax approaches zero

In Figure 3B, the tax is represented by a decline in the net price received by sellers and is subtracted from the price paid by buyers, which is represented by the markets demand curve. When the market supply is perfectly inelastic, sellers suffer a net reduction in the price received for the item they sell, but they do not after the quantity supplied in response. As a result, their net revenue from selling the product falls but no change occurs in the quantity of the product made available to buyers. Also, the excess burden is zero because the change in the amount of the product sold as a result of the tax is zero. In general, the

more inelastic the supply of an item, other things being equal, the smaller the reduction in the quantity sold after the tax and the smaller the excess burden.

The Efficiency Loss Ratio of a Tax

To compare the relative loss in efficiency of various taxes, economists often calculate the excess burden per dollar of tax revenue. The ratio of the excess burden of a tax to the revenue collected each year by that tax is called the efficiency –loss ratio of the tax (W/R):

$$\frac{W}{R} = \frac{Excess\ Burden}{Tax\ revenue}$$

An efficiency –loss ratio of 0.2 means that the excess burden of a tax is 20 cents for each dollar of revenue raised per year. The efficiency –loss ratio of tax sometimes is called the coefficient of inefficiency of the tax.

Estimates of the efficiency-loss ratios of different kinds of taxes are extremely useful in achieving the goal of minimization of the total excess burden of taxation. By reducing use of taxes with high excess burdens per dollar of revenue while increasing use of taxes with lower excess burdens per dollar, the total excess burden of the tax system can be reduced without sacrificing revenues. for example, suppose that the

efficiency –loss ratio for taxes on interest income is estimated to be 0.33, while the efficiency –loss ratio for taxes on gasoline is only 0. Each extra dollar of revenue gained from increasing gasoline taxes results in an excess burden of 10 cents. On the other hand, each dollar increment in revenue obtained from taxes on interest income is associated with an increase of 35 cents in excess burden. if follows that, on the margin, each dollar reduction in taxes on interest made up by a dollar increase in taxes on gasoline results in a net reduction of total excess burden equal to 25 cents. Estimated efficiency-loss ratios for taxes thus can be used to recommend policy changes that will result in net gains in well- being.

One study of the US. Tax system estimated that the excess burden per dollar of tax revenue ranged from 13 cents to 24 cents per dollar of revenue in the mid -1970s and was running at about 18.5 cents in the mid – 1980s.[44] based on the tax laws and the tax rates effective in 1973, Ballard, Shoven, and Whalley concluded that the present value of the gain in well-being that would have been possible by replacing the tax system of 1973 with a system of lump-sum taxes would have been

[44] Charles L. Ballard. John B. Shoven, and John Whatley," the total welfare cost of the United States Tax System: A General Equilibrium Approach, "National Tax Journal 38 (June 1985):125-140. Also see Don Fullerton and Diane Lim Rogers, who bears the lifetime: Tax burden? (Washington, DC.: The Brookings institution, 1993)163-170.

between $1.86 trillion and $3.36 trillion! The range of their estimates varies with assumptions made about price elasticities in their various simulations of the impact of taxes on the economy.

They found that the taxes on interest and investment income caused the greatest distortion in 1973. The average rate of taxation of capital income was about 45 percent in that year. Since that time taxes on capital income have been reduced substantially compared with the levels that prevailed in 1973. Depending on the assumption made about the interest elasticity of supply of savings, the efficiency loss ratio for taxes on industrial capital income in 1973 ranged from 15 to 35 cents per dollar of revenues collected.

The researchers concluded that savings would be 80 percent higher if a lump sum tax collected the same revenue as that collected by the U.S. tax system in 1973. This estimate is based on tax rates of 1973 and on an interest elasticity of saving supply of 0.4. In their simulations, over 100 years the higher savings would increase the ratio of capital to labor in production by 31 percent. This would. This would contribute to higher labor productivity and higher wages for workers.

A study by the Joint Economic Committee staff of the U.S. Congress in 1999 concluded that the marginal efficiency loss of federal taxation in the United States as of the late 1990s was in the range of 25

to 40 cents for each additional dollar of federal revenue raised[45]. The researchers also concluded that the federal tax system was based against saving and investment. As was the case in the 1970s, the U.S. tax system still taxes saving and investment more heavily than consumption. The efficiency loss of taxes on capital is higher than that on consumption because of the higher rates of taxation.

Research on the excess burden of taxation by Martin Feldstein takes a more inclusive approach to the concept and finds much higher excess burden at tax rates prevailing in the United States as of the mid-1990s. Feldstein argues that the excess burden stems for reallocation of resources away from taxed activities toward untaxed activities. For example, tax rates can influence occupation choices by discouraging people from taking high-wage jobs because of the high tax rates on that income. High tax rates on money income also encourage workers to seek compensation such as good working conditions and more fringe benefits such as health insurance. When tax rates are high, some people might choose to retire earlier than they would under lower tax rates.

For tax deductible activity, taxpayers are encouraged to engage in those activities beyond the point at which their marginal benefit falls to their marginal cost. For example, if a person is subject to a 40 percent marginal tax rate (MTR) on income, and if interest on borrowing money to buy a home is tax deductible (as it is in the United States), then this

[45] US congress Joint Economic Committee Study "Tax reduction and the economy" (July 1999) also see Richard vedder and Lowell Callaway, the size and function of government and economic growth, joint economic committee (April 1998).

person is encouraged to borrow until the marginal benefit of doing so falls to 60 cents per dollar borrowed. This $1 of interest paid will cost only 60 cents after taxes are reduced by the remaining 40 cents. Although the marginal cost of the borrowing remains $1, the individual rationally continues to borrow until the marginal benefit falls to 60 cents the net price after tax. The tax system induces you to give up a dollar for something that is only worth 60 cents – an excess burden of 40 cents on the dollar.

Feldstein argues that the excess burden of taxation depends on the elasticity of demand for tax-favored goods (those activities which reduce your tax bill if you engage in them) with respect to the net of tax price. With estimates of these relevant elasticities, Feldstein concludes that the excess burden per additional dollar of tax revenue raised for US. Tax system in 19994 was $1.65. With a marginal excess burden of $1.65, the total cost of raising a dollar of tax revenue would be $2.65: $1.00 for the tax and an additional $1.65 in lost net benefits as the higher tax rates induce greater pursuit of activities for which marginal benefit falls short of marginal cost.[46]

Incidence of a unit tax

As illustrated in figure 2, a unit tax can cause the market price of the taxed good to change. Tax-induced price change reduces the real incomes of groups other than those from whom the tax is collected. The shifting of a taxis the transfer of the burden of paying a tax from those who are legally liable for it to others. When a tax is shifted, those liable

[46] See Martin Feldstein How Big Should government be? National tax journal 50.

for its payment succeed in recouping some of the reduction in their income caused by tax payments through changes in the prices of items that they either buy or sell. These changes in prices are caused by tax-induced shifts in either supply or demand.

