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A Comparative Study of Household Consumption Patterns and Optimal Commodity Tax Rates between Korea and Japan*

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This study compares consumption patterns and optimal commodity taxes between Korea and Japan using household data. We also calculate how the average optimal tax burdens in each income quintile change depending on inequality aversion. The results show that commodity groups with high spending shares in the poor (the rich) should be subsidized (taxed). The magnitudes of subsidization and/or taxation are greater in Korea than in Japan due to more unequal income distribution in Korea. Strengthening inequality aversion causes subsidization and/or taxation to increase. Our results are in line with Srinivasan (1989), Ray (1987 and 1986), and Deaton (1977). Our work contributes to related literature by presenting the optimal commodity taxes using household data of Korea and Japan, taking inequality aversion into account.

JEL Classification: D13, D61, H21
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I. Introduction

In the early stage, optimal commodity taxation was mainly directed to efficiency. Ramsey's (1927) work describes an "efficient" tax design and has become a classical

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paper in the field of optimal taxation. Ramsey (1927, p.51) finds the rule that "the taxes should be such as to diminish the production of all commodities in the same proportion" to be a maximum subject to a given tax revenue. The Ramsey rule in commodity taxes can also be derived by minimizing excess burden or deadweight loss, as Atkinson and Stiglitz (1972, p.100) describe, "so that for each commodity the marginal deadweight loss associated with raising a marginal dollar of tax revenue must be same." The Ramsey rule can be reshaped as the inverse elasticity rule.[1] That is, the theory of optimal commodity taxation implies that tax rates should be inversely proportional to price elasticities of supply and demand if the commodities are unrelated in their consumption.[2] Mirrlees (1975) applies the Ramsey rule to various fields of two class economies. Mirrlees (1975, p.29) remarks that "the differences in demands of the two classes should be proportional, commodity by commodity, to terms that are approximately equal to the changes in aggregate compensated demands resulting from the commodity taxation."

The equity criterion or the distributional issue has been an important aspect concerning the Ramsey rule. On the one hand, Jacobs and Boadway (2014, p.207) discuss that optimal commodity taxes are not employed to redistribute incomes directly; they are utilized only to reduce the distortions of the income tax. On the other hand, Coady and Drèze (2002, p.296) point out that the Ramsey rule has had little impact on commodity taxation in practice. One reason for this small influence is that the motivation underlying that rule (i.e., minimizing the "deadweight loss" associated with indirect taxation) is often overshadowed by distributional consideration. Bargain and Olivier (2014) emphasize the role of redistribution by indirect taxation. Moreover, Bargain and Olivier (2014, p.59) state that "the planner should discourage less the consumption of those commodities which the slope of the Engel curves of the targeted person is the greater. Indirect taxation can be successfully used as a redistributive policy." Our study also proposes a distribution function of indirect taxation based on the model that takes account inequality aversion in the setting of the commodity tax rule.

Whether a government imposes a uniform tax or a non-uniform tax is another controversial issue in the theory of optimal taxation. According to Atkinson and Stiglitz (1972, p.117), welfare loss may still be involved in using uniform tax rather than optimal taxes being small. Meanwhile, Fukushima and Hatta (1989, pp.236-237) argue that, "for the vast majority of commodities that are not particularly related to leisure, their tax rates should be made uniform. When the labor supply

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[1] Ramsey (1927, p.56) refers to the inverse elasticity rule that "the tax *ad valorem* on each commodity should be proportional to the sum of the reciprocals of its supply and demand elasticities."

[2] Meanwhile, Nishimura (2003, p.517) mention "an aspect of taxation based on envy: to determine the tax rate, the preferences of the envying agent and the price elasticity of the envied agent play important roles." Nishimura (2003) argues that the necessities (the goods preferred by the low skilled agent) and the goods with high Hicksian elasticities should be taxed heavily.

elasticities take realistic values,[3] the gain from adopting an optimal commodity tax structure is small compared with that from adopting a uniform one." In a many-person economy, however, the optimal commodity tax rule depends on the distributional characteristic, which is called the many-person Ramsey rule (see Atkinson and Stiglitz, 2015; Coady and Drèze, 2002; Diamond, 1975). Ray (1986) and Murty and Ray (1987) present non-uniform optimal commodity taxes for a many-household economy based on the data from the *Indian National Sample Survey*, which show that redistribution could occur via the optimal commodity taxes.

In this study, we use the data from the *Annual Report on the Family Income and Expenditure Survey* in Korea and Japan and consider inequality aversion in calculating optimal commodity tax rates. We investigate both Japan and Korea is that the revenue and expenditure items of the two countries in the data almost coincide each other. Particularly in the case of workers' households, the expenditure items can be matched with each other to an exact degree, and the observations are classified in detail. We attempt to compare the consumption patterns computing the spending shares of commodity groups and to calculate optimal commodity tax rates based on the model of a many-household economy. Concretely, we employ the income quintiles as a many-household economy and estimate the optimal commodity taxes putting more weight on low-income groups than on high-income groups.

The contribution of our study is as follows. According to the results of our analysis, spending on the commodity groups with high shares in expenditures of the poor should be subsidized. Those commodity groups include food and beverages; housing, fuel, light, and water charges; and medical care in Korea and Japan. In contrast, spending on the commodity groups with higher shares in expenditures of the rich should be relatively taxed more. Those commodity groups are clothes and footwear; transportation; education; and cultural products and recreation in the two countries. However, the magnitudes of subsidization and/or taxation are greater in Korea than in Japan because income distribution was more unequal in Korea than in Japan.

In addition, when the degree of inequality aversion is intensified, governments should increase subsidies for consumption groups with high shares in the expenditures of the poor and impose more taxes on those with high shares in the expenditures of the rich in the two countries. The results of our analysis are in line with the Indian cases of Srinivasan (1989) and Ray (1987 and 1986) and the case of Deaton (1977) in the UK. Moreover, our results can add value, as we present the optimal commodity taxes using household data of Korea and Japan taking inequality aversion.

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[3] The compensated wage elasticity of labor supply is assumed to be 0.5 in Fukushima and Hatta (1989, p.236).

In Section II, we introduce the existing studies on computed optimal or effective commodity tax rates and distinguish our results from those studies. In Section III, we build a model of optimal commodity taxation with a many-household economy. Section IV specifies the model and describes the calculation procedure. Then, Section V explains the data we use and compares the consumption patterns of household between Korea and Japan. In Section VI, we present the results of calculations and interpret them. Section VII provides our concluding remarks.

II. Existing Studies

Dozens of existing studies have examined computed optimal commodity tax rates. We mention such existing studies and distinguish our results from theirs (Refer to Table 6 and Table 7 in Section VI). Korea introduced the value-added tax (VAT) in 1977 at 10% tax rate, and has kept the same rate. Meanwhile, Japan started the consumption tax in 1989 at 3% tax rate and raised the tax rate to 5% in 1997, to 8%

[Table 1] Optimal Commodity Tax Rates in Asano and Fukushima (2006) and Effective Commodity Tax Rates in Urakawa and Oshio (2010)

	Asano and Fukushima (2006)		Urakawa and Oshio (2010)	
	Optimal Commodity Tax Rates in Japan[1)]		Effective Commodity Tax Rates	
	R=20,000	R=50,000	Japan	Korea
Consumption group	%	%	%	%
(1) Food and beverages	6.6	18.2	5.86	8.87
(2) Housing	6.9	19.0	2.12	5.65
(3) Fuel, light, and water charges	6.7	18.5	5.49	9.10
(4) Furniture and household utensils	7.1	19.6	4.76	13.14
(5) Clothes and footwear	7.0	19.2	4.76	9.09
(6) Medical care	6.7	18.3	1.91	3.21
(7) Transportation and Communication	7.1	19.7	9.59	16.51
(8) Education	6.9	18.9	1.04	5.72
(9) Culture[2)] and recreation	7.1	19.5	4.76	10.69
(10) Others (Miscellaneous)	7.2	19.9	7.36	11.71
	Uniform tax rates		Total	
	7.0	19.1	5.61	10.19

Notes: 1) Optimal commodity tax rates in Japan are at levels in which labor is non-taxable and the wage rate is JPY1,500. The elasticity of labor supply shows 0.390 when tax revenue required (R) is 20,000 yen, and its elasticity is 0.388 when R is 50,000 yen.
2) Although Asano and Fukushima (2006) use the term of "reading and recreation," the correct name is "culture and recreation."

