The Welfare Approach To the Measurement of Policy Impact

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I. Introduction

Increasing attention has been given recently to the role of indirect taxes in the tax structure of the Less Developed Countries (LDCs).[1] In the context of economic growth, indirect taxes on domestic or foreign products have some advantages over direct taxes in that the former penalizes consumption while favoring savings.[2] Given the favorable impacts that increased savings has on economic growth, many LDCs have adopted indirect taxes as a major source of government revenue as well as a major policy tool. Accordingly, studies on indirect taxes in LDCs have been mainly concentrated on the analysis of the relationship between indirect taxes and economic growth,[3] on the change in the role and structure of indirect taxes as economies develop,[4] and on the formation of the optimal tax structure in terms of economic growth.[5]

Meanwhile, general indirect taxes often have regressive impact on the distribution of income. This is so because consumption as a percentage of income declines as a household moves up the income scale. In this context, the economy is faced with a trade-off between growth and equity. Along with the progress of economic modernization commonly

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1) D.J. Wolfson, *Public Finance and Development Strategy*, Baltimore: Johns Hopkins Press, 1979, pp. 169-79; S. Cnossen, *Excise System: A Global Study of the Selective Taxation of Goods and Services*, Baltimore: Johns Hopkins Press, 1977, pp. 23-5; W.W. Heller, "Fiscal Policies for Underdeveloped Countries," in *Readings in Taxation in Developing Countries*, ed. by R.M. Bird and O. Oldman, 3rd. ed., Baltimore: Johns Hopkins Press, 1975, pp. 5-28; J. Levin, "The Effects of Economic Development on the Base of a Sales Tax: A Case Study of Columbia," *IMF Staff Papers #15*, March, 1968, pp. 30-99.

2) John F. Due, *Indirect Taxation in Developing Economics*, Baltimore: Johns Hopkins Press, 1970, Chapter 1.

3) R.M. Bird, *Taxation and Development: Lessons from Columbian Experience*, Cambridge: Harvard University Press, 1969.

4) H.H. Hinrichs, *A General Theory of Tax Structure Change During Economic Development*, Cambridge: Harvard Law School International Tax Program, 1966.

5) Avinnash K. Dixit, "On the Optimum Structure of Commodity Taxes," *American Economic Review*, June 1970, pp. 295-301; David F. Bradford and Harvery S. Rosen, "The Optimal Taxation of Commodities and Income," *American Economic Review*, May 1976, pp. 94-101.

accompanied by some degree of equity problem, the incidence analysis of the indirect taxes in LDCs has appeared as an important element in efficient tax administration and economic development planning.[6] The incidence analysis, in this context, refers to the distribution of the tax burden among individual households or various income groups. The common problem related with tax in LDCs are the complexity of tax structure, the arbitrariness in tax administration, and consequently, the lack of understanding the implication of the overall tax system on the growth as well as the tax burden distribution. Thus, knowing the accurate incidence effects of any change in the tax structure become one of the most important steps in the formation of fiscal policies.

In this context, the Korean Indirect Tax Reform of 1977 draw the particular interest of many economists, development planners, and international development institutions. Since its implementation, the distributional impacts of the reform, which aimed mainly to eliminate the inefficiency in the indirect tax system by substituting the value added tax (VAT) for turn-over and several excise taxes, have been almost continuously discussed and still are the topic of serious debate given the possibility of future revision of the system. Two previous strudies by Hong (1980) and Heller (1981) provided some indications of the change in tax burden distribution caused by the reform. Hong measured the incidence in terms of the cost of living by evaluating a fixed quantity basket and concluded that the reform decreased regressiveness in the tax burden distribution among the rich and poor households. Heller measured the incidence using a ratio of tax revenue to the absolute level of income within the framework of a fixed expenditure pattern and found that the reform made the tax burden distribution more progressive. However, two studies do not provide true picture of the reform impact directly. In this context, there is a need for a study which can provide an accurate measurement of the incidence of the actual tax reform, where the tax burden is measured in terms of welfare using a more realistic demand estimation. This paper represents an attempt to meet this need by developing a model for the measurement of the incidence effects in terms of the change in economic welfare, applying it to the Korean Indirect Tax Reform of 1977, and analyzing its impact on the distribution of income between rural and urban households.

6) For example, recent study by Korea Development Institute revealed that 1% improvement in income distribution (the Gini coefficient) would increase the housing demand by 2%. *Dong-A Ilbo*, July 27, 1984.

II. The Framework for the Utility Measurement of Indirect Tax Incidence

1. The Money Metric Measure of Utility

The evaluation of any suggested changes in an economic policy requires detailed analysis of its impacts that ultimately rest upon an individual or an income class. In the context of policy makers, it is necessary to have some form of well-defined cardinal index of consumer's ordinal utility written only with the observables such as prices (p^i), quantities consumed (q^i), money expenditure (Y), and parameters of his (or its) demand function. Commonly used measures such as consumer's surplus and other index numbers including the cost-of-living index are the product of continuously accumulated efforts for the accurate measurement of utility. However, they all suffer from well-known weaknesses such as "inexactness" or "superfluousness" and "region of ignorance," which make their general application in empirical studies less reliable. An alternative is the direct measurement of ulitity itself.

Consider a situation in which the functional form of the utility function ($U=U(q^1, q^2, \cdots q^n)$ is not known, but the ordinary demand function ($q^i = m^i(p^1, p^2, \cdots p^n, Y)$0 q^i, p^i, Y for quantity, price for commodity i and consumption expenditure respectively) associated with it are known to us. From first order condition for maximizing utility function, we have:

$$\partial U / \partial q^i = U_i = \lambda p^i \tag{1}$$

where subscript i stands for the partial derivatives. By multiplying ∂q^i on both sides of eq (1) and summing up over commodities, we have:

$$dU = \lambda \sum_i p^i dq^i \tag{2}$$

where total utility change (dU) is expressed as a product of the marginal utility of consumption expenditure (λ) and the summation of quantity variations ($\sum p^i dq^i$). Eq(2) also can be expressed in terms of a price variation. Total differentiation of the budget constraint will result in:

$dY = \sum_i p^i dq^i + \sum_i q^i dq^i$, where $\sum_i q^i dq^i$ called a price variation. Then, by replacing $(dY - \sum_i q^i dp^i)$ for $\sum_i p^i dq^i$ in eq(2), we have :

$$dU = \lambda \, (dY - \Sigma q^i dp^i) \tag{3}$$

If dY is equal to zero, dU is a product of λ and a price variation. From FOC, we can obtain $\lambda = U_i / U_j = p^i / p^j$

When dq^i and /or dp^i are infinitesimally small, the value of λ, which is always positive, can be assumed to be constant. Then, the change in total utility can be presented solely by the term ($\Sigma p^i dq^i$) or ($dY - \Sigma q^i dp^i$). The former is the most commonly used utility indicator, which measures the change in consumption (dq^i) valued at based year prices(p^i). Once divided by consumption expenditure (Y), it tells us the percentage change in real consumption. On the other hand, $\Sigma q^i dp^i$ is a Laspeyre price index, which evaluates the change in prices at base year quantities. In this context, $\Sigma p^i dq^i$ represents the change in real consumption which is defined as the change in money expenditure (dY) minus the change in the cost of living ($\Sigma q^i dp^i$).

However, discrete changes in the variables (dY, dq^i, dp^i) invalidate the assumption of constant λ. The above indicators, in this case, no longer can represent an exact measurement of the utility change. The different value of λ in different price and expenditure situations blocks the direct relationship between dU and dp^i. Laspeyres and Paasche indices, whatever variations are used, contain the "regions of ignorance."[7] The well-known triangle of consumer's suprlus ($\Sigma q^i dp^i$) is nothing but an attempt to approximate true utility changes.[8]

One possible way of eliminating the above difficulties in utility measurement is the integration of the differential equation in eq(2) or eq(3). By substituting ordinary demand functions for q^i and its inverse p^i into differential equations, the problem is narrowed down to finding some integrating factor λ, which is exactly the marginal utility of consumption expenditure. The main purpose of this integration is to trace back the utility function itself from observed demand functions[9] and to use it in the measurement of utility change. The existence of the utility function is assured by the assumption that the functional form of the utility function is not known, but the ordinary demand functions associated with it are known to us. Consequently, the existence of λ is guaranteed and it will be a function of prices and consumption expenditure.