Forward shifting of a tax is a transfer of its burden from sellers who are liable for its payment to buyers as a result of an increase in the price of the taxed. Good for example, in Figure $11{,}2$ the price of gasoline increases as a result of a tax levied on sellers, thereby shifting part of the burden to buyers. Backward shifting of a tax is a transfer of its burden from buyers who are liable for its payment to sellers through a decrease in the market price of the taxed good. For example, if employers are liable for payroll taxes on wages paid to workers, they will succeed in shifting part of the burden of the tax to sellers of labor services (workers) if wages decline as a result of the tax. The incidence of a taxis the distribution of the burden of paying it

In Figure 2, the market price of gasoline increased from $\$1.00$ per gallon to PC = $\$1.15$ per gallon at the post tax market equilibrium. As a result, sellers succeeded in shifting 15 cents of the tax of 25 cents per gallon to consumers. The remaining 10 cents of the tax per gallon was borne by sellers as the net price PN that they received declined from $\$1$ to 90 cents per gallon. The incidence of the tax per gallon was shared by buyers and sellers of gasoline. Although the entire tax of 25 cents per gallon is collected from sellers, they recoup 15 cents of the tax per gallon through the increase in the market price of gasoline. The total tax revenues collected can be represented by the rectangle $P_N P_G$CA. The

upper portion of the rectangle represents the part of total tax revenues that, in effect, is paid by buyers of gasoline. This is the 15 cents per gallon portion of the unit tax that is shifted to buyers multiplied by the annual consumption of gasoline. If after the tax is imposed 10 million gallons of gasoline are sold per year, consumers pay $\$1.5$ million of the $\$2.5$ million in tax revenue. The remaining $\$1$ million per year is paid by sellers.

Ad valorem taxes

Ad valorem taxes are levied as a percentage of the price of good or service. For example, retail sales taxes are ad valorem taxes levied as certain percentage of the price received by sellers of a good. Similarly, the payroll tax is an ad valorem tax because it is levied as a percentage of wages paid by employers. The higher the price of the taxed good or service, the greater the amount of the per unit under ad valorem taxation.

The preceding analysis for a unit tax is easily applicable to ad valorem taxes. Suppose consumers must pay certain percentage of the market price of gasoline as a tax. In this case, the Amount of tax collected per unit of output, T, is the tax rate, t, multiplied by the gross price paid by consumers of the product.[47]

$$\text{T} = tP_G = \text{tax revenue per unit of output} \qquad (5)$$

[47] In many cause , the tax is levied on the net price, P_N, received by seller . sellers. For example, under a retail sales tax, the actual gross price paid by consumers includes the tax that is levied as a percentage of the net price received by retailers , in such cases T = tP_N

Where P_G is the gross price paid by consumers. For example, if a flat-rate tax of 10 percent were levied on gasoline, the amount collected would be 10 cents per gallon if the market price of gasoline paid by buyers were $\$1$ per gallon. However, if the market price paid by buyers were $\$2$ per gallon, the same tax of 10 percent would collect 20 cents per gallon. An ad valorem tax automatically collects more revenues per unit of the taxed item when the market price of that item increases.

Substituting equation 11.5 for the tax per unit in equation 11.3 for the excess burden of a unit tax gives.

$$W = \frac{1}{2}\ t^2 P_G^2 \frac{Q*}{P*}\ \frac{E_S - E_D}{E_S - E_D} \qquad (6)$$

For taxes that result in very small changes in price so that the difference between the initial market price, P_G , and the post tax market price is negligible, the excess burden of the tax can be approximated by the following equation, which is derived from Equation 11.6, by setting P_G = P*

$$W = \frac{1}{2}\ t^2 (P^* Q^*)\ \frac{E_S - E_D}{E_S - E_D} \qquad (7)$$

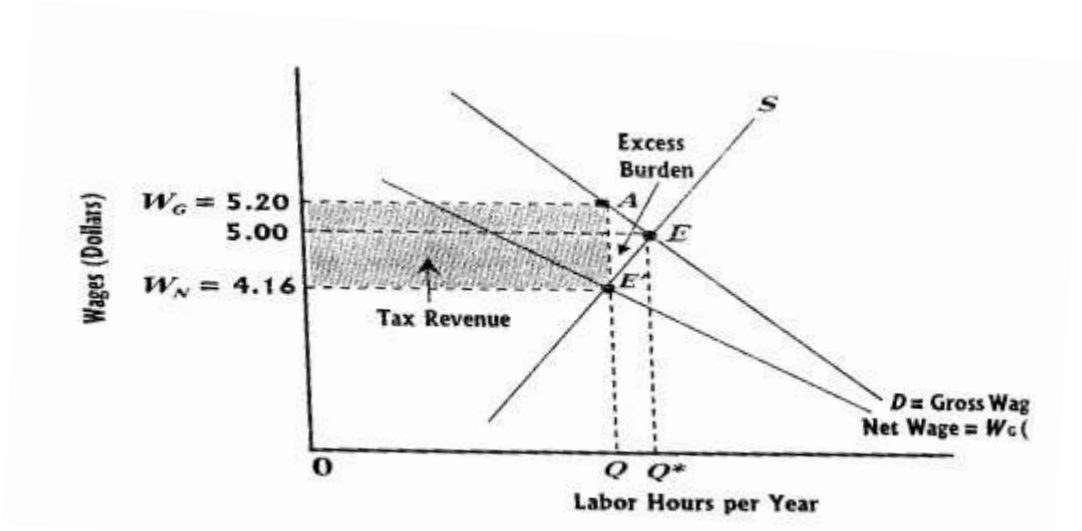
P*Q* is the total expenditure on the taxed commodity prior to the tax. Economists often use a formula like this one to estimate the excess burden that results from ad valorem taxes levied on the sale of goods or services.

As with the unit tax, the loss due to the excess burden of an ad valorem tax varies with the square of the tax rate. To. Predict the loss due to the excess burden of an ad valorem tax, equation 11.7 requires estimates of the relevant price elasticities of supply and demand of the taxed item and data on current expenditure on the item to taxed.

Ad valorem taxes on labor

Figure 11.4 shows the impact of an ad valorem tax on market equilibrium. Suppose all wage earned are subject to a flat-rate tax of 20 percent deducted from the wages of workers. The tax is collected from workers rather than employers. the tax can be thought of as a reduction in the gross wage received by workers for each hour of work. This is similar to the payroll tax used to finance social security benefits.

Impact of an Ad valorem Tax on Labor



A payroll tax equal to 20 percent of wages collected from workers decreases the wage received by workers from W_G to W_N (1 – t) for each hour worked per year. Workers respond to the reduction in their take-home wage by reducing the quantity of labor hours supplied per year. Part of the tax burden is shifted to employers as the market wage increase from $5.00 per hour to $5.20 per hour.

In Figure 4, the actual demand curve for labor indicates the gross wage that employers would pay for each yearly amount of labor hours. The pretax equilibrium is at point E, where workers of given skill earn $5 per hour and Q* labor hours are employed per year. A tax of 20 percent would reduce the net wage received for any amount of work per week to 80 percent of the gross wage that employers actually pay. In Figure 4, the curve labeled Net wage shows the actual wages received by workers after the tax has been deducted from the gross wage paid by employers. The tax per labor hour is represented by the difference between the gross wage curve and the net wage curve. In general, the following relationship exists between the gross wage, WG, at any level of employment and the net wage W_N:

$$W_N = W_G(1 - t) \qquad (8)$$

Where t is the tax rate. As the gross wage increases, the actual tax per labor hour paid, tWG, increases. This is why the difference between the gross wage curve and the net wage curve increases as gross wage increases. For example, if the market wage were only $2 per hour, the tax collected per labor hour would be only 20 cents under a tax rate of 10 percent. At a wage of S10 per hour, the same tax rate would collect $1 per labor hour at the same rate of percent.