Sources: Table 7 in Asano and Fukushima (2006, p.64). Table 3 in Urakawa and Oshio (2010, p.585).

in 2014, and to 10% in 2019. Moreover, Japan introduced the local consumption tax when it raised the tax rate from 3% to 5%. Optimal commodity taxes about the case of Japan have been proposed by Asano and Fukushima (2006). In another study, Urakawa and Oshio (2010) compute the effective commodity tax rates to compare the tax structure between Korea and Japan. Table 1 demonstrates the main results of the two studies.

While many existing studies have illustrated that optimal tax commodity structures are non-uniform, Asano and Fukushima (2006) show a uniform optimal tax structure. Asano and Fukushima (2006, p.66) argue that "the compensated inverse price elasticity rule, which is theoretically justified when there are no cross-price effects among commodities, was not helpful at all in predicting the optimum rates." However, as shown in Table 6 and Table 7, our results demonstrate non-uniform optimal tax rates, which differed from Asano and Fukushima's (2006) uniform tax rates. Meanwhile, Urakawa and Oshio (2010) use the effective commodity tax rates to compare the tax structure between Korea and Japan. According to Urakawa and Oshio (2010, p.585), the effective tax rates are calculated on the basis of dividing estimated tax payments by household spending of each commodity group. Their effective tax rates for each commodity group greatly differ from the optimal commodity tax rates we showed in Section VI.

Few existing studies have calculated optimal commodity taxes in countries other than Korea and Japan. Table 2 summarizes the results of Ray (1987) and Nygård (2014). Ray (1987) estimates the optimal commodity tax rates for the poor in India, which is inserted on the left side of Table 2. Nygård (2014) computes optimal tax rates in Norway, covering commodity groups with cross-border shopping, which is reported on the right side of Table 2.

Ray (1987) provides empirical evidence of commodity tax rates for both the rich and the poor. Ray (1987, p.91) argues that "such a policy leads to a substantial increase in the redistributive capabilities of indirect taxation." Table 2 shows optimal commodity tax rates for only the case of the poor. As presented in Table 2, spending on all the commodity groups should be subsidized with a variety of ranges. We may judge that Ray's (1987)'s result is extreme compared with the optimal commodity tax rates we illustrated in Section VI (See Table 6 and Table 7).
Nygård (2014) focuses on the commodities exposed to cross-border shopping, such as alcoholic beverages, tobacco, and food. Nygård (2014) computes optimal commodity taxes conditional on the preexisting wage income tax and non-labor income. The optimal tax structure is highly differentiated among the commodities as demonstrated on the right side of Table 2. Nygård (2014, p.336) explains the result of non-uniform tax structure in contrast to what Asano and Fukushima (2006), Fukushima (1991), and Fukushima and Hatta (1989) have found. From Table 2, we confirm that optimal tax rates vary among commodity groups in Norway. The tax rates of commodity groups, such as (2) Spirits, (3) Wine, (4) Beer,

[Table 2] Optimal Commodity Tax Rates in Existing Studies (2)

Ray (1987) #	India		Nygård (2014) # Norway with Cross-Border Shopping	
Optimal commodity tax rates for the poor			Restriction A[1)]	In %
Inequality aversion (ε)	0.1	5	(1) Food/non-alcoholic beverages	15.0
Consumption groups	In %	In %	(2) Spirits	77.2
(1) Cereals	-40.8	-56.3	(3) Wine	69.1
(2) Milk and milk products	-36.5	-25.7	(4) Beer	84.0
(3) Edible oils	-46.3	-50.7	(5) Tobacco	62.6
(4) Meat, fish, and eggs	-52.1	-50.1	(6) Other goods and services	15.0
(5) Sugar and tea	-37.7	-40.7	RestrictionB[2)]	In %
(6) Other food	-36.5	-36.0	(1) Food/non-alcoholic beverages	-10.3
(7) Clothing	-34.3	-14.0	(2) Spirits	65.0
(8) Fuel and light	-38.0	-45.5	(3) Wine	56.1
(9) Other non-food	-32.9	-16.9	(4) Beer	76.6
			(5) Tobacco	38.3
			(6) Other goods and services	19.1

Notes: # Optimal tax rates in Ray (1987) and Nygård (2014) were modified as percentages here.
1) Restriction A refers to a restricted version where the labor supply and the amount of cross-border shopping are exogenous with base-year values.
2) Restriction B refers to a restricted version where all cross-border shopping is endogenous but labor supply is exogenous with base-year values.
Sources: Table 2 in Ray (1987, p.92). Table 7 in Nygård (2014, p.335).

and (5) Tobacco, appear greatly high relative to the other commodity group of (1) Food/non-alcoholic beverages. Although these non-uniform tax structures are similar to our results, Nygård (2014) estimates optimal tax rates focusing on cross-border shopping, which is different from the results in Section VI where we deal with domestic spending.

Finally, Table 3 reports the optimal commodity taxes calculated by Atkinson and Stiglitz (1972) and Srinivasan (1989).

As Atkinson and Stiglitz (1972) emphasize, the calculations of optimal tax rates on the left side of Table 3 are presented only to illustrate the application of their theoretical approach.[4] They bring forward the debate about a uniform system of indirect taxes. Atkinson and Stiglitz (1972, p.117) mention that “there is no general presumption in favors of uniform taxation on grounds of allocated efficiency.” Their illustrating calculation of optimal commodity taxes in Table 3 shows a non-uniform taxation that does not consider distributional considerations. The result of Atkinson

[4] Atkinson and Stiglitz (1972) state that the use of alternative specifications of the demand equations may well give rather different results.

[Table 3] Optimal Commodity Tax Rates in Existing Studies (1)

Atkinson and Stiglitz (1972)*		Srinivasan (1989)	India	
		Inequality aversion	0	5
Consumption groups	In %	Consumption groups	In %	In %
(1) Meat, fish, dairy products, and fats	11.1	(1) Cereals	3.2	-25.6
(2) Fruits and vegetables	8.2	(2) Milk and milk products	6.3	59.4
(3) Drink and tobacco	10.1	(3) Edible oil	2.7	1.1
(4) Household running expenses	5.3	(4) Meat, fish and eggs	3.9	32.2
(5) Durable goods	5.6	(5) Sugar and gur	3.4	20.6
(6) Other goods and services	6.2	(6) Other food items	3.3	9.4
		(7) Clothing	3.2	37.9
		(8) Fuel and light	3.1	-17.9
		(9) Other nonfood items	3.2	30.9

Note: *Optimal tax structure is calculated based on linear expenditure system and the figures suppose that the ratio of the Lagrangian multiplier of government budget constraint (λ in their paper) to the marginal utility of income (α in it), i.e., λ / α , is 1.025.

Sources: Table 2 in Atkinson and Stiglitz (1972, p.116). Table 1 in Srinivasan (1989, p.387).

and Stiglitz (1972) in Table 3 indicates that the optimal tax rates of consumption groups, such as (1) Meat, fish, dairy products, and fats and (3) Drink and tobacco are relatively high. Our results in Section VI (Table 6 and Table 7) demonstrate various optimal tax rates that are similar to some extent with the result of Atkinson and Stiglitz (1972) in the aspect of non-uniform taxation. However, their results are much different from our result in the magnitudes of taxation and the subsidization for commodity groups with high spending share to the poor.