However, the existence of an arbitrary constant term in the primitive function derived through integration of the differential equation causes the problem of an infinite number of integrating factors, multiple λ_s in

7) For detailed discussions on index numbers and the measurement of utility change, see Allen, *Index Numbers*.

8) If more than one price changed, accuracy of the indicator depends upon the formulation and solution of a "line integral," which requires the specification of the path of price change. Eugene Siberberg, *The Sturcture of Economics: A Mathematical Analysis*, N.Y.: McGraw-Hill Book Company, 1978, pp. 353-55.

9) Silberberg, *ibid.*, pp. 335-42.

the current case, unless appropriate information is provided in defining the arbitrary constant. The result of the change in the constant term in a preference function is a monotonic transformation of any other in the family. Consequently, the integration requires a long search procedure to derive even one of many integrating factors, because there are no general rules for it.[10]

To escape this difficulty, McKenzie and Pearce used a Taylor series expansion to express an accurate utility indicator.[11] The choice of Taylor series, however, does not lessen the burden of expressing λ and its derivatives in terms of information contained in the observed demand function.

The starting point it to look at the change in utility from the base year position. Set the marginal utility of consumption expenditure (λ) stationary, at base year prices, with respect to consumption expenditure (Y). Then, the problem is to find a monotonic transformation of the underlying utility function which satisfies the stability condition of λ . The utility indicator derived from this utility function is the money metric utility because the equivalent variation is evaluated with unitary λ at base year.

Let us now define the indirect utility function in terms of prices and consumption expenditure ($V(p^1 \cdots p^n, Y) = U(P, Y)$). This function represents the maximum attainable utility with given P (a vector of prices) and Y. By using the duality theorem in demand theory, U(P, Y) can be written in the following form of a cost function:

$$C(U, P) = \min_q (P q \; ; U(q) = U) \tag{4}$$

Eq(4) defines the minimum cost of attaining a given level of utility (U) at prices P. Since $C(U, P) = Y$, inversion will give U as a function of P and Y, the indirect utility function U (P, Y). These two functions are simply alternative ways of writing the same information. In this context, C(U, P) itself is a utility indicator because it is a monotonic increasing function of U with given P.

Using the method of Taylor series expansion, instead of integrating differential equations, the change in utility represented by the indirect utility function U (P, Y) can be expressed in the form of:

$$dU = {}^1U - {}^0U = \sum_i U_i ({}^1p^i - {}^0p^i) + U_y ({}^1Y - {}^0Y) + \frac{1}{2} \sum_{i} \sum_{j} U_{ij} ({}^1p^i - {}^0p^i)({}^1p^j - {}^0p^j)$$

10) Alpha C. Chiang, *Fundamental Methods of Mathematical Economics*, 2nd ed., N.Y.: McGraw-Hill Book Company, 1974, pp. 428-430. G.W. McKenzie and I.F. Pearce, "Welfare Measurement — A Synthesis," *AER*, Sept. 1982, pp. 672-73.

11) McKenzie and Pierce, *ibid.*, pp. 674-75.

$$+\sum_i U_{iy}({}'p^i-{}^op^i)({}'Y-{}^oY)+\tfrac{1}{2}U_{yy}({}'Y-{}^oY)^2+R \tag{5}$$

where subscripts (i, j, y) are for the partial derivative of utility function and presuperscript ° and ′ designate the original and changed situation respectively, and R represents the terms of the remainder associated with the second-order approximation, of which magnitude will be diminished with the extension of the series beyond second-order. In eq (5), the partial dervatives of utility functions (U_i, U_j, U_{ij}, U_y, U_{ij}, etc.) are non-observable entities, because utility functions themselves are defined in ordinal form. However, we know that, if utility functions exist, there must exist λ , the marginal utility of expenditure.

With given price vector °P, we defined the indirect utility function U (°P, Y) as utility indicator which satisfies U(°P, Y) = Y for all Y. Then, the marginal utility of expenditure evaluated at the base year prices °P can be written:

$$\lambda = \frac{\partial U({}^oP,\ Y)}{\partial Y} = \lambda({}^oP,\ Y) = 1 \tag{6}$$

for all Y. Then, higher order derivatives of λ (°P, Y) with respect to expenditure will be:

$$\frac{\partial^i \lambda({}^oP,\ Y)}{\partial Y^i} = 0 \tag{7}$$

(i = 1, - - - - - - -, ∞ : order of partial derviatives)

By the definition of the money metric, eq (6) sets the value of λ at base year equal to 1 for all Y. This result also characterizes the property of monotonic transformation of the utility function. If eq (6) is evaluated at base year prices for all Y, eq (7) is a natural conclusion drawn from the property of monotonic transformation.

From the first order condition of a maximizing indirect utility function, we have:

$$\frac{\partial U({}^oP, Y)}{\partial p^i} = U_i = -q_i \tag{8}$$

Further differentiation of eq (8) will produce the following higher order partial derivatives:

$$\frac{\partial^2 U({}^oP, Y)}{\partial p^i \partial p^j} = U_{ij} = -q^i \frac{\partial \lambda}{\partial p^j} - \lambda \frac{\partial q^i}{\partial p^j} \tag{9}$$

$$\frac{\partial^2 U({}^oP,\ Y)}{\partial p^i \partial Y} = U_{iy} = \frac{\partial \lambda}{\partial p^i} - q^i \frac{\partial \lambda}{\partial Y} - \lambda \frac{q^i}{\partial Y} \tag{10}$$

By evaluating eq(8)-(10) with eq(6) and (7), we have:

$U_i = -q^i$

$$U_y = {}^{o}\lambda = 1$$
$$U_{ij} = q^i q^j_y - q^i_j \qquad (11)$$
$$U_{iy} = -q^i_y$$

where q^i are for demand functions and subscripts (i, j, Y) for the partial derviatives of demand functions.

Now we transform the unobservable entities of partial derivatives of indirect utility function to the observables. By inserting eq(11) into eq(5), we have the final versions of the money metric all in the observable entities.

$$dU = (-\Sigma q^i \cdot dp^i + dY) + \frac{1}{2}\{\sum_i\sum_j(q^j_y \cdot q^i - q^i_j)\ dp^i \cdot dp^j - \sum_i q^i_y \cdot dp^i\ dY\} + R \qquad (12)$$

If we further assume a fixed level of consumption expendituES, eq(12) further reduces to:

$$dU = (-\sum_i q^i \cdot dp^i) + (\frac{1}{2}\sum_i\sum_j(q^j_y \cdot q^i - q^i_j)\ dp^i \cdot dp^j) + R \qquad (13)$$

Eq(12) and (13) will be used in this study. By utilizing the cost function approach in demand theory and evaluating the derivatives at the base year price vector, we have one version of the money metric measure of utility expressed in the observable entities.

2. The Almost Ideal Demand System: AIDS[12]

As seen in the previous sections, once the money metric, defined in terms of the prices (p^i), consumption expenditure (Y), and quantity demanded(q^i), is accepted as an accurate measure of utility, the question is directed naturally to the estimation of the demand function, which possesses all of the properties essential to the existence of a utility function. Furthermore, if an income gropus, instead of an individual, is used as an agent of economic beahvior, problems of aggregation over individuals in an income group cause another problem in estimating the group's demand functions. The natural choice among many others,[13] which can handle those difficulties most efficiently and still can maintain simplicity

12) AIDS was first introduced by Deaton and Muellbauer as an alternative model of testing the law of demand by introducing the PIGLOG class of preferences and by integrating the aggregation theory developed around the concept of representative consumers into the estimation of the system of demand. See, for detail, Angus Deaton and John Muellbauer, "An Almost Ideal Demand System," *AER*, June 1980, pp. 312-25.