Workers base their work- leisure choices on the net wage; employers decide how much labor to hire on the basis of the gross wage. The posttax market equilibrium corresponds to point E', at which the Quantity of labor that workers are willing to supply based on their net wage equals the quantity of labor that employers are willing to hire

based on the gross wage. At the posttax equilibrium, the market wage, WG' increases to $\$5.20$ per hour but the wage received by workers WN id only 80 percent of that amount, or $\$4.16$ per hour. The quantity of labor hired declines from Q* to $\boldsymbol{Q_1}$ hours per year because workers decrease the quantity of labor hours supplied per year as a result of tax, they succeed in shifting part of its burden of payment forward to employers as the market wage rises to $\$5.20$ per hour.

The loss due to the excess burden of the tax could be estimated as the area of the triangle AEE in Figure 4. Actual estimate of the tax would require an estimate of the reduction in hours worked due to the substitution effect of the tax-induced wage reduction.

Further analysis of tax incidence

Tax incidence is independent of legal liability for taxes

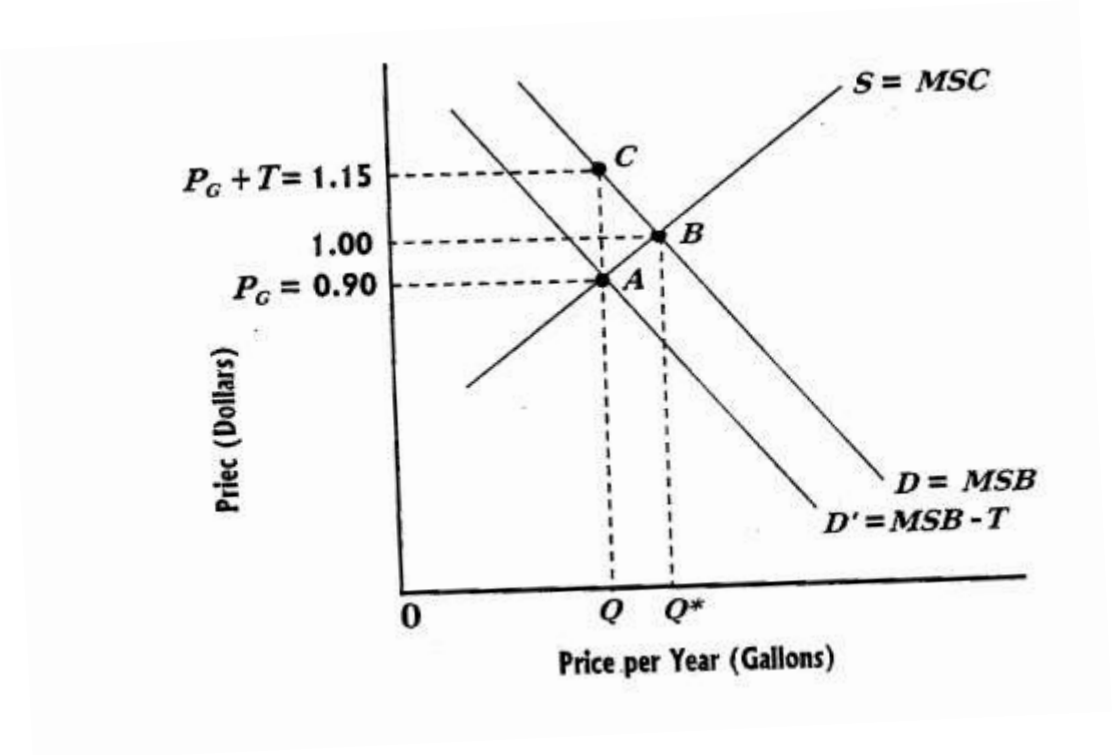
The final incidence of a tax is independent of whether the tax is collected from buyers or sellers of goods and services. To see this, suppose the unit tax on gasoline discussed earlier in this chapter were collected from buyers instead of sellers this would be the case if the tax were added on to the market price of gasoline. Buyers would pay the market price plus the tax for each gallon purchased. The tax can be thought of as being deposited in a box near each gas pump to be picked up each day or week by the tax authorities. the tax is the legal liability of buyers, not sellers.

When the tax is collected from buyers in this way, the marginal cost to sellers does not increase. Instead, the tax is subtracted from the marginal benefit that consumers get from each gallon of gasoline. Therefore, the maximum price that any buyer would pay for a gallon of gasoline, no matter how much was available, would fall by exactly 25 cents. Assume that the marginal benefit received by consumers also equals the marginal social benefit of the good.

Figure 5 shows that the demand curve D would shift downward to MSB – T subtracting T from the marginal social benefit of each quantity gives the net marginal benefit that consumers would get from gasoline after paying the tax. They now base their decision to buy gasoline on their net marginal benefit. The pretax market equilibrium corresponds to point B. the decrease in demand caused by the tax results in a new market equilibrium corresponding to point A. at that point, the market price of gasoline falls to 90 cents per gallon. This is now the gross price received by sellers, because they are not liable for the tax. This is exactly the amount that sellers received per gallon, after taxes, when they were liable for the tax (see Figure 2)! However, the total amount paid by buyers for each gallon is $1.15, because in addition to paying the market price of 90 cents per gallon, they also have to pay the tax of 25 cents each gallon that they purchase. This corresponds to point C on the original demand curve D. the total amount that buyers pay per gallon, including the tax, is exactly the same as the market price of gasoline that would prevail if the tax were collected from sellers.

When the tax collected from buyers, the decrease demand for gasoline caused by the tax results in backward shifting from buyers to sellers as the market price of gasoline declines. However, the distribution of the burden of the tax between buyers and sellers is exactly the same as when sellers were liable for the tax.

Incidence of a tax collected from buyers



The incidence of a tax is independent of whether it is collected from buyers or sellers, here, a 25 cent unit tax on gasoline is collected from buyers. This causes a decrease in the demand for the good. The market price received by sellers falls to 90 cents per gallon. The total price paid by buyers, including the tax goes up to $1.15. this result in exactly the same distribution of tax burden that prevailed when the tax was collected from sellers (see figure 2)

Tax incidence and price elasticities of demand and supply

Other things being equal, the more inelastic the demand for taxed good or service, the greater the portion of the tax borne by buyers. This is shown in figure 6. The demand curve labeled D’ is more inelastic at any price than the demand curve labeled D at each price. However, D' Intersects the pretax supply curve, S, at point B. Therefore, the pretax price would be the same no matter which demand curve prevailed. Suppose the taxed good is once again gasoline. When the demand curve D prevails, a 25 cents per gallon tax increases market price to $1.15 and results in a 90 cent net price to sellers. The same tax of 25 cents per gallon that is collected from sellers would result in a sharper increase in market price when the more inelastic demand curve D prevails. The posttax market equilibrium would correspond to point E when the market demand curve is D'. The market price paid by buyers would be $1.20 per gallon under those circumstances. The net price that sellers would receive would be 95 cents per gallon. the more inelastic demand allows the sellers to shift 5 cents more of the tax per gallon to buyers than they could when demand was D, because buyers are less responsive to price increases when demand is more inelastic. in Figure 11. 5 ΔQ' , the reduction in quantity demanded due to the tax when the demand curve is D', is less than ΔQ' , the corresponding reduction when the demand curve is D.