Srinivasan's (1989) results of optimal commodity tax rates for nine different commodity groups are presented on the right side of Table 3 regarding the two cases of inequality aversion of 0 and 5. Srinivasan (1989, p.387) points out that when the inequality aversion is 0, the optimal commodity tax rates are positive for all the commodity groups. However, with a positive inequality aversion of 5, the optimal commodity tax rates suggest that (1) Cereals and (9) Fuel and light should be subsidized[5] while other commodity groups should be taxed. The magnitude of the tax or subsidy (negative tax) rates rises along with the degree of inequality aversion. Srinivasan (1989, p.387) says that this result implies a greater redistribution to the poor. Srinivasan's (1989) results are qualitatively similar to our results in Section VI, where we illustrate various optimal commodity tax rates at each commodity group depending on the degree of inequality aversion.

[5] Srinivasan (1989, p.388) describes that "when the objective is to minimize the poor's tax burden (or equivalently maximizing the redistribution to the poor) the optimal rates suggest that all items except 'meat, fish, and eggs' and 'sugar and gur' should be subsidized."

III. Model for Optimal Commodity Taxation

With reference to the existing studies, including Myles (1995) and Atkinson and Stiglitz (2015), this section presents a standard framework of optimal commodity taxation with a many-household economy to compute optimal tax design in Korea and Japan. Although this study supposes a many-household economy, the basic framework is a partial equilibrium model.[6] As Coady and Drèze (2002, p.310) point out, the classical Ramsey problem, which appears as a partial equilibrium format, has a general- equilibrium foundation as long as shadow prices and producer prices coincide.[7] Coady and Drèze (2002, p.297) mention that two aspects of the formulation of the classical Ramsey rule are worth noting: (1) a single consumer is present, and (2) producer prices are assumed to be fixed. We assume that producer prices are fixed so that the model basically has a partial equilibrium format.

We suppose that preferences are represented by quasi-concave differentiable utility functions like the model of Wildasin (1977, p.890). H numbers of households and J goods exist in the economy. A household h maximizes its utility function subject to budget constraint as follows.

$$\text{Maximize } U^h = U^h(x_1,\cdots,x_J),\ s.t.\ \textstyle\sum_{j=1}^{J} q_j x_j = I\,, \tag{1}$$

where x_j, q_j, and I denote a good j, consumer's price of the good j, and household income, respectively. Atkinson and Stiglitz (1972, p.102) build a budget constraint that consists of $\sum_{j=1}^{J} q_j x_j = L$, where L is the amount of labor supplied. Here, we assume that the budget is exogenous. Under the assumption of the quasi-concavity of the direct utility function shown in Equation (1), the indirect utility function of household h can be written as

$$U^h = V^h(q_1,\cdots,q_J,I) \quad \text{for all} \quad h = 1,\cdots,H\,. \tag{2}$$

Assuming the producer price p_j is fixed, the relation between consumer price and producer price can be expressed as[8]

[6] Harris and Mackinnon (1979) propose a technique for computing optimal taxes in a general equilibrium model. Coady and Drèze(2002) begin with a brief overview of the classical Ramsey tax problem and take a step toward generalization where many consumers are present. They develop a general equilibrium model composed of both consumption and production sectors to capture the generalized Ramsey rule.

[7] The issue of how shadow prices are calculated belongs to the theory of cost-benefit analysis. Moreover, shadow prices provide a useful bridge between the theory of cost-benefit analysis and the theory of the second-best. See Drèze and Stern (1987).

[8] If we consider the side of producers, observing the heterogeneity in the tax burden relating to intermediate goods markets may be better. For simplicity, researchers usually assume that the producer

$$q_j = t_j + p_j \quad \text{for all} \quad j = 1, \cdots, J. \tag{3}$$

where p_j is the producer's price of a good j and t_j is the tax rate.

As illustrated in Diamond and Mirrlees (1971, p.265) and Harris and Mackinnon (1979, p.198), the objective of the planner of government is to maximize the indirect social welfare function. Wildasin (1977, p.898) emphasizes that "distributional questions are really of the essence of the commodity taxation problem. Perhaps the whole approach to the study of optimal commodity taxation as an exercise in social welfare maximization of the usual type is due for reconsideration." Our study forms the social welfare function W as the type of Samuelson-Bergerson that consists of the indirect utility functions.[9]

$$W = W(V^1(\cdot), \cdots, V^H(\cdot)). \tag{4}$$

The tax revenue or the budget constraint of government to maximize the social welfare function (4) is given by

$$R = \sum_{j=1}^{J} \sum_{h=1}^{H} t_j x_j^h, \tag{5}$$

where x_j^h means a good j consumed by household h in Equation (5).[10]

We can obtain the first order condition (FOC) that maximizes the social welfare function (4) subject to budget constraint (5). Equation (6) shows the FOC.

$$\sum_{h=1}^{H} \frac{\partial W}{\partial V^h} \frac{\partial V^h}{\partial q_k} + \lambda \left(\sum_{h=1}^{H} x_k^h + \sum_{j=1}^{J} \sum_{h=1}^{H} t_j \frac{\partial x_j^h}{\partial x_k} \right) = 0, \text{ where } k = 1, \cdots, J. \tag{6}$$

Here, we introduce Roy's identity:

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price is fixed in computing the optimal commodity tax rates. Our result will be valid enough (or basic implications are not changed) under the assumption that the producer price is fixed because we focus on the side of households (or consumers).

[9] According to Jacobs and Boadway (2014, p.206), the optimal structure of commodity taxes depends neither on the particular social welfare function nor on the distribution of skills.

[10] Coady and Drèze (2002, p.313) consider a lump-sum transfer to clarify the underlying distributional assumption. Hence, in their research, the budget constraint of government has the following form.

$$R = \sum_{j=1}^{J} t_j^h x_j^h - m, \tag{n1}$$

where m denotes a lump-sum transfer in Equation (n1).

$$\frac{\partial V^h}{\partial q_k} = -\alpha^h x_k^h , \tag{7}$$

where α^h is the marginal utility of the income of household h, or $\alpha^h = \frac{\partial V^h}{\partial I^h}$. Using Roy's identity, we can express the social marginal utility of income, or β^h, as Equation (8), following Diamond and Mirrlees (1971, p.265).

$$\beta^h = \frac{\partial W}{\partial V^h}\alpha^h . \tag{8}$$

Substitution effect creates an excess burden or efficiency loss. Wilson (1989, p.1196) mentions that "the tax system creates an efficiency loss by encouraging consumers to move their expenditures away from taxed commodities and into untaxed commodities." The Slutsky equation would be necessary to indicate the substitution effect as well as the income effect.

$$\frac{\partial x_j^h}{\partial q_k} = s_{jk}^h - x_k^h \frac{\partial x_j^h}{\partial I^h} . \tag{9}$$

In Equation (9), s_{jk}^h denotes the Slutsky substitution matrix whose sign is negative. Inserting Roy's identity (7), social marginal utility (8), and Slutsky equation (9) into Equation (6), we can obtain the optimal tax rule as follows.

$$\frac{\sum_{j=1}^{J}\sum_{h=1}^{H} t_j s_{kj}^h}{\sum_{h=1}^{H} x_k^h} = -\left(1 - \frac{1}{\lambda}\frac{\sum_{h=1}^{H}\beta^h x_k^h}{\sum_{h=1}^{H} x_k^h} - \frac{\sum_{h=1}^{H}\left(\sum_{j=1}^{J} t_j \frac{\partial x_j^h}{\partial I^h}\right) x_k^h}{\sum_{h=1}^{H} x_k^h}\right). \tag{10}$$

Equation (10) represents the optimal tax rule that reflects both equity and efficiency criteria. The sign of the left-hand side (LHS) of Equation (10) is negative because the sign of the Slutsky substitution matrix, or s_{jk}^h, is negative. That is, the value in parenthesis of the right-hand side (RHS) of Equation (10) is positive. The second term of RHS in the parentheses of Equation (10) represents equity criteria in that the individuals with high values of β^h should be considered more socially important. Equity criteria entail that individuals with high values of β^h should be taxed lower or be subsidized on the commodities they spend. From Equation (10), we can easily confirm that the higher the value of β^h is, the smaller the reduction in demand of good k, or x_k^h, should be.