13) Since the pioneering work of Richard Stone in 1954, which estimated a system of demand functions directly based on consumer theory, many models have been continuously developed in the process of seeking alternative specifications. The most important in the current use are the

in the estimating process is the Almost Ideal Demand System (AIDS). The AIDS, starting not from arbitrary preference ordering, but from a specific class of preferences, seeks a way of exact aggregation over consumers, derives market demand equations as if they were the outcome of rational decisions by representative consumers and, in this process, fully utilizes the properties of cost functions or indirect utility functions which which define the minimun expenditure necessary to maintain a specific level of utility at given prices.

The basic equation of the AIDS takes the form of:

$$\log C(U_o, P) = (1-U_o) \log a(P) + \log b(P) \qquad (14)$$

where U_o stands for the representative utility and P for price. This logarithmic form is known as "price independent generalized linear log (PIGLOG)" form and used here to represent consumer preferences. Here U_o lies between O (subsistence) and 1 (bliss). In this context, the positive linear homogenous functions a (P) and b (P) can be regarded as the cost of subsistence and bliss.[14]

Now, define the following specific forms for log a(P) and log b(P):[15]

$$\begin{aligned} \log a(P) &= \alpha_0 + \sum_i \alpha^i \log p^i + \tfrac{1}{2} \sum_i \sum_j \bar{\gamma}^{ij} \log p^i \cdot \log p^j \\ \log b(P) &= \log a(P) + \beta_0 \pi_i p^{i\beta^i} \end{aligned} \qquad (15)$$

where α^i, β^i, $\bar{\gamma}^{ij}$ are parameters.

Eqs (15) are substituted into eq (14). Then, the AIDS cost function will be:

$$\begin{aligned} \log C(U,P) &= (1-U) \{\alpha_0 + \sum_i \alpha^i \log p^i + \tfrac{1}{2}\sum_i\sum_j \bar{\gamma}^{ij} \log p^i \log p^j\} \\ &\quad + U\{\alpha_0 + \sum_i \alpha^i \log p^i + \tfrac{1}{2}\sum_i\sum_j \bar{\gamma}^{ij} \log p^i \log p^j + \beta_0 \pi_i p^{i\beta^i}\} \\ &= \alpha_0 + \sum_i \alpha^i \log p^i + \tfrac{1}{2}\sum_i\sum_j \bar{\gamma}^{ij} \log p^i \log p^j + U\beta_0 \pi_i p^{i\beta^i} \end{aligned} \qquad (16)$$

Rotterdam Model, the translog model, and the original linear expenditure model. For the Rotterdam model, see Henry Theil, "The Information Approach to Demand Analysis," *Econometrica*, Jan. 1965, pp. 67-87 *Theory and Measurement of Consumer Demand*, vols. 1 and 2, Amsterdam: North Holland Publishing Co., 1976; A.P. Barten, "Maximum Likelihood Estimation of a Complete System of Demand Equations," *European Economic Review*, October 1977, pp. 651-675. For the Translog Model, see L.R. Christensen, D.W. Jorgensen, and L.I. Lau, "Transcendental Logarithmic Uitlity Functions," *AER*, June 1975, pp. 367-383. For Stone's original work, see Richard Stone, "Linear Expenditure Systems and Demand Analysis: An Application to Patterns of British Demand," *Economic Journal*, Sept. 1954, pp. 511-527.

14) Deaton and Muellbauer, *op. cit.*, 1980, pp. 323-324.

15) *Ibid.*, 1980, p. 313. The primary requirement of specific functional forms for log a(P) and log b(P) is that they must have enough parameters so that the cost function can be derived from them in a flexible functional form. Thus, functions in eq (15) are chosen in a way to meet this requirement and also to generate a system of demand functions which have the desirable properties.

The demand function can be derived directly from eq (16). Based on the fundamental property of the cost function that the price derivatives of the cost function are the quantities demanded ($\partial C/\partial p^i = q^i$), the budget share equation can be derived in the following way:
Multiply $p^i/C(U, P)$ on both sides of $\partial C/\partial p^i = q^i$.
Then,

$$\partial C/\partial p^i \cdot p^i/C(U,P) = q^i \cdot p^i/C(U,P) = S^i$$

The left-hand side is equivalent to $\partial \log C(U, P)/\partial \log P^i$ and the right-hand side to S^i. So,

$$\frac{\partial \log C(U,P)}{\partial \log p^i} = \frac{p^i q^i}{C(U,P)} = S^i \qquad (17)$$

Thus, logarithmic differentiation of eq (16) gives the budget share as a function of prices and utility.

$$\begin{aligned} S^i &= \alpha^i + \tfrac{1}{2}(\bar{\gamma}^{ij} + \bar{\gamma}^{ij}) \sum_j \log p^j + \beta^i U \beta^j \pi_j p^{j\beta^j} \\ &= \alpha^i + \sum_j \gamma^{ij} \log p^j + \beta^i U \beta_0 \pi_j p^{j\beta^j} \end{aligned} \qquad (18)$$

In order to apply eq (18) to an empirical study, the element U in eq (18) must be converted into an observable entity. A utility maximizer will equate his expenditure (Y) to his cost function (C(U, P)). This equality can be inverted to give U as a function of P and Y, the indirect utility function. If eq (16) is inverted in this fashion, we have:

$$U = \frac{\log Y - \log(\alpha_0 + \sum_i \alpha^i \log p^i + \tfrac{1}{2} \sum_i \sum_j \gamma^{ij} \log p^i \log p^j}{\beta_0 \pi_i p^{i\beta^i}}$$

By substituting this U into eq (18), then we have the budget share as a function of Y and P.

$$S^i = \alpha^i + \sum_j \gamma^{ij} \log p^j + \beta^i \log (Y/P^*) \qquad (19)$$

where $P^* = \alpha_0 + \sum_k \alpha^k \log p^k + \tfrac{1}{2} \sum_j \sum_k \gamma^{jk} \log p^k \log p^j$.

This is the AIDS demand function in budget share form. in order for eq (19) to be consistent with the requirement for a valid representation of preferences, the following restrictions must be met:

For linear homogeneity in prices; $\sum_i \gamma^{ji} = 0$

For adding-up; $\sum_i \alpha^i = 1$, $\sum_i \beta^i = 0$, $\sum_i \gamma^{ij} = 0$ (20)

For symmetry; $\gamma^{ij} = \gamma^{ji}$

If the above restrictions hold, eq (19) represents a system of demand functions which add up to total expenditure ($\Sigma S^i = 1$), are homogeneous of degree zero in prices and total expenditure taken together, and satisfy the Slutsky symmetry conditions.

In this study, initial estimation of eq (19) will be performed using OLS method, in which, prior to estimation, P* will be computed using $\log P^* = \Sigma S^i \cdot \log p^i$. Then, the Full Maximum Likelihood methodd (FIML) is employed to estimate the demand parameters with all restrictions imposed.

3. Price Determination

Indirect taxes are commonly imposed on the value of production or on sales. Thus, in contrast to direct taxes, their primary impact is generally presented in the form of instantaneous changes in prices at the factory level or at the final retail level. Furthermore, the use of the convenient hypothesis of balanced-budget incidence, which keeps the output level of the economy unchanged, makes the static analysis deviate little from the actual course of the changes.

By reading down a column (J) of the I/O table, we have the following decomposition of output in terms of cost:

$$X^j = \Sigma_i X^{ij} + V^i \tag{21}$$

where I is N by N identity matrix and $(I\text{-}A)^l$ is the Leontief inverse, and V intermediate purchase by sector j from sector i, and V^j is the value of the value added[16] in sector j's output. In input-output relationships, it is customary to assume that intermediate purchases of each input factor by sector j are proportional to its value of production. Thus, $\sum_i X^{ij} = \sum_i a_{ij} X^j$, where $a_{ij} = X^{ij}/X^j$. Then, eq (21) can be rewritten in the following matrix form:

$$X = AX + V \tag{22}$$

Solving eq (22) for X, we have:

$$X = (I - A)^{-1} \cdot V \tag{23}$$

where I is a N by N identity martrix and $(I\text{-}A)^{-1}$ is the Leontief inverse, and V is a vector of the value added. Dividing eq (23) by X to obtain the share of each input in a unit of output in money terms such as \$1 or ₩1, we have:

$$^oP = (I - A)^{-1} \cdot VX^{-1} = (I - A)^{-1} \cdot \bar{V} \tag{24}$$

16) The major items included in the value added are: (1) compensation for employees; (2) business profit and interest income; (3) consumption allowance for fixed capital; and (4) indirect taxes less subsidies (domestic indirect tax only).

where ${}^{O}P$ (= X/X) is the vector of unity and $\overline{V}$ is the vector of the value added per dollar of output ($\overline{V} = V/X$). Eq (24) shows the per dollar of output of each sector in terms of the direct and indirect value added incorporated in the output. In this context, eq (24) is a vector of prices determined by cost elements.