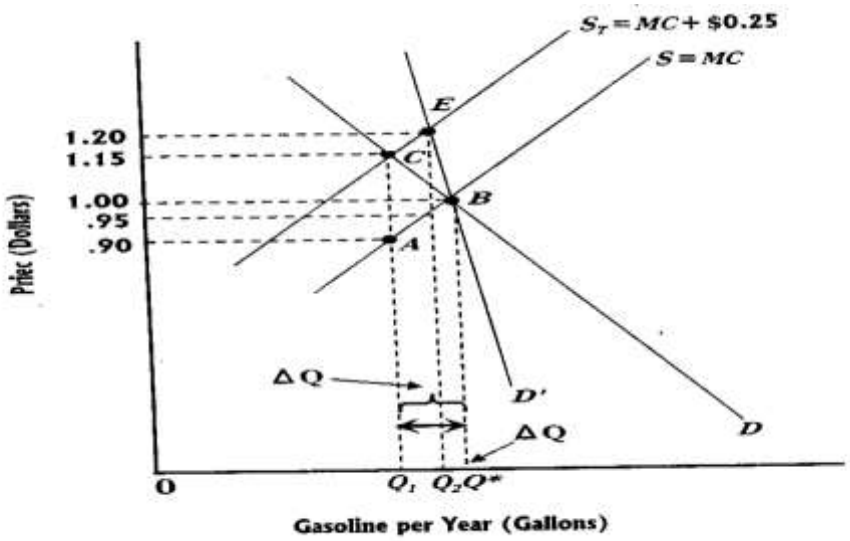
Also, other things being equal, the more elastic the supply of a taxed good or service, the greater is the portion of a tax borne by buyers. Suppose a tax is levied on the sale of a good that is so elastic

in supply in the long run that supply curve is indistinguishable from a horizontal line. For example, suppose housing services can be produced under conditions of constant costs in the long run, under those circumstance, the supply of housing services will be infinitely elastic.

Figure 7 shows the demand and supply for housing services, empirical evidence does support the hypothesis that the long-run supply curve for this good is in fact a horizontal line.[48] This indicates that the marginal cost of producing housing in the long run is constant and equal to the long-run average cost. In figure 7 the pretax market equilibrium corresponds to point E, where rent is 50 cents per square foot, so a 600 – square–foot apartment would rent for $ 300 per month in the absence of any taxes on housing.

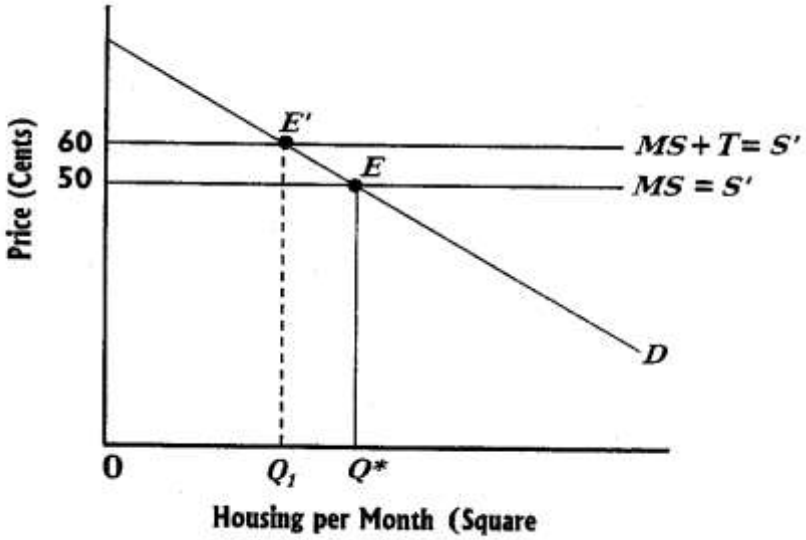
[48] See James R Follain Jr the price elasticity of the long –run supply of new Housing construction, land economics 55 (May 1979): 190-199.

The more inelastic the demand the greater the portion of a tax



The demand curve D' is more inelastic than the demand curve D at each possible price. As a result, the same unit tax of 25 cents would result in a greater increase in market price when demand is D;. more of the tax is shifted to buyers when the more inelastic demand prevails.

impact of a tax on a good with a perfect elastic supply



A tax on a good in perfectly elastic supply collected from sellers is shifted to buyers

Now suppose a tax of 10 cents per square foot is levied on sellers of housing services. This would shift the supply curve up, from MC to MC + T, where T is the 10 cent tax. The new market equilibrium will be at point E', at which the equilibrium quantity falls from Q* to Q_1 squre feet rented per month. The gross price paid by buyers of housing services rises from 50 cents to 60 cents per square foot. The sellers of housing services succeed in shifting the entire tax of 10 cents per square foot to buyers. Suppose the market price did not increase by the full amount of the tax. The net price received by sellers then would be less than 50 cents per square foot per month; that is, the net price would fall below the average costs of production. Firms would leave the industry, and the quantity supplied would decrease until the market price rose enough to eliminate the losses. If price were to rise more than 10 cents per square foot per month, firms would earn economic profits, and new firms would enter the industry. This would increase quantity supplied until market price once again was 60 cents per square foot. This would return the net price received by sellers to 50 cents per square foot after paying the tax. If this were the case in the housing market, the tax of 10 cents per square foot would raise the monthly rental rate on a 600-square-foot apartment from $\$300$ to $\$360$.[49]

[49] This conclusion holds as well for an ad valorem tax on sellers of housing services. This is because $P_N = MC = AC$, where P_N *is the net* price received by sellers in long-run equilibrium. An ad valorem tax on P_N increases MC* to MC = MC + tP_N at all quantities. This will shift up the supply curve parallel to itself, because $P_N = MC = AC$. In the posttax equilibrium P_G= (I +t) P_N because P_N = MC under constant costs, it follows that the posttax market price is P_C = (I + t) MC. When an ad valorem tax is levied on P_G, equilibrium price in posttax equilibrium is P_G = MC/(I +t) because market P_N = MC = (I + t) P_G.