The third term in the parentheses of Equation (10) shows efficiency criteria in that, if the tax payments of individuals change with a large amount as income changes, the reduction in demand of good k should be smaller to not induce a greater distortion by imposing taxes meeting a tax revenue target. In other words, goods with high price elasticity of demand, such as luxury goods, should be taxed at a lower rate to minimize the excess burden, which corresponds to the Ramsey rule.

We attain the equation structures for optimal tax rates by inserting Roy's identity or Equation (7) and the social marginal utility of income of household h or Equation (8) into Equation (6).[11]

$$\sum_{h=1}^{H} \beta^h x_k^h = \lambda\left(\sum_{h=1}^{H} x_k^h + \sum_{j=1}^{J} \sum_{h=1}^{H} t_j \frac{\partial x_j^h}{\partial q_k} \right) \text{ where } k = 1, \cdots, J. \quad (11)$$

Equation (11), which encompasses the first-order conditions, involves J numbers of demand functions. Moreover, Equation (11) composes the equation structures with J tax rates when we put the estimated demand functions that consist of J numbers into Equation (11). We will be able to calculate optimal tax rates using the structure of Equation (11) and budget constraint (5). Those equations include $J+1$ variables: J tax rates and Lagrange multiplier λ, which will result in a unique solution. In short, with constant producer prices, we can obtain J tax rates and Lagrange multiplier λ using $J+1$ equations. We will specify the model in the next section and show the calculation procedure of optimal commodity tax rates in Korea and Japan.

IV. Model Specification and Calculation Procedure

4.1. Model Specification

We need to specify the functional forms of utility to allow the computation of optimal commodity tax rates, including demand functions. Harris and Mackinnon (1979, pp.211-212) note that "many of the results suggest that optimal tax rates can be extremely sensitive to the specification of the model used to derive them."[12] Here, we specify the utility function of household h with minimum consumption as follows.

[11] Equation (11) is basically the same as Equation (74) derived by Diamond and Mirrlees (1971, p.268).

[12] Harris and Mackinnon (1979, p.212) add the explanation that "thus, optimal tax theory should be used with extreme caution until a great deal more is known about the specification of realistic systems of consumer demand and labor supply functions."

$$U^h = \prod_{j=1}^{J} (x_j^h - \gamma_j^h)^{\delta_j} , \tag{12}$$

where γ_j^h denotes a minimum consumption of good j of household h in Equation (12). γ is positive and δ has the value between zero and one. Maximizing Equation (12) subject to budget constraint in Equation (1), we can drive the indirect utility function, which is expressed as

$$V^h = \prod_{j=1}^{J} \left(\frac{\delta_j}{q_j} \right)^{\delta_j} (I^h - \sum_{j=1}^{J} q_j \gamma_j^h) . \tag{13}$$

From the indirect utility function (13), we can attain the expenditure function of household h, or e^h, which results in the linear expenditure system (LES).

$$e^h = V^h \prod_{j=1}^{J} \left(\frac{q_j}{\delta_j} \right)^{\delta_j} + \sum_{j=1}^{J} q_j \gamma_j^h . \tag{14}$$

By differentiating this LES of Equation (14) with respect to consumer prices, the compensated demand function can be drawn as

$$x_k^{*h} = \frac{\delta_k}{q_k} V^h \prod_{j=1}^{J} \left(\frac{q_j}{\delta_j} \right)^{\delta_j} + \gamma_k , \text{ where } k = 1, \cdots, J. \tag{15}$$

In computing optimal tax rates from Equation (11), we must acquire the differentials of demand functions with respect to consumer prices, or $\frac{\partial x_j^h}{\partial q_k}$, as well as the social marginal utility of income of household h, or β^h. The differentials of the demand functions of Equation (15) of good x_j with respect to consumer price are given by

$$\frac{\partial x_k^{*h}}{\partial q_k} = \frac{\delta_k (\delta_k - 1)}{q_k^2} V^h \prod_{j=1}^{J} \left(\frac{q_j}{\delta_j} \right)^{\delta_j} < 0 \quad \text{for} \quad j = k , \tag{16}$$

$$\frac{\partial x_j^{*h}}{\partial q_k} = \frac{\delta_j \delta_k}{q_j q_k} V^h \prod_{j=1}^{J} \left(\frac{q_j}{\delta_j} \right)^{\delta_j} > 0 \quad \text{for} \quad j \neq k . \tag{17}$$

According to the Ramsey rule, tax rates should be high on goods such as necessities with inelastic demand. However, it is not appealing because distributional considerations are ignored.[13] We focus on the calculation of optimal taxes considering equity criterion. We adopt β^h, which considers distributional aspects putting more weight on lower income groups than on higher income groups.[14] The methods for placing weights along with the income groups of household h can be thought of as follows (See Myles, 1995).

$$\beta^h = \left(\frac{I^1}{I^h} \right)^v, \tag{18}$$

where I^1 and I^h denote the income of the lowest income group and that of the income group h, respectively. h stands for the household from the first income quintile to the fifth income quintile. In our paper, I^1 denotes the first income quintile in calculating optimal taxes. Equation (18) puts a larger weight in the welfare of the less well-off income group.

Larger values of v in Equation (18) reflect a degree of aversion toward inequality or inequality aversion. Under this distributional consideration, the optimal tax rates would vary to some extent or in a great deal.

4.2. Calculation Procedure

To calculate optimal tax rates, Equation (11) requires us to obtain the information on β^h, x_k^h, and $\frac{\partial x_j^h}{\partial q_k}$. In addition, we need to set a given tax revenue (R) relating to Equation (5). First, in the calculation of the social marginal utility of income of household h, or β^h, in Equation (18) for the data set, we make use of income quintiles; hence, h is 5. The income of the first quintile or the lowest income group is allotted to I^1. From Equation (18), we can easily observe that the higher the value of v is, the larger the weight of the low-income group will be. That is, the value of v implies the degree of inequality aversion. We will compute and compare the optimal tax rates of the two cases of $v = 1$ and $v = 2$ in the next section.

Second, the demand functions of household h, or x_k^h, can be calculated from Equation (15) with the information about the consumer prices (q_i), the level of minimum consumptions (γ_i), and the value of consumption shares of each commodity (δ_j). Producer prices are not required because they are assumed to be

[13] Harris and Mackinnon (1979, pp.210-211) refer to “the result that tax rates should be high on goods such as food, which are inelastically demanded, is well known in the optimal tax literature, but not very appealing. Distributional considerations have obviously been ignored.”

[14] The household income may depend on the household head’s age, which will require us to perform a regression analysis to test the effects of the household head’s age on the household income. That is another topic.

fixed. As shown in Table 4 and Table 5 of the next section, 10 commodity groups can obtain the demand functions. Thus, we use the consumer price indices of each commodity group that are offered by both the National Statistical Office in Korea and the Statistical Bureau of the Ministry of Internal Affairs and Communications in Japan. We also need to estimate the parameter of consumption shares, or δs, from the individual data of all the income quintiles in two countries. However, such data are not available. Hence, we use the actual values of each share of commodity groups as δs using the data from the *Annual Report on the Family Income and Expenditure Survey* in both Korea and Japan.

We will deal with the case of $\gamma \neq 0$ because some amount of minimum consumption is needed in Equation (12).[15] The minimum consumption level may depend on the composing numbers of household that generally increase with income level. As a result, we may be able to approximate that the minimum consumption, or γ_i, would be different among the income quintiles. Usually, the rich will have more amounts of minimum demand than the poor.

The Japanese and Korean governments[16] provide data on public assistance (PA) considering household members. For instance, for the case of composing numbers of two, the PA is paid at the amount of JPY136,333 on average in Japan in 2019. The household members at each income quintile are 2.39, 2.65, 3.08, 3.27, and 3.45 from the first quintile to the fifth quintile in Japan in 2019, respectively. However, no data are available for the PA of these concrete numbers. We figure out the method of proportional rationing to which we allot the minimum consumption levels for each income quintile.