The indirect tax reform will bring about a change in the indirect tax element in the value added. Thus, the term $\overline{V}$ will change due to the tax reform and the value of the gross output will also change even though physical production is constant. Let's decompose $\overline{V}$ in the I/O table into the component of net value added (V^*) and indirect taxes (t); $\overline{V} = V^* + t$. Inserting $\overline{V}$ into eq (24), price will be ${}^{O}P = (I\text{-}A)^{-1} . (V^* + t)$.

Now the tax reform replaces the existing indirect taxes, which imposes the tax on the value of output, with the new value added tax (VAT) of which tax base is the value of net value added (V^*). Then, the new tax rate in the I/O context will be $t' = V^* \cdot r$, where r is the vector of new VAT rates and t' is the tax rate in terms of output value. Then, the new value added coefficients ($\overline{\overline{V}}$) will be:

$$\overline{\overline{V}} = V^* + V^* \cdot r = V^* (1 + r) \qquad (25)$$

By inserting eq (25) into ${}^{o}P$, we have a new price quation in the following from:

$${}^{1}P = (I - A)^{-1} \cdot (V^* (1 + r)) \qquad (26)$$

From above, $V^* = \overline{V}\text{-}t$. By replacing V^* with $(\overline{V}\text{-}t)$ in eq (26), we have a new price equation which reflects the impact of substituting the VAT for the old indirect taxes.

$${}^{1}P = (I - A)^{-1} \cdot ((V - t) \cdot (1 + r)) \qquad (27)$$

Now consider the impact on the price of imposition of the Special Consumption Tax (SCT), the single-stage sales tax, and the National Defense Surtax (NDS). The SCT is levied *ad valorem* on the selling price of commodities prior to the imposition of the VAT. Thus, its tax base is equivalent to the net output value of commodities. The NDS is imposed on the SCT. Define r^5 as the SCT rate and r^n as the NDS rate. The additional impact of these two taxes on the price after the VAT imposition can be written:

$$\Delta P = [\{(I - A)^{-1} \cdot ((\overline{V} - t) \cdot (1 + r))\} - (\overline{V}\text{-}t) \cdot r] r^s (1 + r^n) \qquad (28)$$

where $(\overline{v}\text{-}t)r$ represents the share of the value added tax in the output value and r^s $(1 + r^n)$ is the combined effective tax rate of the SCT and NDS. Thus, the term in large brackets represents the net value of output in a no-tax situation. In this context, P is an additional impact on price coming from the imposition of two new taxes. The final price vector can be written by combining eq (27) and (28).

$$'P^* = 'P + \Delta P$$
$$= Z(1+r^s(1+r^n)) - ((V-t)\cdot r\cdot r^s(1+r^n)) \quad (29)$$
$$: Z = (I-A)^{-1}\cdot((V-t)\cdot(1+r))$$

As a final step of price analysis, 'P* in index form can be converted into actual price in monetary units and price differences (dP) will be obtained.

III. Empirical Results and Discussion

Consumer goods are grouped into 8 categories: main cereal, subsidiary foods, other foods, housing, fuel and lights, clothing, medical care and education, and other goods and services. Their classification correspond to the industry classification used in 1975 Input-output (I/O) Table (60 and 392 sectors respectively).

Table 1-I and -II reports the first-stage estimates of demand for each consumer group. The β parameters reflect the impact of real consumption and thus, determine whether goods are luxuries or necessities. The Y^{ij} parameters measure the change in the i-th budget share following a 1% change in p^j with real consumption held constant. The estimates of β indicates that the following are necessities: subsidiary food, housing, clothing, medical care and education for rural households; and main cereal, other foods, housing, medical care and education, and other goods and services for urban households. A large number of Y coefficients for rural households (17 out of 49) are significantly different from zero, while for urban households only 9 out of 49 Y coefficients are statistically significant.[17] In this evaluation, the critical value of t at $\alpha = 0.1$ (± 1.68) was used.

We can proceed to complete the stochastic model of the system of demand equations by imposing the following restriction of symmetry across the equations:

$$\gamma^{ij} = \gamma^{ji} \quad (30)$$

17) This suggests that the demand structure of the urban is more complex than the rural and its improvement requires the inclusion of additional variables such as demographic structure and more detailed data on the distribution of consumption budgets. Due to the data limitations, instead of expanding the model, the level of significance is relaxed a little bit to $\alpha = 0.3$ (t = 1.05), the number of non-zero Y coefficients increases to 21 and 24 for rural and urban households, respectively.

[Table 1-II] Homogeneity Imposed Parameter Estimates; the Urban Households.

...ters / ...dity i	$*\alpha_2^i$	β_2^i	γ_2^{i2}	γ_2^{i3}	γ_2^{i4}	γ_2^{i5}	γ_2^{i6}	γ_2^{i7}	γ_2^{i8}	R^2	D.W.	ρ
...ary	-0.4191	-0.0827 △	0.1129*	-0.0359	0.1750 △	0.0873 △	0.0698	0.0637	0.1108 △	0.548	1.7535*	0.1386
	(-0.8716)	(1.0316)	(2.2139)	(-0.6189)	(1.3365)	(-1.2529)	(0.6271)	(0.5876)	(-1.302)			(0.8135)
	-0.2455	0.014	0.0121	0.0817*	-0.1156*	0.0265	-0.099*	0.0768	-0.0424 △	0.8678	1.8354	-0.1454
...)	(0.9803)	(-0.34)	(0.4799)	(3.0121)	(-1.9051)	(0.7544)	(1.9915)	(1.4799)	(-1.1096)			(-0.8802)
...g (4)	1.102	-0.1807*	-0.041	0.1*	-0.3612*	0.0857 △	0.4109*	0.[illegible]228	-0.0239	0.5443	1.971	0.9374*
	(2.9570)	(-2.6279)	(0.8894)	(1.811)	(-2.0801)	(1.3034)	(2.2411)	(1.041)	(-0.1953)			(19.5214)
	-0.1306	0.0713*	0.0101	-0.0299 △	0.0534	0.0533*	-0.097 △	0.0486	0.0358	0.4830	1.8258	0.5378*
...)	(-0.7064)	(2.2288)	(0.473)	(-1.1418)	(0.8408)	(1.8336)	(-1.5945)	(0.9915)	(-0.7964)			(4.1232)
...g (6)	-0.3173	0.0301	0.0082	0.0011	0.0513	-0.0308	0.1071 △	-0.0321	-0.0977 △	0.4927	2.03321	0.5891*
	(-1.0722)	(0.5838)	(0.2338)	(0.0249)	(0.4904)	(-0.6532)	(1.0411)	(0.4140)	(-1.2986)			(4.8413)
...l care &	1.044*	-0.2092*	-0.0005	0.0038	-0.1582	0.0047	0.0241	0.121 △	-0.0144	0.4192	2.3013	0.5468*
...on (7)	(2.9999)	(-3.4689)	(-0.0135)	(0.0768)	(-1.318)	(0.0859)	(0.2082)	(1.3061)	(-0.1688)			(4.4083)
...Goods &	0.1821	-0.0094	-0.0317	0.0107	-0.0072	-0.0374	-0.1055 △	0.1219 △	0.1753*	0.5468	1.8710	0.3093*
...s (8)	(0.5403)	(-0.1658)	(-0.8513)	(0.2435)	(-0.6658)	(-0.7439)	(-1.1851)	(1.5018)	(2.594)			(2.1008)

...ficant at $\alpha = 0.1$
...ficant at $\alpha = 0.3$
...lue in parenthesis and $i = 2, 3 \ldots 8$).