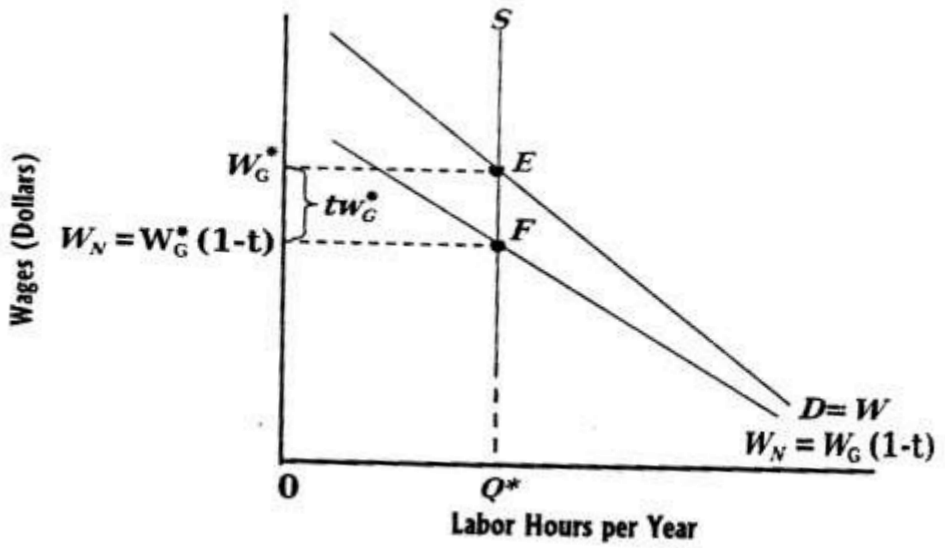
Generally, the supply of most goods and services is much more elastic in the long run than in the short run. I other words, buyers are likely to pay more of a tax in the long run regardless of whether that tax is levied on buyers or sellers in a market industry in which resources can easily be shifted to other use over a long period will have supply that is close to infinitely elastic over the long run, and prices will eventually rise by the full amount of taxes levied on the products of those industries. If the labor and capital employed in production can be reemployed easily elsewhere in the economy with no reduction in price received, then little backward shifting of taxes to suppliers of resources will occur. Therefore, for industries of constant costs, in the long run it is quite likely that the prices of taxed products will rise to reflect the entire tax while the equilibrium output of the taxed products will decline.

Suppose the supply of a taxed good or service were so unresponsive to changes in its price that its supply could be regarded as perfectly inelastic. For example, if the supply of labor hours were perfectly inelastic, the amount of labor hours supplied per year would be fixed. Figure 8 illustrates the impact of a flat –rate tax, such as a payroll tax, on wages under these conditions in a competitive labor market.

As shown in Figure 4, a tax on labor services deducted from the wages of workers causes the net wage received by workers to fall below the gross wage paid by employers. The flat-rate payroll tax on wages reduces the gross wage by tw_G for any given amount of labor hours supplied per week. The net wage is W_G (1 –t). because the supply of

labor hours per week is perfectly inelastic, workers do not respond to the tax – induced wage reduction by varying the amount of hours worked per week. Workers cannot shift the burden of the tax backward to employers. The quantity of labor hours supplied must decline to result in an increase in the gross, or market, equilibrium wage paid by employers. In other words, the tax must have the effect of making labor scarcer for shifting to occur, as shown in figure 8, the tax has no effect on either the market equilibrium quantity of labor hours per week or the wage. The pretax equilibrium wage is W_G^*. The posttax equilibrium wage is also W_G^* because the equilibrium quantity supplied remains Q* hours per week. The entire tax per labor hour is borne by workers as a reduction in the wages received per hour to $W_N = W_G^*(1-t)$

Impact of an Ad Valorem Tax on labor



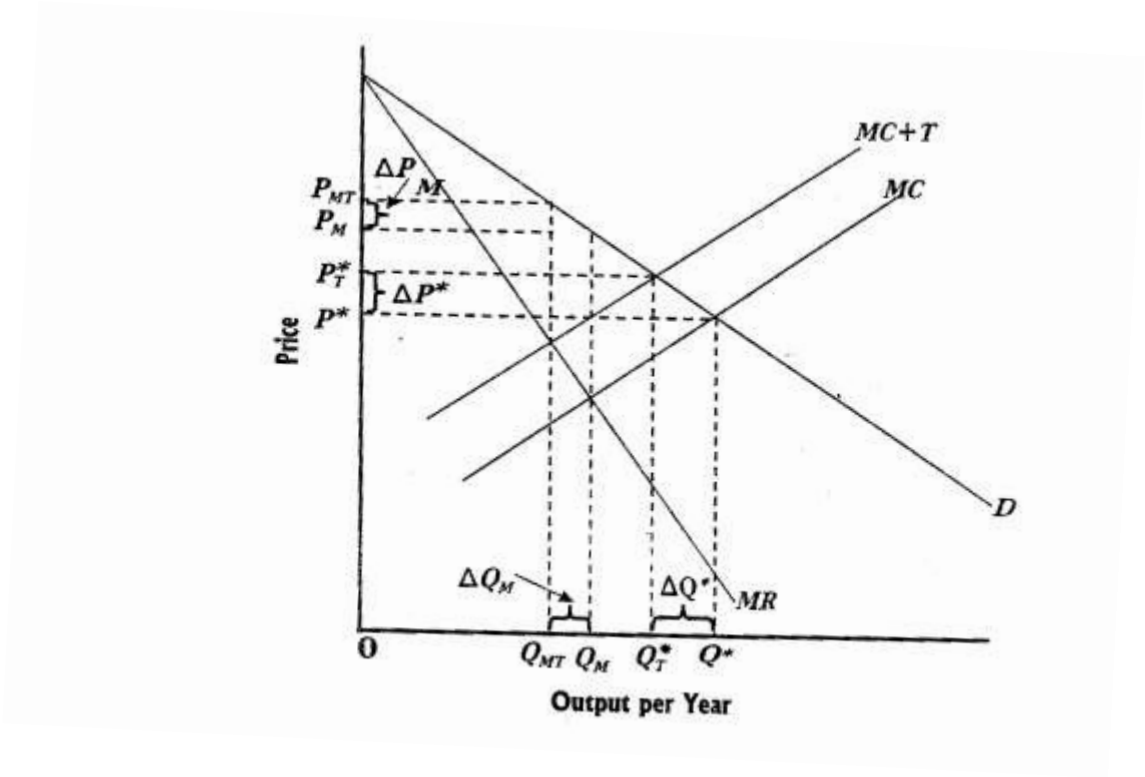
If the supply of labor hours were hours were perfectly inelastic, a payroll tax would decrease the net wage

Shifting under monopoly

A monopolist maximizing profits will choose that output level corresponding to the point where marginal revenue is equal to marginal cost. The marginal revenue curve for a monopolist is steeper than the average revenue (or demand) schedule and falls below the average revenue curve. A unit excise tax on output produced by a monopoly increases marginal cost at each level of output by an amount equal to the unit tax. However, in this case the effect on price is somewhat more complex.

To understand this, consider a perfectly competitive industry that has been transformed into a cartel and behaves as if it were a monopolist. This is illustrated in figure 11.9. the demand curve for the industry's output is D, and the marginal revenue schedule corresponding to this demand is MR. the curve MC is the initial marginal cost schedule, while MC + T is the marginal cost schedule after the imposition of the excise tax. if the industry were perfectly competitive, the initial price would be P*, and the quantity sold would be Q*. These are the price and quantity corresponding to the intersection of the MC curve and the demand schedule. But under monopoly, the equilibrium price and quantity correspond to the intersection of the marginal revenue and marginal cost curves. The monopolist or cartel would produce Q_M < Q* at price P_M > P*. accordingly, the cartel initially produces less than the perfectly competitive industry, ant it charges more.