We take an example regarding the case of household members of 2.39 at the first quintile mentioned above. We need to allocate the portion of 0.39 and allocate it on the basis of the difference between the amount of the PA of household members of two (JPN¥136,333) and that of three (JPN¥144,667). Their difference is JPN¥8,334. We allocated the amount of the portion multiplying 0.39 by JPN¥8,334, which is JPN¥3,250. As a consequence, we can obtain the minimum consumption level of the first income quintile with household members of 2.39 by adding JPN¥3,250 to the PA amount of JPN¥136,333, which becomes JPN¥139,583. We calculated all the minimum consumption levels for each income quintile in the same manner in Korea and Japan.

Third, we need to calculate the values of the differentials of the demand function of good x_j^h with respect to consumer price, or $\frac{\partial x_j^h}{\partial q_k}$, which can be computed using Equations (16) and (17).[17]

[15] The case that $\gamma = 0$ in Equation (12) represents the Cobb-Douglas utility function.

[16] The data are provided by the Ministry of Health, Labor, and Welfare in Japan and by the Ministry of Health and Welfare in Korea.

[17] The 100(=10×10) partial differentials should be derived because 10 commodity groups and their 10 consumer prices exist.

Lastly, we must set a certain amount of a given tax revenue (R). Optimal tax rates depend on the size of tax revenue, which means that it requires selecting a benchmark in tax revenue comparing optimal tax rates. Slemrod (1990, p.170) also mentions that "the optimal tax rates would change depending on the amounts of tax revenues as well as the types of utility function." We have selected the consumption tax share in 2000 in Japan as a benchmark in tax revenue from the data of *Revenue Statistics* provided by OECD, which was 19.3%. Then, we computed the consumption tax amounts applying the 19.3% to the cases of 2000 and 2019 in the two countries and regard them as a given tax revenue.

Taking the procedures mentioned above, we can construct equation structures to obtain optimal tax rates by inserting the results of calculations about the β^h, x_k^h, $\frac{\partial x_j^h}{\partial q_k}$, and R. They consist of 11 simultaneous equations, which are composed of Equation (11) and Equation (5). Solving the equation structures, we will be able to attain optimal commodity tax rates and a marginal utility of tax revenue or a Lagrange multiplier.

V. Data Description and Consumption Patterns

Before we present the results of optimal tax rates and interpret them, we must explain the data and compare the consumption patterns of household between Korea and Japan. The National Statistical Office in Korea as well as the Statistical Bureau of the Ministry of Internal Affairs and Communications in Japan release *the Household Income and Expenditure Survey*. The commodity groups are matched in the Korean and Japanese household survey data with each other. Particularly, the observations of workers' households are classified in detail. Concretely, we use the commodity groups on monthly income and expenditure per household by income quintiles in the two countries. The fact that the two household surveys have almost the same consumption groups provides an advantage in comparing the consumption patterns and optimal commodity tax rates under a common analytical framework.

Korea referred to the case of Japan when introducing *the Household Survey*. With this background, the survey data have almost the same classification of consumption groups of households in Korea and Japan. Hence, the data provide a good tool for comparative study between the two countries. This similarity is the main reason we have used data from *the Household Survey* and compared the household consumption patterns and optimal commodity tax rates of Korea and Japan.[18] The

[18] Korea changed its questionnaire design and sampling methodology in 2017. However, the Korean Government provides the summary statistics on consumption expenditures regarding income quintiles that include the same classification of commodity groups with the household survey.

comparative study would be more informative when we present how our calculation results of optimal commodity tax rates are different from or similar with the existing studies (see Section II).

We use the data in 2000 and 2019 from the annual long-term series to find and compare the similarities and/or differences of consumption patterns and optimal tax rates. The sample sizes of households are about 5,500 in 2000 and about 7,200 in 2019 in Korea, and 7,921 in 2000 and 7,522 in 2019 in Japan. We handle the published official data that include average values because individual observation values are not available. The survey covers 10 commodity groups: (1) Food and beverages; (2) Housing[19], fuel, light, and water charges; (3) Furniture and utensils; (4) Clothes and footwear; (5) Medical care; (6) Transportation[20]; (7) Communication; (8) Education; (9) Culture and recreation; and (10) Others. Table 4 and Table 5 show the shares of each commodity group in Korea and Japan, respectively.

[Table 4] Consumption Shares of Households by Income Quintiles in Korea

	Consumption Shares (in %) by Income Quintiles in 2000			Consumption Shares (in %) by Income Quintiles in 2019		
Consumption group	I (Poor)	Average	V (Rich)	I (Poor)	Average	V (Rich)
(1) Food and beverages	24.7	18.2	14.6	22.1	15.0	12.1
(2) Housing, fuel, light, and water charges	14.2	10.2	8.9	19.6	11.3	7.8
(3) Furniture and utensils	2.9	3.5	4.1	4.8	4.7	5.3
(4) Clothes and footwear	5.5	6.8	7.6	3.9	5.6	6.4
(5) Medical care	7.7	5.5	4.8	12.9	8.2	7.1
(6) Transportation	9.1	12.5	14.1	7.3	12.0	12.8
(7) Communication	5.7	5.2	4.5	4.7	5.0	4.4
(8) Education	7.4	11.2	12.1	2.2	8.3	11.9
(9) Culture and recreation	5.0	6.1	6.8	5.3	7.3	9.1
(10) Others	17.8	20.8	22.6	17.3	22.5	23.1
Total in % (Amounts in thousands of Won)	100 (805)	100 (1,484)	100 (2,380)	100 (1,023)	100 (2,457)	100 (4,221)
Quintile Distribution Index: [Income of I] ÷ [Income of V]	33.8%			24.2%		

Source: Calculated by authors based on data from National Statistical Office, Korea, *Annual Report on the Family Income and Expenditure Survey*, 2001 and 2020.

[19] Housing is included in the category of the commodity group of (2) Housing, fuel, light, and water charges in Korea, whereas housing is separately classified from the commodity group of "Fuel, light, and water charges" in Japan. We merged the spending on housing into the commodity group of fuel, light, and water charges in Japan to make the commodity group coincide with the case of Korea.

[20] Transportation and communication are included in the same commodity group in Japan, whereas they are separately classified in Korea. We separated the commodity group of "Transportation and communication" into (6) Transportation and (7) Communication each in Japan for comparison.

[Table 5] Consumption Shares of Households by Income Quintiles in Japan

	Consumption Shares (in %) by Income Quintiles in 2000			Consumption Shares (in %) by Income Quintiles in 2019		
Consumption group	I (Poor)	Average	V (Rich)	I (Poor)	Average	V (Rich)
(1) Food and beverages	27.1	23.3	20.4	30.6	25.7	22.3
(2) Housing, fuel, light, and water charges	17.5	13.3	10.3	17.0	13.3	10.3
(3) Furniture and utensils	3.9	3.5	3.4	4.1	3.9	3.7
(4) Clothes and footwear	4.1	5.1	5.8	2.6	3.7	4.6
(5) Medical care	4.6	3.6	2.9	6.1	4.7	4.0
(6) Transportation	7.1	8.5	8.8	7.6	10.2	11.7
(7) Communication	3.2	3.0	2.7	4.6	4.6	4.2
(8) Education	1.5	4.4	5.7	0.7	3.9	6.6
(9) Culture and recreation	8.8	10.1	10.5	8.2	10.0	11.1
(10) Others	22.2	25.3	29.5	18.4	19.9	21.5
Total in % (Amounts in thousands of Yen)	100 (206)	100 (317)	100 (465)	100 (192)	100 (293)	100 (428)
Quintile Distribution Index: [Income of I] ÷ [Income of V]	44.8%			46.5%		

Source: Calculated by authors based on data from Statistics Bureau, Management and Coordination Agency, Japan, *Annual Report on the Family Income and Expenditure Survey*, 2001 and 2020.

Table 4 and Table 5 show the spending shares of each commodity group with regard to the first income quintile (the lowest income group or the poor), the average, and the fifth income quintile (the highest income group or the rich) in Korea and Japan for both years of 2000 and 2019, respectively. We compare household consumption patterns between Korea and Japan referring to Table 4 and 5. In the analysis of Urakawa and Oshio (2010), no substantial difference is observed in the composition of consumption expenditures between Korea and Japan.[21] However, the household consumption patterns in the two countries are somewhat different. We provide the total expenditure amounts of the absolute value at the penultimate bottom lines of Total in Table 4 and Table 5. Hence, we can calculate the absolute amounts multiplying the share of each consumption group by the total expenditure amount. However, we will use the relative shares of each consumption group.