[Table 1-I] Homogeneity Imposed Parameter Estimates; the Rural Households.

Parameters / commodity i	$*\alpha_i^*$	β_i^*	γ_{i2}^*	γ_{i3}^*	γ_{i4}^*	γ_{i5}^*	γ_{i6}^*	γ_{i7}^*	γ_{i8}^*	R^2	D.W.	ρ
subsidiary	-0.0640	-0.0173	0.0912*	-0.05	-0.2319	0.01	0.1003△	0.185*	0.006	0.5247	2.0999	0.3338*
food (2)	(0.0239)	(-0.5333)	(2.7696)	(-1.2627)	(-2.6707)	(0.2035)	(1.2501)	(2.5086)	(0.0095)			(2.3416)
other	-0.1194	0.0367*	0.0986*	0.0321*	-0.0686*	0.0434*	-0.0331	-0.0011	-0.0197	0.0722	1.8361	0.1447
food (3)	(1.0562)	(2.344)	(0.6249)	(1.7609)	(-1.7824)	(1.7811)	(0.9286)	(-0.0032)	(0.709)			(0.3607)
Housing (4)	-0.2216	-0.011	0.0235	0.031	0.0119	-0.0092	0.2170*	-0.20348	-0.2589*	0.8091	1.9782	-0.0324
	(-0.9116)	(-0.3259)	(0.7047)	(0.8314)	(0.1542)	(0.1728)	(2.9902)	(0.485)	(4.6316)			(-0.2104)
fuel &	0.5418*	0.0201	0.0104	0.0416	-0.0262	0.0191	-0.0741*	0.0049	0.0819*	0.7860	1.8968	0.5166*
light (5)	(3.5267)	(0.9263)	(0.3847)	(0.6665)	(0.8366)	(0.3222)	(1.4721)	(- 0.1048)	(3.8148)			(3.9232)
clothing (6)	0.1368	-0.0432*	0.0403*	0.0351△	0.0168	-0.0132	0.1163*	0.007	-0.0332	0.7333	1.8471	-0.0082
	(0.7777)	(-1.7619)	(1.6589)	(1.2937)	(0.2976)	(- 0.3416)	(2.1966)	(0.1349)	(0.8122)			(0.0533)
medical care &	0.2369	-0.0506	0.0462	0.0562	0.3869*	0.1661*	0.0716	0.2539*	0.0208	0.6008	2.0651	0.2779*
education (7)	(0.689)	(-1.0786)	(0.9682)	(-0.9921)	(-3.1539)	(2.3175)	(0.6335)	(2.4)	(0.2328)			(1.8457)
Other Goods &	-2.1648*	0.5167*	0.0389	-0.0028	0.0745	0.1074△	0.3193*	0.0309	0.3324*	0.7803	2.0904	0.3984*
Services (8)	(-4.1832)	(7.1977)	(-0.5318)	(0.0316)	(0.375)	(1.0001)	(- 1.7306)	(0.1865)	(2.2798)			(2.9028)

* Significant at $\alpha = 0.1$
△ Significant at $\alpha = 0.3$
(t value in parenthesis and i = 2, 3. . . .8).

The imposition of eq (30) requires the use of the variance-covariance matrix of the residuals as a part of the estimation structure.

The results of the estimation are shown in Table 2-I and -II. Due to a system of demand share equations being estimated simultaneously, many statistical tests commonly used to evaluate the single equation model cannot be employed in this study. Instead, the measure of pseudo-R^2 is used as an indicator of the goodness-of-fit. The likelihood ratio is used for testing hypotheses on the significance of restrictions on parameters, and asymptotic t-statistics are employed for the evaluation of the individual coefficient estimates.

The pseudo-R^2 measures the goodness-of-fit for the model by comparing the explained vs. the unexplained variance in a system of equations. Berndt et al. defined it as "$(1-D^R)/D^F$", where D^R is for the determinant of residual moment matrix produced in the FIML process with full restrictions imposed, and D^F for that of actual shares, free of restrictions.[18] However, unlike the R^2 from the OLS, the value of pseudo-R^2 is not confined to the zero-to-one interval and is a less powerful statistical indicator for the goodness-of-fit. The calculated pseudo-R^2 is 0.9103 for rural households and 0.8857 for urban households, both of which represent very respectable goodness-of-fit for the system of equations.

The significance of the restrictions on the parameter estimates is checked through the use of the likelihood ratio, which is directly related to the pseudo-R^2. The likelihood ratio defined as "$-n \cdot \log [1-(\text{pseudo-}R^2)]$", where n, the number of observations, is distributed asymptotically as a chi-square variable with the degree of freedom equal to the number of independent slope coefficients (35 in this study). The null hypothesis with reference to the restrictions of the parameter estimates are rejected if and only if the respective test statistics exceed the critical value. As shown in Table 3, the restrictions on parameters are not rejected at $\alpha = 0.01$. At this stage, the monotonicity of cost functions is checked by the fitted values of the expenditure shares. Since all 416 (52 periods by 8 share equations) fitted expenditure shares for each rural and urban households, respectively, are positive, the monotonicity condition is satisfied.

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18) E.R. Berndt, M.M. Darrough, and W.E. Diewert, "Flexible Functional Forms and Expenditure Distributions: Application to Canadian Consumer Demand Functions." *International Economic Review,* Oct. 1977, pp. 651-675.

[Table 2-I] Homogeneity and Symmetry Imposed Parameter Estimates (Rural Households)

parameters commodity i	$*\alpha_i$	γ_i^1	γ_i^2	γ_i^3	γ_i^4	γ_i^5	γ_i^6	γ_i^7	γ_i^8	β_i
main food (1)	2.2406	0.4568	-0.0642	-0.0382	0.0851	-0.0373	0.0605	-0.1006	-0.0520	-0.6711
subsidiary food (2)	-0.2167* (-1.2829)	0.0642	0.0704* (1.3459)	-0.0099 (-0.3473)	0.0366* (1.0855)	0.0123 (0.4074)	-0.0512* (-1.0834)	-0.0085 (0.0786)	0.0145 (0.1477)	0.0808* (1.5140)
Other foods (3)	1.425* (-2.3108)	0.0382	-0.0099	-0.0438* (1.0862)	0.0021 (0.0424)	0.0078 (0.1695)	0.0415* (1.0503)	-0.0277 (-0.5622)	-0.0152 (-0.2622)	0.0891* (2.9332)
Housing (4)	0.2405 (0.5266)	0.0851	0.0366	-0.0021	0.0249 (0.1674)	0.0548* (1.0970)	0.0315 (0.4007)	-0.0233 (-0.1782)	-0.2095* (-1.9318)	-0.04021* (1.0499)
fuel & light (5)	0.2199* (1.5523)	0.0373	0.0123	0.0078	0.0548	0.0170 (0.3020)	-0.0058 (-0.0686)	-0.0527* (-1.0786)	-0.0077 (-0.0980)	-0.0700* (1.4758)
clothing (6)	0.1007 (0.1664)	-0.0605	0.0512	0.0415	0.0315	0.0058	0.0939* (1.0805)	-0.0079 (-0.0789)	-0.0531* (-1.0848)	-0.0355 (0.3872)
med care (7) & education	0.7884* (-2.0141)	0.1096	0.0085	0.0277	0.0233	-0.0527	-0.0079	0.1369* (1.6398)	0.0928* (1.2725)	0.1933* (2.2888)
Other Goods & Services (8)	-0.3735 (0.9710)	-0.0520	0.0145	0.0152	0.2075	-0.0077	-0.0531	-0.0928	0.2282* (1.3081)	0.4536* (3.8815)

* Significantly different from zero at $\alpha = 0.3$

Note: 1) Coefficients without t-value are generated from restriction imposed

2) Log of likelihood function = 1318.15

3) Pseudo-$R^2 = 0.8857$

4) (Asymtotic t value in parenthesis)

