role of tax setting in determining expenditure choice. Tax reform calls for changes which render the citizens aware of the opportunity cost of public services and permit him to contribute in line with their evaluation. Taxes should be determined in conjunction with the expenditure side of the budget. True tax reform thus becomes budgetary reform, but this is another theme which I will not impose on you. I regret not having offered you a lighter and more entertaining after-dinner fare. Listening to myself, it seemed like going back to grits after the ice cream, and it did so even though I found myself in agreement with most of what I had to say. Double apologies to those of you who did not.

The tendency of private markets to provide less than optimal quantities of public goods is well documented.\(^1\) The characteristic of joint consumption and the associated problem of exclusion combine to cause individuals, acting independently, to buy too little of such a good.\(^2\) Buchanan has shown how public goods are provided in a market setting under the assumption of wholly independent behavior on the part of the participants.\(^3\) Assuming a world of equals (tastes, productive capacities) and constant costs, Buchanan demonstrates how the final independent adjustment equilibrium is nonoptimal in the Pareto sense, the public good being underprovided and the private good being overprovided. The Cournot duopoly model follows a similar analysis and arrives at a similar conclusion by showing how an oligopolistic industry will underprovide a good with respect to the competitive equilibrium output.\(^4\) Both the Buchanan equilibrium and the Cournot equilibrium assume wholly independent, non-strategic behavior on the part of the participants and the analysis in both cases centers on the production of goods.

This paper, while maintaining the assumption of independence and non-strategic behavior, will concentrate on the demand side of the question and show how private "net" demand curves for public goods are derived. It will be shown how variations in price affect the quantity demanded of a public good and how private demand results in the good being underprovided.

The Model\(^5\)

Assume a situation in which two persons, A & B, act independently in the consumption of two goods, one public and one private. Each individual considers both goods to be private and hence does not recognize the interdependencies associated with the provision of the public good. The assumption of wholly independent behavior implies that A is unaware that his consumption of the public good will affect B's demand for it; the publicness of the one good remains hidden from both A & B. This eliminates the possibility of strategic behavior. While limiting the model's application in the real world this approach (similar to that of the Buchanan and Cournot models) provides a framework on which a model incorporating strategic behavior can be developed. Further assumptions include equal tastes, costs, and

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\(^1\) Department of Economics, University of Tampa, Tampa Florida 1968.


equal money incomes and constant costs in the provision of each good.

The following analysis develops the concept of "net" demand curves as they apply to the provision of public goods. Although Milton Kafoglis has developed a model (1961) for deriving net demand curves, the analysis that follows differs in many respects from his.

Net demand curves are the result of interdependencies in the consumption of public goods. If one individual's consumption of a good can lead to enjoyment by another individual, the latter's demand for that good will be affected. He will have a "net" demand curve which reflects the enjoyment he receives as a result of the first individual's purchases of the good. That is, when individual A purchases more units of the public good, B's real income increases which causes him to adjust to the new income constraint. After each successive purchase of the public good both A & B are surprised to find that they have more or less of the public good than they anticipated. These feedback effects continue until a final equilibrium is established.

The following analysis indicates how partial individual net demand curves are developed and then proceeds to show how net demand curves are derived.

Partial Individual Net Demand Curves

Figure 1 illustrates individual A's preference field for good X, a public good, on the horizontal axis and private goods on the vertical axis. A's original income or budget line is B, which corresponds to price P; for good X. Superscripts indicate the level of provision by individual B. Subscripts indicate price. This


*An analysis showing how the final equilibrium is reached can be found in Chapter 2 of Buchan's The Demand and Supply of Public Goods, Rand McNally and Company, 1968.

Figure 1. Demand for a Public Good With Income Effects

Figure 2. Partial Individual Net Demand Curves

THE NET DEMAND FOR PUBLIC GOODS

by B. Although he chooses Qf of good X, he only pays for Qf - 4 units.