As shown in Table 4 and Table 5, (1) Food and beverages and (2) Housing, fuel, light, and water charges, and (10) Others have large shares in the two countries. The spending shares of (1) Food and beverages on average account for 18.2% in 2000 and 15.0% in 2019 in Korea, and 23.3% in 2000 and 25.7% in 2019 in Japan.

[21] Urakawa and Oshio (2010, p.584) compute the correlation coefficient between Korea and Japan in terms of each commodity group's share, the value of which is 0.851. They use the data of 2008 in Japan and 2007 in Korea.

The spending shares of (2) Housing, fuel, light, and water charges on average account for 10.2% in 2000 and 11.3% in 2019 in Korea, and 13.3% in both 2000 and 2019 in Japan. We see that the relative shares of both (1) and (2) commodity groups are higher in Japan than in Korea. In addition, the commodity groups of (9) Culture and recreation account for relatively higher shares at 10.1% in 2000 and 10.0% in 2019 in Japan but not so high in Korea at 6.1% in 2000 and 7.3% in 2019. Meanwhile, the share of spending on (8) Education appears quite higher in Korea than in Japan, accounting for 11.2% in 2000 and 8.3% in 2019 in Korea, and 4.4% in 2000 and 3.9% in 2019 in Japan.

What are the different characteristic changes in consumption patterns between the two countries in 2000 and 2019? Education spending shows a big difference on spending share in the two countries. The spending share of (8) Education on average is higher at 11.2% in Korea than at 4.4% in Japan in 2000. Although the share of spending on education declined to 8.3% on average in Korea, it still shows a higher share in Korea than in Japan at 3.9%. In particular, the share of spending on education of the first income quintile (the poor) has fallen greatly from 7.4% in 2000 to 2.2% in 2019 in Korea owing to the increase of public expenditure on education. Meanwhile, the share of spending on education of the fifth income quintile (the rich) in Korea has remained almost the same from 12.1% in 2000 to 11.9% in 2019. It implies that the rich in Korea have spent a lot of private expenditures on education.

The share of spending on (1) Food and beverages has decreased with a certain range from 18.2% in 2000 to 15.0% in 2019 in Korea, whereas the share has increased a little from 23.3% in 2000 to 25.7% in 2019 in Japan. This outcome implies that the Engel coefficient will be larger in Japan than in Korea. The share of spending on (5) Medical care also shows a different aspect in the two countries. The spending share of the first income quintile (the poor) on medical care in Korea has increased to a larger extent from 7.7% in 2000 to 12.9% in 2019. However, the share in Japan has risen to a small extent from 4.6% in 2000 to 6.1% in 2019. Meanwhile, the spending on (6) Transportation, it has risen from 8.5% in 2000 to 10.2% in 2019 in Japan, while Korea has maintained similar shares at both 12.5% in 2000 and 12.0% in 2019 in Korea.

VI. Calculation Result and Interpretation

Table 6 and Table 7 show the results of the optimal commodity tax rates and Lagrange multiplier in the cases that $v = 1$ and $v = 2$ based on the calculation procedure in Section IV in Korea and Japan, respectively.[22]

[22] We can calculate the optimal commodity tax rates by setting the values of inequality aversion (v)

[Table 6] Optimal Commodity Tax Rates in Korea

	2000		2019	
Inequality aversion	$v=1$	$v=2$	$v=1$	$v=2$
Consumption group	In %	In %	In %	In %
(1) Food and beverages	-12.01	-28.37	-15.60	-38.64
(2) Housing, fuel, light, and water charges	-9.80	-25.36	-33.48	-75.77
(3) Furniture and household utensils	14.24	23.69	9.10	11.69
(4) Clothes and footwear	12.90	21.92	18.70	35.54
(5) Medical care	-9.33	-24.63	-16.30	-42.75
(6) Transportation	15.48	27.58	19.24	39.37
(7) Communication	-2.60	-7.74	2.06	4.07
(8) Education	13.70	25.86	37.43	73.29
(9) Culture and recreation	11.80	20.11	19.91	35.63
(10) Others	10.25	16.74	12.60	24.44
λ (Marginal utility of income: not in %)	0.5431	0.3368	0.4174	0.2196

Source: Calculated by authors based on data from National Statistical Office, Korea, *Annual Report on the Family Income and Expenditure Survey*, 2001 and 2020.

[Table 7] Optimal Commodity Tax Rates in Japan

	2000		2019	
Inequality aversion	$v=1$	$v=2$	$v=1$	$v=2$
Consumption group	In %	In %	In %	In %
(1) Food and beverages	-0.93	-5.59	-1.75	-7.37
(2) Housing, fuel, light, and water charges	-6.42	-16.45	-6.05	-15.56
(3) Furniture and household utensils	2.21	0.05	1.95	0.24
(4) Clothes and footwear	9.94	15.69	14.72	24.97
(5) Medical care	-4.71	-13.19	-4.78	-13.74
(6) Transportation	7.09	10.66	12.01	20.20
(7) Communication	0.70	-2.05	2.46	1.75
(8) Education	18.59	34.92	29.26	54.40
(9) Culture and recreation	6.19	9.01	9.14	14.55
(10) Others	9.69	14.76	6.63	9.09
λ (Marginal utility of income: not in %)	0.6491	0.4544	0.6546	0.4598

Source: Calculated by authors based on data from Statistics Bureau, Management and Coordination Agency, Japan, *Annual Report on the Family Income and Expenditure Survey*, 2001 and 2020.

Slemrod (1990, p.170) gives a description that "the theory of optimal taxation tells us that, in general, all goods should be taxed at different rates." Table 6 and Table 7 tell us that commodity groups should be taxed or be subsidized at various rates. The results imply that subsidization should be operated or lower tax rates should be

other than the values of 1 and 2. We selected the values of v in the two cases of 1 and 2 because it can give enough calculation evidences for our discussion.

imposed on the commodity groups with high shares in expenditures of the poor. In other words, the optimal tax rates of those commodity groups with high shares in the expenditures of the poor should be lower than those of the rich. Smith (2005, p.1028) proposes the view that "government subsidies should, other things being equal, be directed at interventions" that "have relatively high incidence amongst the poor."

When the consumption share of the poor is higher, its optimal tax rate should be levied lower (or subsidized) at almost all cases if we construct optimal commodity taxes. One example is the case of the poor wherein v (inequality aversion) equals 1 in Korea. (see Table 4 and Table 6 at the same time.) The consumption share of (1) Food and beverages is 24.7%, which is relatively very high, and the optimal tax rate is -12.01% (i.e., should be subsidized). The consumption share of (6) Transportation of the poor is 9.1%, which is not relatively so high, and the optimal tax rate is 15.48%. The consumption share of (4) Clothes and footwear is 5.5%, which is not also relatively so high, and the optimal tax rate is 14.24%. From these calculation results, we know that while the consumption share of the poor for (7) Transportation is higher than that of (4) Clothes and footwear, the optimal tax rate is higher for transportation than for clothes and footwear. These two cases do not show the inconsistency because the optimal tax rates depend on the scheme of the model with various parameters as well as the consumption volumes of each income group. We can propose that the consumption groups of the poor with not-so-high shares should be taxed to some extent.