[Table 2-II] Homogeneity and Symmetry Imposed Parameter Estimates (Urban Households)

parameters / commodity i	$*\alpha_2^i$	γ_2^{i1}	γ_2^{i2}	γ_2^{i3}	γ_2^{i4}	γ_2^{i5}	γ_2^{i6}	γ_2^{i7}	γ_2^{i8}	β_2^i
main	0.9503	0.1894	-0.0937	-0.0314	0.1546	-0.0090	-0.1126	0.2194	-0.0883	-0.0263
food (1)										
subsidiary	0.4649	-0.0937	0.0980*	-0.0092	0.0515*	0.0149	0.0497	-0.0609*	-0.205	0.0295*
food (2)	(0.6707)		(2.2867)	(-0.2045)	(1.2115)	(-0.02968)	(0.6309)	(-1.092)	(-0.2693)	(1.6863)
Other	-0.2075	0.0314	-0.0092	0.0963*	0.0218	-0.0066	0.0730*	-0.0938	-0.0693*	0.0304*
foods (3)	(-0.5544)			(2.2264)	(-0.2221)	(-0.0801)	(1.6884)	(-1.4169)	(-2.6285)	(1.9718)
Housing (4)	0.098*	0.1546	0.0515	-0.0218	0.1646*	0.0536	0.1347*	-0.2401*	-0.0121	-0.2125*
	(2.3100)				(1.8273)	(0.7558)	(1.6461)	(-2.2969)	(0.0774)	(-1.8635)
fuel &	-0.1605	0.0090	-0.0149	-0.0066	0.0536	0.0512*	-0.0607*	-0.0460	0.0144	0.0221*
light (5)	(-0.7431)					(2.0304)	(-1.2979)	(-0.4459)	(0.2873)	(3.4553)
clothing (6)	0.0646	-0.1126	0.0497	0.0730	0.1347	-0.0607	0.1956*	-0.1401*	-0.1396*	-0.0493*
	(-0.1966)						(1.2267)	(-1.7174)	(-2.3150)	(-2.7152)
med care (7)	-0.0613	0.2134	0.0609	-0.0938	-0.2401	-0.0460	-0.1401	0.1977*	0.1638*	0.0135
& education	(0.811)							(1.8362)	(3.0923)	(0.0974)
Other Goods	-0.0111	-0.0883	0.0205	-0.0693	0.0121	-0.0144	-0.1396	0.1638	0.1274*	0.1826
& Services (8)	(-0.5560)								(2.7472)	(1.3330)

* *Significantly different from zero at* $\alpha = 0.3$

Note: 1) Coefficients without t-value are generated from restriction imposed

2) Log of likelihood function = 1318.15

3) Pseudo-$R^2 = 0.8857$

4) (Asymtotle t value in parenthesis)

[Table 3] Test of Hypothesis

	Rural household	Urban household
Test statistics	54.4543	48.9816
Degree of freedom	35	35
Critical Chi-Square value ($\alpha = 0.01$)	57.29	57.29
Test result	not rejected	not rejected

The evaluation of individual parameter estimates is performed through the use of asymptotic t-statistics, which is calculated as the ratio of the value of parameter estimates to that of standard error. For rural households, 23 out of 42 coefficients are significantly different from zero (4 out of 7 constant terms, 6 out of 7 income coefficients, and 13 out of 28 price coefficients), while 25 parameter estimates are non-zero for urban households (1 out of 7 constant terms, 6 out of 7 income coefficients, and 18 out of 28 price coefficients). This indicates to us that the consumption behavior of the urban household is more flexible and sensitive to the changes in prices than the rural household, whose demand pattern is rather heavily influenced by the constant terms and income coefficients.

The cost-determined prices of 8 aggregated commodities are subject to change when the portion of the value added in cost structure varies along with the change in indirect taxes. Theoretically, the use of I/O Table for the purpose of measuring these changes in prices does not cause any particular complications (see eq (21) through (29) in previous section). However, the composition of the value added in I/O Table necessitates some minor adjustment on the value added coefficients to be used in the measurement of price change.

The results of the application of actual tax rates specified in the reform to Korean I/O Table in 1975 are reported in Table 4. The direct and indirect impact of substituting the VAT for turn-over taxes and excise taxes on the price is a rather mixed one. Firstly, the price of main food, which is exempted from the VAT, declined slightly (0.17%), but more than indirect tax burden per "dollar" output (0.13%). Secondly, prices of subsidiary food, other food and housing are decreased by 0.054%-3.96%. Thirdly, those of fuel and light, clothing, medical care and education, and other goods and services are increased by 0.02%-2.13%. These price changes are consistent with the theoretical assertion that relative prices will rise for commodities with lower tax rates originally (fuel and light, clothing, medical

[Tablr 4] Impact of the Reform on Prices (°P and dP: 1973, 1975, and 1976)

			(1) main food	(2) subsidiary food	(3) other food	(4) housing	(5) fuel & lights	(6) clothing	(7) med. care & education	(8) others
Pre-reform price	1973		115	223	276	2369	201	3845	8747	100
	1975		212	341	520	2985	305	5225	14332	253
	1976		263	495	653	3626	372	6658	19119	288
value added/output			0.8316	0.4607	0.3415	0.4925	0.2072	0.2862	0.6322	0.5790
indirect tax/output			0.0013	0.1239	0.0815	0.0170	0.0240	0.0118	0.0098	0.1258
Change in prices	1973	VAT Only	-0.1955	1.2042	-11.3760	-93.8124	4.2009	83.4960	31.1904	0.0360
		VAT, SCT, NDS	-0.1955	-0.6244	18.6048	30.0863	4.2009	83.4960	(31.904)	5.0940
	1975	VAT Only	-0.3604	-1.8414	-20.5400	-118.2060	6.3745	111.2925	45.8624	0.0506
		VAT, SCT, NDS	-0.3604	0.9548	33.5920	37.9095	6.3745	111.2925	45.8624	7.1599
	1976	VAT Only	-0.4471	-2.6730	-25.7935	-143.5896	7.7748	141.8154	61.1808	0.0576
		VAT, SCT, NDS NDS	-0.4471	-1.3860	42.1838	46.0502	7.7748	141.8154	61.1808	8.1504

care and education) and/or higher value added/output ratio (other goods and services).

However, the combined impact of the VAT, SCT, and NDS on prices shows a definite increase in prices except in main and subsidiary food, two categories largely exempted from the SCT and NDS. Thus, the original intention of imposing the SCT and NDS on top of the VAT to reduce the regressiveness of the indirect tax system is correctly reflected in the price structure after the reform. The most price-sensitive commodity of these additional excise taxes is other food, whose price increased by 10.84% solely due to these taxes, and the least is subsidiary food (0.26% increase). In addition, these taxes raised the price of housing by 5.45% and that of other goods and services by 2.81%.

Three sets of tax runs are simulated in this section for each of three different time periods: 1973, 1975, and 1976. In the first set, Korean indirect taxes are reduced across the board by 75.3% except tobacco (67.7%) and at the same time, a uniform rate of 10% VAT (statutory rate) is applied to the value added portion of output. The main purpose of this tax run is to measure the distributional impact of the reform's main feature, the replacement of the turn-over and various excise taxes by the value added tax (VAT). In the second set, an attempt is made to estimate the combined impact of imposing the VAT, Special Consumption TAX (SCT), and National Defense Surtax (NDS) together on consumption. The result of this tax run represents the actual incidence of the reform in the framework of this study.

1. Results of the First Set of Tax Run

The initial result of the incidence of the VAT in the money metric is presented in Table 5. It is the first order approximation that determines the incidence result; it ranges from 224 to 527 for the rural household and from 1376 to 1892 for the urban household. The sum of the higher order approximation above the first, which is commonly assumed to be zero in empirical studies, has a non-zero value and positive impact on the final value of the money metric. However, its influence on the determination of the incidence result is not so significant; only 2.42-6.81% of final value of money metric is counted for the rural and 0.4-2.69% for the urban. In general, the primary source of distributional changes would be the difference in the spending pattern of various socio-economic groups. In this context, relative prices play a very important role in the determination of the incidence result. Empirical measurement of the distributional results of the VAT show, as expected, apparent regressiveness in the new tax system.