Shifting under Monopoly



A monopolist would shift less of a given unit tax forward than would be the case if the same output were produced by a competitive industry assuming a linear demand curve

Now the tax increases marginal costs from MC to MC + T at all levels of output. Under conditions of perfect competition, the effect of tax would be to reduce quantity sold from Q* to Q_T^* and raise consumer prices from P* to P_T^*. but, under monopoly, the effect of the tax is to reduce quantity sold by an amount less than the reduction that would

prevail under perfect competition when the demand curve is linear. Thus, in figure 9, when the monopolist readjusts output after the tax is imposed, output falls to Q_{MT}, and price rises to P_{MT}. The reduction in monopolistic output, ΔQ_M, due to the tax is less than the reduction in output ΔQ*, that would prevail for the same tax levied on a competitive industry. This is because the marginal revenue schedule is steeper than the demand schedule. The price rise to consumers as a result of the tax is less than that which would occur under perfect competition, because the reduction in quantity supplied as a result of the tax is less.[50] Therefore, in Figure 9. ΔP_M < ΔP*. Less forward shifting occurs under monopoly than under perfect competition. This however, is not really good news for consumers, because they pay a higher price for the commodity under monopoly in the first place. As can be seen in figure 9, consumers still pay a higher price for the commodity in the taxed monopoly relative to the taxed perfectly competitive industry (PM_T>P_T^*).

Under monopoly, the degrees to which taxes are shifted in the long run also varies with the cost structure of the monopolistic firm. The greatest forward shifting is likely to occur under conditions of constant long-run average costs, because the marginal cost curve would be horizontal under those circumstances in general, the greater the rate of increase of marginal costs with output for a monopolistic firm, the smaller is the portion of a unit or ad valorem tax shifted forward to buyers.

General equilibrium analysis of the excess burden and incidence of taxes

[50] For complete analysis of shifting under monopoly see Elchanan Cohn. A Reexamination of the price effects of a unit commodity tax under perfect competition and monopoly, public finance Quarterly 24,3.(Jules 1996)

In our discussion of the excess burden and incidence of taxes, we have thus far examined only the impact of taxes on a single market. In reality, a system of taxes affects many markets and results in resource flows among many sectors of the economy. A general, or multimarket, analysis of excess burden and tax incidence helps us obtain a more realistic picture of the impact of taxes on resource use and provides insights to help reduce the efficiency loss from taxes.

An economy is composed of complex interrelated markets. This implies that the effect of a tax in any one market is not likely to be confined to that market alone. Instead, repercussions are likely in related markets, along with possible feedback effects in the market initially taxed.

For example, a tax on the consumption of electric power affects not only the price of electricity but also the demand for various electrical appliances and for natural gas for cooking and heating. These secondary shifts in demand affect the prices of these substitutable and complementary activities. This, in turn, might result in feedback effects on both the demand and the supply of electricity because electricity is used as an input in most productive processes, one also might expect that the goods that require proportionately more electricity than others for production likewise will rise in price relative to those others. Tracing the full multimarket, or general equilibrium, effect on a tax on electricity is difficult because of the large number of markets likely to be affected.

Minimizing The Excess Burden of Sales and Excise Taxes.

Suppose tax authorities wish to minimize the excess burden associated with a system of sales and excise taxes. Surprisingly, they must tax various goods at differing rates rather than at uniform rates to

accomplish this. to see why this is so take two goods, say, food and clothing. Assume that the demand for food is more inelastic than the demand for clothing and that the demand for each of these goods is independent of the price of the other. Accordingly, when the price of either good changes, the demand curve for the other does not shift.

Figure 10 shows the demand curves for food and clothing assume that income effects of price changes for these goods are negligible so that the resulting changes in quantities demand reflect only the substitution effects caused by the taxes. the curves have been drawn under the presumption that, at any given price, the demand for food is more inelastic than the demand for clothing. Now suppose a flat-rate sales tax of t percent is levied on both of these goods. Prior to the tax, the price of food is P_F and the price of clothing is P_C. Assume that the supply of both of these goods is infinitely elastic in the long run so that ultimately the tax raises the price of each of these goods by t percent.

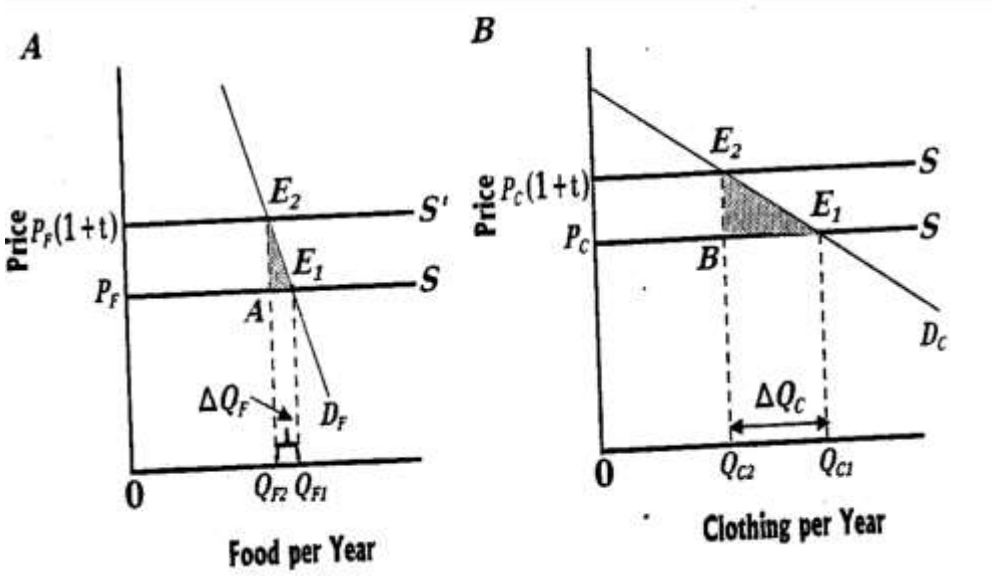
Because the demand for food is more inelastic than the demand for clothing the excess burden in the clothing market exceeds that in the food markets. The excess burden in the food market is the triangular area AE_2E_1 in figure 10A the excess burden in the clothing market is the triangular area BE_2PE_1 in Figure 10B. the excess burden is higher in the clothing market because the substitution effect of the tax is greater there than in the food market.

This analysis suggests a way to minimize the excess burden associated with any system of sales or excise taxes. The total excess burden associated with the sales tax could be reduced if the tax rate were raised in the food market and lowered in the clothing market. By adjusting the tax rates in the two markets until the marginal reduction in the excess burden in the clothing market is balanced by the marginal

increase in the excess burden in the food market, the total excess burden can be minimized.