We present the consumption shares according to income class in Table 4 and Table 5. The two tables are closely related to the calculation results of the optimal commodity tax rates of Table 6 and Table 7. From Table 4 and Table 5 in the previous section, we can observe that the spending shares of the commodity groups such as (1) Food and beverages, (2) Housing, fuel, light, and water charges, and (5) Medical care[23] are higher in the first quintile or the poor than in the fifth quintile or the rich in Korea and Japan. The results in Table 6 and Table 7 show negative values for those commodity groups. Those commodity groups should be subsidized in the two countries. However, the degree of subsidization is a lot different between Korea and Japan. Table 6 and Table 7 show that the magnitudes of subsidization for the commodity groups such as (1) Food and beverages, (2) Housing, fuel, light, and water charges, and (5) Medical care are quite greater in Korea than in Japan.[24]

[23] Korea and Japan have experienced an aging society, which requires the expenditure on medical care to increase. In this case, the expenditure share of medical care for the poor may rise higher than that for the rich. We think that Table 4 and Table 5 may show the circumstances of an aging society in the two countries. The calculation results of Table 6 and Table 7 present the different patterns in medical care from other consumption groups, whether the different patterns of medical care originated from the medical reform remains uncertain.

[24] The optimal commodity tax rates may not be monotonous according to household income groups

Meanwhile, higher taxes should be imposed on the commodity groups that account for high shares in expenditures of the rich. As shown in Table 4 and 5, those commodity groups include (4) Clothes and footwear, (6) Transportation, (8) Education, (9) Culture and recreation, and (10) Others in Korea and Japan. Furthermore, the magnitudes of taxation for those commodity groups are quite larger in Korea than in Japan except for the case of (8) Education in 2000. In addition, the optimal tax rates are much higher for (3) Furniture and utensils in Korea because the group accounts for a higher share in Korea than in Japan. The share of (3) Furniture and utensils appears larger in the high-income group in Korea may be because of the difference in the house structure between the two countries. Usually, the Japanese do not hold many luxurious furniture owing to the risk of natural disasters, such as earthquakes and typhoons. In contrast, high-income groups in Korea are inclined to possess a good deal of expensive furniture.

Deaton (1981, p.1257) drives that "differential commodity taxes are related quite generally both to the degree of luxury of the goods and to the degree of complementarity with leisure." We can say that the commodity groups of (6) Transportation and (9) Culture and recreation of Table 6 in Korea and Table 7 in Japan would be related to the luxury of goods and complementarity with leisure. The results imply an anti-inverse elasticity rule. Minagawa and Upmann (2018, p.666) derive an anti-inverse elasticity rule under not a revenue constraint but a quantity target; "the higher consumer prices should be charged for the commodities with a more elastic demand."[25] The calculation results of optimal taxes in Table 6 and Table 7 indicate that those ((6) and (9)) commodity groups should be taxed at relatively high rates in Korea and Japan. Notably, the tax rates on those groups are higher in Korea than in Japan. This difference may reflect the tendency that high income groups in Korea are fond of the luxuries.

The high value of v suggests that more weight be placed on the income of the poor. Mirrlees (1975, p.32) drives the result that "makes precise intuition that higher taxes should be levied on commodities that are consumed by the less-deserving class." v in Table 6 and Table 7 indicates the magnitude of inequality aversion putting more weight on the income of the poor than that of the rich. We compare between the case $v=1$ and the case $v=2$.[26] Table 6 and Table 7 illustrate that much lower (higher) tax rates should be imposed on the commodity groups with

because the optimal tax rates depend on the scheme of the theoretical model with various parameters as well as the consumption volumes of each income group.

[25] Minagawa and Upmann (2018, p.666) argue that "higher consumer prices should be charged for commodities with high price elasticities for the total demand and for commodities with low consumption shares. Intuitively, this means that higher prices should be charged for those commodities whose prices induce large changes on the total demand."

[26] The value of v as 0 means that it does not take the equity criterion into account at all. We can confirm it from Equation (18). Using the case v=0 is not enough in our study.

high spending shares in expenditures of the poor (the rich) in the case $v=2$ compared with the case $v=1$. The case $v=2$ in Table 6 and Table 7 demonstrate that Korea and Japan should more strongly subsidize or negatively tax commodity groups with high spending shares in the first income quintile or the poor. Those commodity groups include (1) Food and beverages; (2) Housing, fuel, light, and water charges; and (5) Medical care. In contrast, high tax rates should be imposed on the commodity groups with large spending shares in the fifth income quintile or the rich. Those commodity groups include (4) Clothes and footwear, (6) Transportation, (8) Education, and (9) Culture and recreation. In particular, the optimal tax rates on (8) Education are greatly high in the case $v=2$ in 2019 in two countries.

The discussion analyzed above implies that when inequality aversion is taken into consideration, the redistribution strongly functions through the framework of optimal taxation in Korea and Japan. This result is consistent with Deaton's (1977) UK case. The redistribution effect more clearly appears in the case that the inequality aversion is intensified; however, how much the commodity groups should be taxed or subsidized somewhat differs in the two countries. Srinivasan (1989, p.385) describes that "the presence of subsidies on the consumption of certain commodities allows for a redistribution of income from the rich to the poor." Murty and Ray (1987) also suggest that redistribution takes places through the optimal commodity tax framework.[27] Jacobs and Boadway (2014) point to the redistributive aspects of commodity taxation. Jacobs and Boadway (2014, p.206) mention that "naturally, by reducing the distortions of the income tax – for a given desire to redistribute income – commodity-tax differentiation indirectly helps to redistribute more income by allowing for a more progressive income tax system."

Finally, we explore how the commodity tax burden would be changed if governments impose optimal tax rates computed in Table 6 and Table 7 for all income quintiles, which means an average optimal commodity tax rate along each income group. To compute the average optimal tax rates, we calculate total tax amounts along each income quintile assuming that the optimal tax rates in Table 6 and Table 7 are imposed. Then, we divide the total tax amounts by the total income of each income quintile in the two countries. Table 8 reports the results of the average optimal commodity tax rates by each income quintile in 2000 and 2019 to cases $v=1$ and $v=2$.

[27] Murty and Ray (1987) report that cereals and milk and milk products should be subsidized while high tax rates should be imposed on edible oils.

[Table 8] Average Optimal Commodity Tax Rates by Income Quintiles (in %)

		2000					2019				
Quintiles		I	II	III	IV	V	I	II	III	IV	V
Korea	$v=1$	3.2	4.5	4.9	5.4	5.8	-5.4	-0.7	2.7	5.0	7.8
	$v=2$	-2.6	1.4	3.2	4.9	6.9	-6.2	-5.9	1.5	6.3	12.1
Japan	$v=1$	2.4	2.9	3.5	4.3	4.9	1.8	2.5	3.5	4.4	5.4
	$v=2$	0.9	2.0	3.2	4.8	5.9	-0.2	1.2	3.1	4.9	6.9

Note: Figures indicate average optimal tax rates to which we adjusted the optimal tax rates in Table 6 and Table 7.

Sources: Calculated by authors based on the same data shown at the bottoms of Table 6 and Table 7.

The results in Table 8 indicate that the optimal commodity tax rates of the rich appear higher than those of the poor in Korea and Japan. In the case that $v=1$, the first income quintile or the poor should be imposed on the average commodity tax rate at 3.2% in 2000 and -5.4% in 2019 in Korea; 2.4% in 2000 and 1.8% in 2019 in Japan. In contrast to the first income quintile, the fifth income quintile or the rich should be levied on the average commodity tax rate at 5.8% in 2000 and 7.8% in 2019 in Korea, and 4.9% in 2000 and 5.4% in 2019 in Japan. From the results, we know that the first income quintile or the poor should be subsidized in Korea.

Furthermore, intensifying inequality aversion from $v=1$ to $v=2$ makes the average optimal tax rates of the poor much lower. In contrast, it makes the tax rates of the rich much higher. Table 8 shows that, in the case $v=2$, the first income quintile or the poor should be imposed on the average tax rate at -2.6% in 2000 and -6.2% in 2019 in Korea, and 0.9% in 2000 and -0.2% in 2019 in Japan. The fifth income quintile, or the rich, in the case $v=2$ should take a burden of average optimal tax at 6.9% in 2000 and 12.1% in 2019 in Korea, and 5.9% in 2000 and 6.9% in 2019 in Japan. The results illustrate that intensifying inequality aversion results in the decrease of tax rates of the poor and the increase of tax rates of the rich. In addition, we can observe that the differences of tax burden between the poor and the rich are much larger in Korea than in Japan. This difference is due to the income distribution appearing more unequal in Korea than in Japan.