[Table 5] **The Money Metric Measure of the Reform Impact: The VAT = 0.1**

(in Won)

	1973		1975		1976	
	Rural	Urban	Rural	Urban	Rural	Urban
1st Order	224.6591	1376.1409	527.4587	1892.4241	454.5093	845.7234
2nd Order	16.2831	38.1687	13.0011	7.9231	22.9592	49.4903
3rd Order	0.1335	-0.0731	0.0553	-0.3335	0.2484	0.0549
4th Order	0.0037	-0.0034	0.0022	-0.0173	0.0070	0.0008
Money Metric	241.0794	1414.3331	540.5173	1899.8964	477.7238	1895.2694

Table 6 reveals that the rural household is experiencing an increase of utility by the range of 0.19% to 0.37%, depending upon the different timing of the reform, and the urban household by 0.82% to 0.87%. It is also exemplified in here that: (1) the ratio of the change in money metric utility of the rural to the urban is greatly different from unity, ranging from 0.2317 to 0.3814; and (2) the sign of the change in utility is consistently plus (increase) regardless of the income group and of the timing of

[Table 6] **The Money Metric Measure of the Incidence (the Change in Real Consumption): VAT (0.1) only**

	(1) Rural	(2) Urban	(3) (1)/(2)
1973	0.19	0.82	0.2317
1975	0.37	0.97	0.3814
1976	0.30	0.92	0.3261

the Reform. These results show clearly that the urban would benefit more than the rural from the change in relative prices caused by the introduction of the VAT.

Since the impact of the indirect tax burden is mainly coming from the use-side of the income, the primary determinant in the incidence picture is the variation in the change of consumption share of individual commodities among the rural and urban household. In this context, the empirical result of the study—the regressiveness of the VAT—requires some explanation. The imposition of general VAT definitely implies regressive incidence. In contrast to the rich, the poor households tend to allocate a higher proportion of their budget to less sophisticated goods, generally associated with high value added/output ratio and/or low indirect taxes, of which prices rise relative to those characterized by low value added/output ratio and/or high indirect taxes. However, when VAT loses its generality by allowing exemptions for the less sophisticated goods, which is the case in this study, the pattern of the change in prices and consumption is no longer guaranteed to follow the above scenario. In this case, the result of incidence is totally dependent upon the variation in the change of consumption share, after the price change, of commodities among the rural and urban households.

[Table 7] **Changes in the Consumption Expenditure on Price-Declined Commodities (in % changes weighted by consumption share)**

	VAT only			VAT, SCT, and NDS		
	(1) Rural	(2) Urban	(3) (1)/(2)	(4) Rural	(5) Urban	(6) (4)/(5)
1973	-0.7018	-0.2325	3.0185	-0.5030	-0.5321	0.9453
1975	-0.6254	-0.5158	1.2125	-0.2527	-0.2706	0.9339
1976	-0.7035	-0.2206	3.1890	-0.4663	-0.4028	1.1576

The figures represent in percentage terms the spending reduction for the consumption of commodities whose prices has fallen such as main food, subsidiary food, other food and housing. This reduction intuitively indicates the reverse impact on the consumption expenditure on commodities whose price has increased. This is due to the assumption of the balanced-budget incidence as well as the assumption of no change in the source-side of income. These assumptions guarantee that consumer expenditures are not affected by the reform, the result being that noted above. The change in consumption pattern, regardless of its direction, is composed of the price impact as well as the substitution impact among commodities.

The regressiveness of the VAT can be explained by the transfer of consumer expenditures from price-declined commodities onto price-increased commodities. The ratio of the consumption change, presented in the 3rd and 6th columns of Table 7, indicates that the rural households transfer three times more of their consumption budget from price-declined commodities onto price-increased commodities than the urban households. Consequently, it is clear that the rural households' tax payment will increase relative to that of the urban households. Or the money metric measure of the incidence of the Reform shows smaller increase of utility in the rural households than in the urban: 0.19%-0.37% increase in utility for the rural and 0.82-0.97% increase for the urban household (see Table 6).

2. Results of the Second Set of Tax Run

The incidence of the VAT taken alone is shown to be regressive. However, our main concern on this reform is the measurement of overall impact of the reform, which consists of 3 taxes: the VAT, SCT, the NDS. In the second set of tax run, an attempt was made to measure the incidence result of the combined impact of three taxes. The progressive elements in SCT and NDS, which impose taxes only on the consumption of selected luxury goods, are expected to reverse or at least reduce the regressive impact of the VAT.

Table 8 reports the money metric measure of the incidence of the present indirect tax system (3 taxes inclusive). Again the first order approximation plays a major role in the determination of the incidence result. It varies from -₩1576 to -₩2268 for the rural and -₩2265 to -₩2856 for the urban households. The progressive elements in the SCT

[Table 8] The Money Metric Measure of the Reform Impact: The VAT, SCT, and NDS Together.

(In Won)

	1973		1975		1976	
	Rural	Urban	Rural	Urban	Rural	Urban
1st Order	-1576.4151	-2265.5303	-1764.1381	-2565.9440	-2267.9519	-2855.6646
2nd Order	5.9317	4.1682	15.4948	22.3043	13.6572	12.9488
3rd Order	0.3495	0.8449	-0.0360	-0.1133	0.1774	0.5063
4th Order	-0.0301	-0.0746	-0.0119	-0.0225	-0.0235	-0.0560
Money Metric	-1570.1640	-2260.5918	-1748.6912	-2543.7755	-2254.1408	-2842.2655

and NDS override the regressive impact of the VAT, and overall distribution result of the reform becomes progressive. Due to the reform, both the rural and urban houdseholds lose utility in the range of ₩1570-2254 and of ₩2260-2842, respectively. These reductions of utility are equivalent to, as reported in Table 9, the loss of real consumption in the range of 1.19-1.39% for the rural and of 1.29-1.38% for the urban households.

[Table 9] The Money Metric Measure of the Incidence (the Change in Real Consumption): the VAT, SCT, NDS Together

(in % change)

	(1) Rural	(2) Urban	(3) (1)/(2)
1973	-1.26	-1.30	0.8692
1975	-1.19	-1.29	0.9225
1976	-1.39	-1.38	1.0072

	Laspeyres	Rural MM	Paasche	Laspeyres	Urban MM	Paashe
VAT = 0.0794	0.89	0.91	0.93	1.68	1.71	1.71
VAT = 0.1	0.18	0.19	0.21	0.79	0.82	0.83
VAT, SCT, NDS	-1.27	-1.26	-1.26	-1.31	-1.31	-1.30

* MM is for the money metric.
* Signs of Laspeyres and Passche indices were changed to make comparison easier. Thus, positive means the decrease in cost of living and vice-versa.

The significance of the higher order approximation in the determination of the incidence result waned away to less than 1% of the total money metric value (0.4% and 0.22%), even though their absolute values are not zero; 6-15 for the rural and 4-22 for the urban. However, their impact on the final value of the money metric is negative in contrast to the result of first tax run with the VAT only. It hints at the existence of a fairly strong price impact on the consumption of some specific commodities such as other food, housing, and other goods and services, where prices increased notably by the SCT and NDS (see Table 4).

The sign of the change in utility is consistently negative, regardless of different timing of the reform and the income groups. The reason for the reverse in the sign as compared to the first tax run could be found by examining the ratio of the change in money metric utility of the rural to the urban households. In contrast to the result of the first set of tax run, this ratio is very close to 1 ranging from 0.9225 to 1.0072 (see Table 9). This should be understood as an indication of an identical movement in the change of the consumptions after the reform among the rural and urban households. Table 7 supports this contention. In column (6) these ratios were reported for the different timing of the reform: 0.9453, 0.9339, and 1.1576. They are very close to unity, which implies that the rural and the urban households are responding to the reform impact almost with the same intensity of changing their consumption behavior over the commodities. Then, the result of the incidence will be naturally progressive, because the urban households have a tendency to spend a relatively higher share of their expenditure on the consumption of the price-increased luxury goods. However, note that the progressiveness is very mild. Thus, the possibility of the neutrality of the reform in distributional aspects should not be disregarded.