The implication of this analysis is that efficiency loss can be minimized if, other things being equal, goods are taxed at rates that decrease with the elasticity of demand. The more inelastic the demand, the higher the tax rate necessary to ensure minimization of efficiency loss.[51] Such a tax rate structure will ensure that the percent reduction in the quantity demanded due to the substitution effect of the tax–induced price increase is equal for each good.

Multimarket analysis if excess burden



[51] For any two good F and C, the following condition minimizes the total excess burden

$$t_F E_F = t_c E_C$$

Where t is the tax rate for each good (indicated by the subscript) and E its price elastic of demand. This is sometimes called Rumsey's rule , which states that the percent reduction in the quantity demanded of each of the goods must be equal to see this note that t_F andt_C are the percent changes in the prices of food and clothing, respectively. Therefore $\Delta Q_F / Q_F$ =$\Delta Q_c / Q_C$ Given E_C and t_C, the lower $E_C$the higher the tax rate on food necessary to achieve this condition. Therefore, foe a more advanced analysis, see Agnar Sandmo, "Optimal Taxation – An introduction to the Literature, Journal of public Economics 6 (July- August 1976):37-54.

A flat rate sales tax of t percent levied on both food and clothing results in greater excess burden in the clothing market as shown in B than in the food market as shown in A. total excess burden can be reduced by increasing the tax rate on food and lowering the tax rate clothing until the marginal increase in the excess burden in the food market equals the marginal decrease in excess burden in the clothing marker.

An efficient system of sales and excise taxes is likely to face considerable political opposition if it is regarded as unfair. In fact, the demand for such necessities as food and housing is likely to be more inelastic than the demand for luxury goods. Therefore, a system of excise taxes that minimizes excess burden is likely to call for higher, tax rates on the consumption of necessities. This will bear more heavily on the incomes of the poor relative to the rich

Multimarket Analysis of Incidence

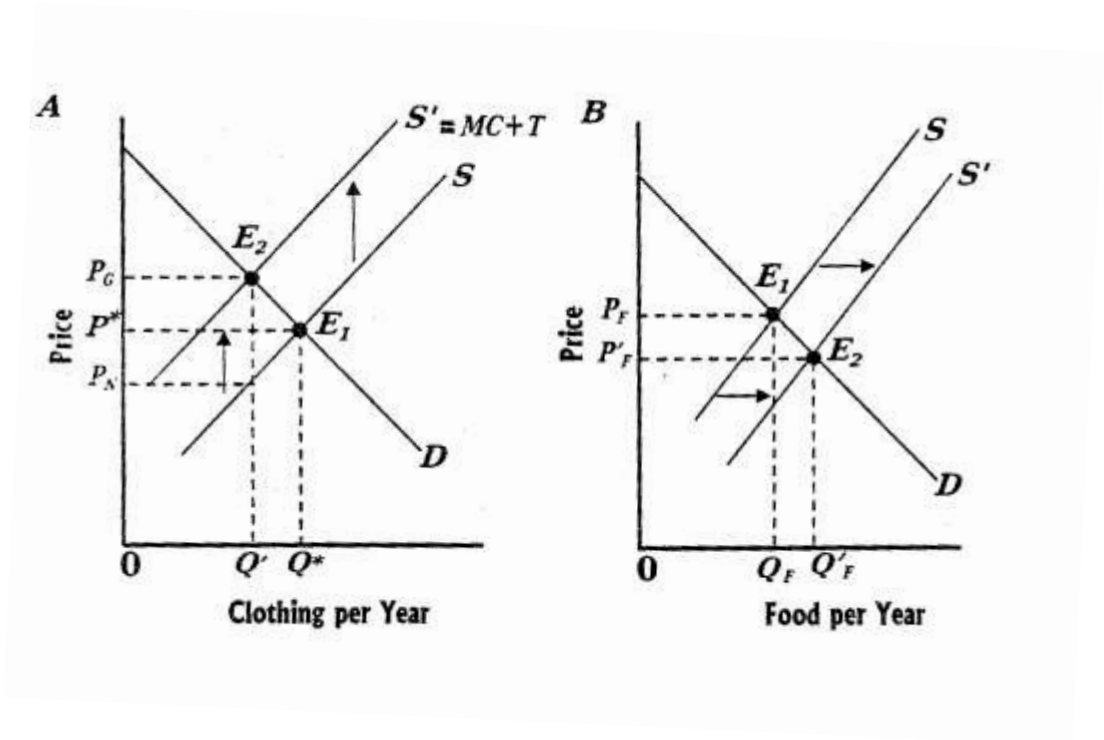
Some of the basic ideas of a multimarket analysis of tax incidence can be illustrated simply by expanding the analysis to deal with two markets. Assume, for example, that the economy produces only two goods, food and clothing, and that a tax is levied on the sale of clothing but not on food. The resource flows induced by taxation and consequent effect are illustrated in figure 11.

The tax on clothing acts to decrease the supply of clothing, with a consequent increase in its market price from P* to P_G and a reduction in quantity demanded from Q* to Q', as shown in Figure 11 A. the reduced production of clothing caused by tax frees productive resources from clothing production for alternative use . if these resources are used to produce government – supplied services, they will be reemployed in the government sector. However, if government does not require the same resources directly freed by the tax, or if the tax revenues are used

to finance transfers, the productive resources that are released would have to find employment in alternative industries.

The tax can cause the price of specialized inputs used in the production of the taxed good to fall. This will reduce the incomes of owners of these inputs, thereby forcing them to bear a portion of the incidence of the tax. this is because the reduction in output in the taxed industry results in suppliers of input to that industry seeking work in other industries where their specialized skills are worth less.

Multimarket Analysis of incidence



A tax on output in one market can affect price in other markets. Here the tax-induced increase in the price of clothing causes inputs to flow into the food industry, this increases the supply of food and decreases its markets price.

Taxes, Government Expenditures, And The Distribution of Income

Policymakers and. Citizens must have reasonably accurate information concerning the effect of government activity on the distribution of well-being among households in the community. Insofar as a household's well-being is correlated with its real income, changes in the distribution of welfare can be approximated by measuring changes in the distribution of disposable income. Predictions of the effect of proposed tax and expenditure policies on the distribution of income can permit more informed collective choices on the extent and nature of government activities, Quantitative estimates of the extent and nature of government expenditures and tax policies help voters compute their true cost shares of collectively supplied services relative to the net benefits that they receive from government activities.

The incidence of a specific government policy refers to the resulting change in the distribution of income available for private use attributable to that policy.[52]To determine the incidence of a policy, no other factors can be attributable to, say, other policies simultaneously affecting the distribution of income. This implies that other variables that affect income distribution (for example, other government policies) must be held fixed in order to obtain a meaningful measure of the incidence of any specific policy.