We insert the values of "[the income of the first quintile (I)] divided by [the income of the fifth quintile (V)]" at the bottom lines of Table 4 and Table 5 and call it the "quintile distribution index." In short, the index denotes the ratio of the first quintile income to the fifth quintile income. The high index illustrates that the income of the first quintile or the poor accounts for a relatively larger amount, compared with the income of the fifth quintile or the rich. The quintile distribution index appears at 33.8% in 2000 and 24.2% in 2019 in Korea, whereas the index appears at 44.8% in 2000 and 46.5% in 2019 in Japan. The results imply that the income distribution is more unequal or more uneven across income classes in Korea than in Japan. Although the recent economic growth rates in Korea have been higher than in Japan, income distribution in Korea has worsened more than in Japan. Urakawa and Oshio (2010) find more degree of efficiency-equity trade-off in Korea than in Japan.

VII. Concluding Remarks

We compared the consumption patterns and discussed optimal commodity tax rates between Korea and Japan using household data in the two countries. Also, we distinguished our results from other existing studies that dealt with optimal commodity taxes. Coady and Drèze (2002, p.296) propose a generalized Ramsey rule[28] that integrates three distinct roles: (1) revenue collection, (2) interpersonal redistribution, and (3) resource allocation. Although we did not derive a generalized Ramsey rule from Coady and Drèze (2002),[29] we constructed a model with a many-household economy relating to a many-person Ramsey rule considering inequality aversion. The main objective of our study was to illustrate how the optimal commodity taxes should be imposed on the spending of commodity groups in Korea and Japan. Korea and Japan have a 10% uniform tax rate in consumption taxation in the form of value added tax. However, when we take the equity criterion as well as the efficiency criterion in our framework of the optimal commodity taxation into account, commodity tax rates should be different according to consumption group, which can be our contribution.[30]

The framework with a single tax rate needs to be changed when the tax authority considers the efficiency criterion as well as the equity criterion. The necessity to change a single tax rate can be the policy implication or the main message of optimal commodity taxation in the economy with many households. The results of calculations imply that subsidization should be operated on the goods with high shares in expenditures of the poor, and higher tax rates should be imposed on the goods with high shares in expenditures of the rich. As shown in Table 6 and Table 7 (hereafter, the numbers in the Tables), some commodity groups that should be subsidized cover (1) Food and beverages, (2) Housing, fuel, light, and water charges, and (5) Medical care in Korea and Japan. In contrast, higher taxes should be levied

[28] Coady and Drèze (2002, p.297) point out that the deadweight loss depends on the distributional assumptions being made. The generalized Ramsey rule was also derived from Drèze and Stern (1987).

[29] Coady and Drèze (2002, p.304) also drive a many-person Ramsey rule.

[30] Tax exemption or lower tax rate for food and beverages may cause their consumption to change. However, other factors such as income level, the existence of compliments and substitutes, and price elasticity of demand, can also affect the consumption level. As a result, the consumption change due to VAT or consumption tax may be difficult to explain explicitly. Of course, we can construct a model of partial equilibrium analysis to show the effect of VAT on the consumption level, which will be another topic.

on commodity groups such as (4) Clothes and footwear, (6) Transportation, (8) Education, and (9) Culture and recreation in the two countries. However, the magnitudes of subsidization and/or taxation were larger in Korea than in Japan, which reflected more unequal income distribution in Korea than in Japan. Another difference between the two countries was that (3) Furniture and utensils should be taxed on relatively higher rates in Korea but not in Japan.[31]

We used the linear expenditure system, which includes the minimum consumption level. According to the results demonstrated in Table 6 and Table 7, when the degree of inequality aversion is intensified, the government should provide more subsidies to the consumption groups such as (1) Food and beverages, (2) Housing, fuel, light, and water charges, and (5) Medical care. Those commodity groups show high shares in the expenditures of the poor in Korea and Japan (see Table 4 and Table 5). In contrast, if more weight was placed on the social marginal utility of the income of the poor or the inequality aversion was strengthened, higher tax rates should be imposed on the commodity groups with high shares in expenditures of the rich. Those commodity groups include (4) Clothes and footwear, (6) Transportation, (8) Education, and (9) Culture and recreation in two countries. The results of our calculations imply that a redistribution goal could be attained through the optimal commodity taxes considering inequality aversion in Korea and Japan, which are in line with the Indian cases of Srinivasan (1989) and Ray (1987 and 1986), and the UK case of Deaton (1977).

In addition, we presented how the average optimal tax burdens in each income quintile would be changed depending on inequality aversion (See Table 8). According to the result, the average optimal commodity tax rates of the rich should be higher than those of the poor in both Korea and Japan. We offered the distribution index defined by the value of "the income of the first quintile divided by the income of the fifth quintile." The higher the index becomes, the more equal the income distribution is. The distribution index has slightly risen in Japan, while it has fallen with a certain range in Korea when we compare the two periods of 2000 and 2019. Judging from these indices, income distribution has worsened more in Korea than in Japan.

The practical operation of the tax system is another big issue in the field of taxation. Slemrod (1990) casts a discussion on optimal taxation and optimal tax system. Slemrod (1990, p.159) states that "calculating the optimal commodity tax rates may require knowing price and income responses at points quite different from the current position or anything else previously observed."[32] In addition,

[31] The reason may be the difference of house structure between the two countries. Usually, Japanese homes do not hold luxurious furniture owing to the risk of earthquakes, typhoons, etc. In contrast, high-income groups in Korea are inclined to possess a lot of expensive furniture.

[32] Mayshar (1991, p.77) points out tax-administrative aspects mentioning that "the share of the administrative components in the total excess costs of raising a marginal dollar of revenue by

Mayshar (1991, p.87) argues that if administrative costs are broadly defined, the costs may account for a larger share of the excess cost at the margin than the share accounted for by standard substitution costs. Wilson (1989, p.1204) also remarks the administrative considerations that "clearly make it undesirable to tax each commodity at a different rate. Instead, broad classes of commodities should be taxed at different rates." Broadening the tax base will reduce deadweight loss or excess burden of taxation, but it will raise administrative cost. The question on tax base may be related to how commodity groups should be allotted under an optimal tax structure. However, we did not deal with the optimal tax system and/or tax-administrative costs.

increasing the tax rate is found to be larger than the share accounted for by substitution costs."

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가계조사로 본 소비 형태 및 최적상품세율에 관한 한일 비교*

국 중 호**· 최 석 규***

초 록 본 논문은 한국과 일본의 가계조사를 이용하여 양국의 소비 패턴과 최적 상품과세를 비교분석하였다. 본고에서는 5분위 소득 계층별 평균 최적 과세 부담이 불평등 회피도에 의존하여 어떻게 적용되어야 하는지를 측정하여 제시하였다. 측정 · 분석 결과에 따라 저소득층(또는 고소득층)의 지출 비중이 높은 상품 그룹은 보조금이 지급되어야(또는 과세되어야) 한다는 점을 제시하였다. 저소득층에 대한 보조금 지급 또는 고소득층에 대한 과세의 정도는 한국이 일본에 비해 크게 나타나고 있는데, 이는 한국이 일본에 비해 소득불평등도가 높기 때문이다. 나아가 불평등 회피도가 강화되면 양국 모두 보조금 지급 또는 과세의 정도가 높아지는 것으로 나타났다. 본 논문의 분석 결과는 인도의 최적과세 세율을 측정한 Srinivasan(1989) 및 Ray(1987 and 1986)의 연구, 영국의 사례를 다룬 Deaton(1977) 의 연구 결과와 같은 선상에 있다. 본 논문의 공헌은 한국과 일본의 가계조사를 이용하여 효율성과 공평성을 함께 고려하는 측면에서 불평등 회피도를 고려한 최적상품과세 세율을 제시하였다는 점에 있다고 본다.

핵심 주제어: 소비 패턴, 최적상품과세, 가계조사, 일본, 한국

경제학문헌목록 주제분류: D1, D6, H2

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