3. Comparison of Three Methods.

Up to this point, the main emphasis of this study has been on measuring and analyzing the incidence result by using the concept of the money metric. At this point, let us examine the alternative measure of incidence in order to appraise their accuracies as well as errors in theoretical and empirical context. Three measures have been used in the empirical measurement: the money metric, the cost of living (Laspeyres and Paasche index), and the ratio of tax burden.

(1) The Money Metric and the Cost of Living Index

The first question to be raised on the relationship between the money metric and the cost of living index is whether the money metric can represent true utility index on the measurement of the cost of Living. According to the economic index theory, Laspeyres index overestimates and Paasche index underestimates the true utility index. If the money increasing prices, and vice-versa in case of decreasing prices. If the money metric lies within this interval, the empirical proof of the existence of true utility index based on the convex utility function is provided. Table 10 reports the result of distributional impact of the reform generated by applying the measure of the money metric and the cost of living index to 1973 data. The second row represents the result of the third tax run, in which the VAT rate of 0.0794, instead of the statutory rate of 0.1, is applied to generate a tax situation similar with Hong's study. Rather surprisingly, as seen in the following summary, all the money metric values are within the upper and lower limits specified by the two cost of living indices. Then, within limits of the data set and consumption behavior, it can be said that the money metric measure is an accurate indicator of utility change.

According to Table 10 incidence results are all consistent regardless of the measure used. The results are regressive for the first and third tax runs and progressive for the second tax run. Let us compare, at this stage, Hong's result with the outcome of this study. Hong's study reports the regressive incidence result measured using both the Laspeyres and Paasche indices. It was found that the cost of living for the rural households increased by 0.26% and 0.22%, respectively, which is higher than that for urban (0.1375% and 0.0511%). The third tax run in this study also reports the regressive incidence. However, the cost of living for both households decreased, but a little bit more for the urban (0.91% vs. 1.71%). All indicate regressive incidence. However, some explanation is needed on the conflict in the directions of the change in cost of living or consumers' utility between Hong's and this study. When the VAT rate of 0.1 is used, the magnitude of the gain in both measures declined drastically. Moreover, the combined impact of VAT, SCT, and NDS turns the gain into a net overall loss. The combined effect is progressive rather than regressive.

[Table 10] Distributional Impact of the Reform Measured by the Cost of Living[a)] and Money Metric[b)]; 1973

(In % change)

	Laspeyres		Paasche		Money Metric	
	Rural	Urban	Rural	Urban	Rural	Urban
Hong's Study[c)]	0.26	0.1375	0.22	0.0511		
This Study (VAT -0.0784)	-0.89	-1.68	-0.93	-1.71	0.91	1.71
(VAT -0.1)	-0.18	-0.79	-0.21	-0.83	0.19	0.82
VAT, SCT NDS Together	1.27	1.31	1.26	1.30	-1.26	-1.30

a) Coat of living: + → increase
- → decrease

b) Money metric: + → utility increase
- → utility decrease

c) Case of the
Complete replacement of Old Excise taxes by VAT and Agricultural sector being exempted from the VAT.

(2) The Money Metric and the Ratio of Tax Burden

The tax burden ratio (T/Y ratio), specified as the rate of tax payment to the income, is the oldest measure of gauging the incidence result. Due to the use of income (Y) instead of consumption expenditure (C), it is the direction of the incidence, which has any relevance in its comparison with the money metric measure. Thus, it is expected that the higher T/Y or T/C ratio will result in more loss of the money metric utility. However, the magnitude of the change in tax burden ratio cannot be directly linked to that in the money metric.

Table 11 shows, in comparative form, the incidence results obtained by applying three approaches to 1976 data: Heller's study (T/Y ratio), the money metric, and the T/C ratio. Two versions of T/C ratios are calculated for comparison purpose: one under the assumption of the constant consumption expenditure share and the other of the variable consumption expenditure share. Heller's study indicates the result of very marginal progressive incidence. In this context, for the reference purposes, the money metric value in 1975 showing the progressive incidence is reported here: -1.19 for the rural and -1.29 for urban.

[Table 11] Distributional Impact of the Reform Measured by the Money Metric and Tax Burden Ratio; 1976.

(Unit in %: % change in ( ))

		rural	urban
Heller's study[a]		4.6 → 4.3 (-6.5)	7.74 → 8.1 (4.7)
Money metric[b]		-1.39	-1.40
Ratio of tax burden[c] (t/c)	A[d]	5.07 → 6.61 (30.37)	4.95 → 6.64 (34.14)
	B	5.07 → 6.67 (31.56)	4.95 → 6.70 (35.35)

Note: → indicates the change from pro-reform to post-reform

a) t/y ratio under constant consumption expenditure share

b) based on the imposition of full statutory tax rates (VAT, SCT, NDS inclusive)

c) ratio of tax payment to consumption expenditure

d) A: under the constant consumption expenditure share
B: under the variable consumption expenditure share

e) the money metric value in 1975 is -1.26 and -1.30.

Two versions of T/C ratios indicate the regressive incidence results. In Heller's study, the original distribution of the tax burden was progressive itself, and that progressiveness further improved through the reform. Meanwhile, both T/C ratios imply that the pre-reform tax burden distribution was regressive, and this regressiveness has been ameliorated by the reform. In this context, the net impact of the reform is definitely toward the improvement of the tax burden distribution. Whether the final result is progressive or not depends upon the original distribution of the tax burden. Heller used a set of rather sophisticated but arbitrary assumptions on the distribution of each tax revenue over the farm and non-farm groups, each of them being composed of 10 sub-groups. Meanwhile, this study utilized the historical data on the consumption behavior to estimate parameters, of which sign and magnitude determine the distribution of tax burden through the consumption. To make a judgement on which one is superior is not a simple matter. However, understanding the basic framework of the analysis will always greatly enhance the value of the analysis as well as its implications.

IV. Conclusion

The main objectives of this research have been; a) to develope a model for the measurement of indirect tax incidence in terms of the economic welfare, b) to apply it to the Korean Indirect Tax Reform of 1977, and c) to compare the result with two commonly used method.

The major changes in welfare estimated through the money metric measure (MMM) are captured in the first order Taylor series expansion (91-94%). No significant information is added beyond the fourth order expansion.

The measured incidence based on 1975 price and expenditure data shows that the distributional impact of the VAT (10% rate) alone is clearly regressive. This can be explained by the rise in relative prices of commodities with lower tax rates originally and/or high value added/output ratio, which occupies the main part of the rural households' consumption expenditure. Meanwhile, the impacts of both the Special Consumption Tax (SCT) and the National Defense Surtax (NDS) are clearly progressive, which is a natural outcome of the selective excise tax on some luxury goods. The combined impact of the VAT, SCT, and NDS on the change in welfare, however, shows a mild progressiveness; both the rural and urban households' welfare declined, but more for the urban (1.19 vs 1.40% respectively). The regressive impact of the VAT is offset by the progressive impacts of the SCT and NDS. This is primarily attributable to the new tax rate and base structure of the SCT and NDS and resulting "use-of-income" effects.

Both the cost of living and tax burden ratio approach are applied to the same data set. The resulting incidences are consistent with the outcome of the MMM. In addition, the estimated percentage change of welfare based on the MMM lies between the upper and lower bound specified by the cost of living index. Thus, the MMM is superior in measuring welfare changes, compared to two alternative measures, not only conceptually but also empirically.

The underlying assumptions of this study are a static national economy and full forward shifting of the tax burden. The measurement of the tax impact is limited to the tax incidence resulting from the changes in prices and consumption patterns caused by the reform. The tax burden may be shifted to both the producer and the consumer and the tax incidence may occur due to the variation in the government's spending patterns. Furthermore, the inclusion of a foreign trade sector and shifts in the production function and consumer's tastes in the long-run will ultimately alter the tax incidence. A tax reform may be considered for administrative efficiency, for improvement of revenue sources, distributional justice and a development strategy. In this context, future efforts should be directed to incorporate the above aspects in the tax incidence analysis.

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