[52].for classic study of this topic , see Musgrave; theory of public finance (new York: Mcgraw-Hill 1959):207--208

With that caution in mind, three concepts of incidence that relate to government taxes and expenditures can be distinguished:

1- Budget incidence

2- expenditure incidence

3- Tax incidence

Budget and Expenditure Incidence

Budget incidence evaluates the effects of both government expenditure and tax policies on the distribution of income in the private sector. A comprehensive analysis of budget incidence in the United States would generate data relative to the influence of governments federal, state, and local government activities) on the distribution of income. Alternatively, the incidence of a change in the size of the government budget could be evaluated. This would analyze the effects on the distribution of income of a particular increase in taxes.[53]

Expenditure incidence evaluates the effects of alternative government expenditure projects on the distribution of income. To be sure that only the expenditure project being evaluated is affecting the distribution of income, all other possible influences on the distribution of income must be held fixed. This implies that the total level of expenditure is held constant in real terms and that the particular project being evaluated is substituted for some other project or group of

[53]. Musgrave calls this balanced budget incidence." See theory of public finance, PP.214-215

projects. At the same time, we must adjust for any change in the tax structure that alters the distribution of income. This differential approach to incidence of expenditures allows the economist to generate data concerning the relative redistributive effects of alternative expenditure policies alone.[54] It allows policy makers and citizens to evaluate the relative redistributive effects of alternative expenditure policies. The determination of expenditure incidence remains difficult because of the inherent problems involved in imputing the collectively consumed benefits of government provided goods and services to specific households and business firms.

[54] See Musgrave, theory of public finance, PP 212- 225, for a more extensive discussion of differential incidence

Question for review

1- Why are most taxes likely to cause losses in efficiency? Be sure to relate your answer to the impact of taxes on prices.

2- Why should the excess burden of taxation be added to revenue collected from taxes in order to accurately measure the opportunity costs government-supplied goods and services?

3- Explain why lump-sum taxes will not cause any losses in efficiency. Are lump-sum taxes feasible? Lump-sum taxes do not result in substitution effects, but they do affect prices. Is this a contradiction?

4- Show how a gasoline tax of 10 cents per gallon collected from sellers affects the market equilibrium for gasoline. Assume that the demand curve for gasoline is downward sloping and that the supply curve is upward sloping. Show the excess burden of the tax on your diagram. What is the incidence of the tax between buyers and sellers? How would your answer be affected if the tax were collected from buyers instead of sellers?

5- The price elasticity of demand for automobiles is 2 and the price elasticity of supply is 3. Expenditure on automobiles after imposing a sales tax of 2 percent is 5 billion. Calculate the excess burden of the tax, assuming that automobiles are sold in perfectly competitive markets. Assume that the price elasticities given are based on the substitution effect of the tax and that the difference between pretax and posttax prices of cars is very small.

6- Why would a national land tax be likely to have zero excess burden? Show the incidence of a tax on land between landlords and tenants. In answering this question, assume that the supply of land is perfectly inelastic.

7- Suppose the efficiency- loss ratio of taxes on capital income is 30 percent. The capital income taxes currently collect $50 billion of revenue per year. What would be the gain in well-being if a lump-sum tax replaced the current taxes on capital income?

8- Under what circumstances does a single market analysis of tax incidence give a good approximation of the multi market incidence?

9- How would the differential tax incidence of replacing an income tax with a lump sum tax be determined?

10- What is a Gini coefficient? How can this coefficient be used to determine the impact of taxes on income distribution?

Problems

1- The annual demand for liquor in a certain state is given by the following equation:

$$Q_D = 500.000 - 20.000P,$$

Where P is the price per gallon and QD is quantity of gallons demanded per year the supply of liquor is given by the equation.

$$Q_S = 30.000P.$$

Solve for the equilibrium annual quantity and price of liquor.

Suppose that a $1-per- gallon tax is levied on the price of liquor received by sellers. Use both graphic and algebraic techniques to show the impact of the tax on market equilibrium. Calculate the excess burden of the tax, the amount of revenues collected, and the incidence of tax between buyers and sellers.

2- Figure 11, show that a tax on clothing can reduce the price of food. Suppose that after the tax on clothing consumption is imposed, another tax is levied on the consumption of food. For example, the consumption of both commodities could be subject to a tax of five percent. Show how the conclusions of the analysis in the text are modified when the same tax is present in both markets. Analyze the incidence of the tax. In your answer, assume that the tax revenue is returned in equal lump-sum transfers to all citizens.

3- The price elasticity of demand for wine is estimated to be - I at all possible quantities. Currently, 200 million gallons of wine are sold per year, and the price averages $6 per bottle. Assuming that the price elasticity of supply of wine is 1 and the current tax rate is $1 per bottle; calculate the current excess burden of the tax on wine. Suppose that tax per bottle is increased to $2 per bottle. What will happen to the excess burden of the tax as a result of the tax increase?

4-Suppose you had to design a system of taxation for a republic of the former Soviet Union that was transforming its economy into a modern Western style mixed economy. What criteria would you consider to minimize the excess burden of the system of taxation?

Why would a uniform system of sales taxes likely have a higher excess burden than a system of excise taxes in which tax rates varied among taxed products?

What would be the possible distortions resulting from a tax system that only taxed consumption of goods and services and did not tax leisure activities? Why would a very efficient tax system be unlikely to gain broad political support in the republic?

5- Suppose the supply of housing construction is infinitely elastic at a price of $\$150$ per square foot. Currently 1 million square feet are built per month. if the price elasticity of demand for housing is -1, calculate the monthly excess burden of a 10 percent tax on housing construction. (Hint: Go to the appendix of this chapter and read the discussion of taxation of constant cost industries.) What is the monthly excess burden if the tax is 20 percent? Who will bear the incidence of the tax?

Exercises

Question on chapter Five

Taxation, prices, Efficiency and the distribution of income

Part A True – false questions

Circle whether the following statements are true (T) or false (F)

1- Taxes can cause a loss in efficiency in private use of income and resources.

2- Prices that are distorted by taxes no long simultaneously reflect the marginal social costs a benefit of goods and services.

3- Lump sum taxes prevent prices from equaling the marginal social cost and benefit of any goods and services

4- lump-sum tax provide incentive to substitute one activities for another

5- Lump – sum taxes are likely to affect the distribution of income

6- Ahead tax would not distort any prices in ways that prevent markets from achieving efficiency.

7- such as tax would necessarily be regressive with respect to income, because the tax, as a percentage of income, would increase as income rose.

8- The total excess burden of a tax is an additional cost to society over and above the amount of dollars that citizens pay in a tax

9- The total excess burden of a unit tax is the gain in well- being to buyers and sellers in a market over that which suffer if a lump-sum tax were used to collect the revenues.

10- A lump –sum tax would prevent the attainment of efficiency in markets because it causes no substitution effects.

Part B: multiple – choice questions

Circle the appropriate answer:

1- The ART would…….. with a person's annual income

a- increase b- decline

c- remain the same d- be zero

2- The marginal tax rate (MTR) associated with a lump-sum tax is…….

a- zero b- less than zero

c- larger than zero d- one

3-When the tax is imposed, the marginal cost of selling……, and the quantity sold……the equilibrium price……

a- decrease, decreases, rises b- increases, decreases, rises.

c- increases, increases, fall. d- increases, increases, rises

4-..... is the amount sold after the tax multiplied by the tax per unit

a- revenues of government b- Average tax rate

c- marginal tax rate d- lump sum taxes

5- When the excess burden is .....the total burden of a tax on buyers and sellers in a market..... the tax revenues collected

a- positive, exceeds b- positive, declines

c- negative, exceeds d- negative, declines.

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