A's purchase, Qf - 4 units, is less than Qf, assuming positive income elasticities for both goods. This is because A has been provided with 20 units of good X by B. The amount of X at his disposal relative to all other goods has increased. With the same income at his disposal, the expectation is that A will decrease his purchases after he begins to enjoy B's purchase. At P2, A will now choose Q2 which includes Q2 of X. If the price is changed to P3, he will choose Q3 including Q3 of X. As with P2, the amounts actually purchased will be Q3 - 20 and Q2 - 20. Again, this relationship can be
shown in Figure 2 as $D_x$. $D_x$ is A's partial individual net demand curve for $X$ when $B$ is providing 20 units at no cost to A.

Reading rightward in Figure 1, notice another set of budget lines parallel to the first and second sets. This set begins at point C and proceeds to the horizontal axis. Point C is 20 units from point B and 40 units from point A, indicating that A is being provided with 40 units at no charge. Again it is $B$ who provides the units of $X$. The process of deriving A's demand curve for $X$ in the presence of a 40 unit "gift" from $B$ could be worked through but this would be redundant. At $P_A$, $P_B$, and $P_{AB}$, A will choose $Q_A$, $Q_B$, and $Q_{AB}$ of $X$. He will purchase only $Q_A$, $Q_B$, and $Q_{AB}$ of $X$, respectively, however. This relationship is shown in Figure 2 as $D_x$. A's partial individual net demand curve when $B$ provides 40 units at no cost to A.

Figure 2 shows that $D_x$ lies to the left of $D_y$ and that $D_y$ lies to the left of $D_z$. This is to be expected. The greater the amount of $X$ that $B$ provides for A the less he is likely to purchase at each possible price. It would be possible to redraw A's preference map assuming different prices and income elasticities so that different demand curves would result.

**Individual Net Demand Curves**

Given the assumption that $B$ has exactly the same preference field as $A$, one can eliminate the necessity of deriving his net demand curves since they will be exactly the same as $A$. That is, at each level of provision—zero, twenty, or forty units—he will choose exactly the amounts of $X$ at various prices as did $A$.

Partial individual net demand curves are interesting, but they do not show what quantities of good $X$ individuals A and B will actually purchase. Individual A's partial individual net demand curves show the quantities of $X$ that A will purchase at various prices, given that B has already provided some quantity. Individual B's curves yield the same information, given some quantity purchased by A. Both sets of curves are conditional. It is still not clear what the total quantity purchased will be. We have A's demand curves, given the quantities provided by $B$. We have $B$'s demand curves, given the quantities provided by A. The outcome when the purchases of both A and B are allowed to vary has not been established.

Figure 3 is essentially a rearrangement of the information shown in Figure 1. The horizontal axis measures the quantities of $X$ that A will purchase, given some level of provision by $B$ measured on the vertical axis. The vertical axis measures the quantities of $X$ that $B$ will purchase, given some level of provision by $A$ measured on the horizontal axis. When discussing A's behavior, the horizontal axis measures the dependent variable—A's purchases—and the vertical axis measures the independent variable—$B$'s purchases. When discussing $B$'s behavior, the vertical axis measures the dependent variable—$B$'s purchases—and the horizontal axis measures the independent variable—A's purchases.

The various lines on the graph show either A's behavior at certain prices, given various purchases by $B$, or $B$'s behavior at certain prices, given various purchases by A. $P_A$ indicates the varying amounts of $X$ that A would purchase at $P_B$ if B's purchases were to vary. $P_B$ indicates the varying amounts of $X$ that B would purchase at $P_A$ if A's purchases were to vary. The subscript indicates the price with which we are concerned. The superscript indicates which individual's behavior is dependent.

What quantities will A and B actually purchase at $P_A$? It will be those quantities indicated by the intersection of $P_A$ and $P_B$—point C in Figure 3. Only at this point are both A and B in equilibrium, i.e., there will be no incentive for either individual to alter his purchases. A will purchase 23 units, and B will purchase 23 units. A is in equilibrium because at $P_A$, 23 units is just the quantity that he wishes to purchase, given that B had already purchased 23 units. B is in equilibrium because at $P_B$ 23 units is just the quantity that he desires to purchase, given that A had already purchased 23 units. At any other position, either A or B would be out of equilibrium and the situation would be unstable. There is no reason for either A or B to purchase more or less than 23 units of $X$ if price is $P$. The reason the respective amounts purchased by A and B conveniently turn out to be equal is that we assumed they had equal preferences. Similarly, at $P_A$ and $P_B$, A and B will be in equilibrium at points $C_1$ and $C_2$. As at $P_A$, both will purchase equal amounts of $X$ at $P_B$ and $P_B$.

The locus of points $C_1$, $C_2$, and $C_3$ indicate the various amounts of $X$ that A and B will purchase at various prices in a situation where the amount purchased by A is available to B and vice versa. Both individuals, however, are acting independently and in response to their perceived real income changes. The locus of points is A's demand curve, net of B's purchases. It is also B's demand curve, net of A's purchases. These individual net demand curves are to the left of the independent demand curves and are more price inelastic.

It is necessary to sum the individual net demand curves horizontally to obtain the net total demand curve. The total curve will show what quantity of the public good will be demanded as the price (cost) of the public good changes. The quantities that correspond to the various prices will not be Pareto optimal since the net total demand curve lies everywhere to the left of the independent total
demand curve (which is obtained by vertical summation).

Although the net demand curve model is limited in application due mainly to its two person, non-strategic behavioral assumptions it does appear, nevertheless, to be suitable for extensions to multi-individual situations and strategic behavior. While leading to the usual conclusion that public goods will be underpro-

vided by private markets, the model offers a slightly different perspective by emphasizing the real income effects of joint consumption and the resulting impact on the demand for public goods.

A number of authors1 have recently consid-
ered the impact of price uncertainty on the behavior of the cooperative firm operating in a competitive market. One interesting result demonstrated by Perahia and Kehren is that under price uncertainty the cooperative firm will employ a greater amount of labor input than a cooperative firm facing a non-random price equal to the mean price in the uncer-
tainty case.2 This result is in contrast to the capitalist firm, where the firm facing price uncertainty employs a lesser amount of labor than the firm facing a non-random price.

In this paper this result is reexamined in a situation where the firm faces not only an uncertain future spot price for output, but also a current non-random futures price. It is demonstrated that under such an environment the cooperative firm will employ exactly the same amount of labor as a cooperative firm facing a non-random price equal to the current futures price.

Another related issue which will be explicit-
ly considered in this paper is under what conditions the cooperative will hedge or specu-
late in the market. Specifically, it will be demonstrated that the "hedge versus specu-
late" issue will depend on the relationship between the futures price and the mean of the future spot price.3

One other question to be considered in this paper is whether the existence of futures markets induces the cooperative firm to increase or decrease output. Specifically, it will be shown that the answer to this question is different for the cooperative firm and the capitalist firm.

In the certainty case, the objective function of the cooperative firm can be written as,

\[ IL = (PL_f - FX - FC)/X, \]

(1)

where \( IL \) is the profit per unit labor, \( X \) is the number of units of labor, \( W \) is the wage and \( FC \) is the fixed costs associated with the firm.\(^4\) \( PL_f \) is the certain price equal to the current futures price in the uncertainty case and \( f \), which is a function of \( X \), represents the production technology of the firm with the assumption that \( f' > 0 \) and \( f'' < 0 \).

The profit function of the cooperative firm facing both an uncertain future spot market

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1. These issues have been addressed by Feder, et al. (1980) and Holtonson (1979) within the context of a capitalist firm.

2. A referee has questioned the inclusiveness of the term \( WX \) in the profit function, if by profits is meant an accounting profit concept rather than an economic concept. Actually both have been employed in the literature. For example, Perahia and Kehren, op. cit., include the wage bill while Ramachandran, et al. (1979) and Mirza (1979) omit the wage bill. It would seem to me to be a matter of preference whether one wants to define profits per worker net of the wage bill or gross of the wage bill. However, all of the results in this paper are independent of the definition that is chosen.