

Optimal Consumption Tax and Redistributive Impacts in Thailand: A Theoretical Exploration and Exercise

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ในการศึกษาเรื่องการเก็บภาษีทางอ้อม หลักการสำคัญที่เกี่ยวข้องคือความมีประสิทธิภาพและความเท่าเทียม ด้วยความตระหนักว่าบทบาทของภาษีทางอ้อมในการจัดสรรรายได้ นั้น มีข้อจำกัดในทางทฤษฎีและการศึกษาเพื่อพัฒนาทฤษฎีสำหรับประยุกต์ใช้ในกรณีประเทศไทยยังไม่ปรากฏอย่างเด่นชัดในวรรณกรรมปริทัศน์ งานวิจัยนี้จึงทำการศึกษาในเชิงลึก ภายใต้ข้อสมมติต่อระบบอุปสงค์ลักษณะต่างๆ เพื่อคำนวณค่าตัวแปรทางภาษีที่ส่งผลให้สวัสดิการในบริบทของ “เรมซีประยุกต์” (Modified Ramsey) อยู่ในระดับที่ดีที่สุดในอุดมคติ หรือระดับใกล้เคียงกับสภาวะดังกล่าวมากที่สุดภายใต้สภาวะที่เป็นอยู่ ท้ายที่สุด ผลของการกระจายรายได้โดยอัตรากาฬิที่ได้จากการคำนวณในงานวิจัยนี้ จะนำมาเปรียบเทียบกับอัตรากาฬิที่เป็นอยู่จริงในประเทศไทยในช่วงเวลาสิบปีที่ผ่านมาเพื่อประเมินสถานการณ์กาฬิอุปโภคบริโภคในประเทศที่เป็นอยู่ในปัจจุบัน

Abstract

There are two main aspects of the study of indirect taxation, namely those relating to efficiency and equity. Despite the theoretically limited redistributive role of indirect taxation, as a

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theoretical exploration and exercise not having been much evidenced in Thailand's literature, this study attempts to solve for the 'optimal' commodity tax rates in the context of Modified Ramsey based on alternative demand systems appropriated for the case of Thailand's data. The redistributive impacts of the tax rates obtained in each set of demand system will be compared with those of the actual consumption tax rates collected during the past decade across all the provinces in Thailand.

I. The Intuition

It is generally accepted that progressive tax structure alleviates income inequality. The government may as well utilise tax revenue in its expenditure on education, health and sanitation, to name a few, or transfer in terms of social welfare to less privileged population through social safety net programmes. In developed countries, government expenditure in terms of transfer payments to subsist the unemployed or the low-income will contribute to the aggregate expenditure. However, in Thailand, as in most developing countries, social security expenditure contributes to a relatively low proportion of GDP, that is, less than 2%, compared with the World's average of 14.5%, Asia's average of 6.4% and Europe's Average of 24.8%. Moreover, according to ILO World Labour Report 2000, social security provisions are generally characterised by low coverage, that is, approximately 10% of the labour force in Thailand.

When placing particular emphasis on the revenue policy concerning tax collection of various types on the different tax bases and tax rates, particularly consumption tax, that affects the redistribution of income, there is a strong call for a study that employs a more scientific method in calculating the value of related variables that are socially optimal. This is detailed in section V of the paper. The first reason why there has not been much research of such nature for the case of Thailand may be due to the complicated theoretical formulation that makes it difficult to calculate the optimal tax value. For the second reason, referring to Gordon Tullock's (1997) comment: "I suspect that the reason for the sad state of research on redistribution is a belief that essentially it is a moral rather than a scientific issue. People favour or oppose particular income redistribution

programmes essentially on moral grounds and tend to believe that science and morals do not mix well. Most people believe that science should be the servant of morals, and this leads to a de-emphasis of scientific research on the foundations of income redistribution programmes....”

The third reason may be that, although there are some research such as Diamond and Mirrlees (1971), Dodgson (1983) and Sah (1983), analysing the role of indirect tax, for example, consumption tax, that affects equity and redistribution of income throughout, most studies place more focus on the issue of efficiency. This may be because most researchers are from developed countries where the direct tax system such as income tax could appropriately perform the role of income redistribution. In such developed countries, it is, therefore, not necessarily required to employ indirect tax to assist the role of income redistribution. For the case of Thailand, Likitkijksomboon (1985), Puttamon (1990) and Patamasiriwat et al (1998) indicate that indirect Taxation causes somewhat neutral effect on income redistribution. According to Krongkaew (2001), Pahirah (1978), the impact of the total tax structure on income redistribution varies according to the definition of income, whether it is money income or total income. On the contrary, Apiratanapimonchai (1975) found that tax system makes distribution worse. Nevertheless, Tinakorn (2002) comments that, for the indirect taxes, it depends on assumptions and definition of income.

This research, unlike those previously conducted, does not intend to study about poverty situation in Thailand. Instead, it aims at assessing the role and potentials of indirect taxation, namely consumption tax, on the redistribution of income. This particularly focuses on theoretically optimal consumption tax rate determination in the framework of public economics rationale. This type of indirect taxation, namely, excise duty and value-added tax, VAT, in comparison with the other types of taxes, has the highest value and proportion of Thailand’s tax revenue. However, it is to be noted that a fully comprehensive study of fiscal policy and taxation, in general, requires a coverage of other fields of study as well, such as history, culture and other social sciences, to name a few. Hence, a comprehensive policy design in the future requires taking into account such considerations and modifications.

In the first part of the study, theoretical framework is developed in continuation to those in existence in the international literature. The simulation is then constructed to estimate the values under different assumptions of the degree of inequality aversion. Having obtained the framework, it is applied to the case of Thailand. The analysis is conducted on the commonly used Linear Expenditure System (LES) and its one-parameter generalisation, the Restricted Non-linear Preferences System (RNLPs). The scope of the study covers the average cross-provincial household survey statistics in Thailand during the fiscal years 1990-2001.

II. An Overview of Consumption Taxation in Thailand

The Tax Code (Rasadakorn¹) in Thailand was implemented under the Act to Implement the Tax Code BE 2481 (AD 1938). Originally this code includes many tax laws in Thailand. However, at present, it includes only four categories of tax, namely: personal and corporate income taxes, value-added tax, specific business tax and stamp duty. The value-added tax and specific business taxes, the focus of this research, have been implemented in place of trade taxes since 1 January 1992. The value-added tax, specific tax and stamp duty are indirect taxes. The collection of these four categories of taxes is under the supervision of the Revenue Department, Ministry of Finance. The normal tax rate based on the tax code since first implemented in 1992 was 7% (excluding the taxes in some local constituencies). However, during the economic crisis and baht floating in 1997-1998, the tax rate was raised to single rate of 10% (Article 80) for 9 months and later dropped in compliance with the Royal Decree to the rate of 6.3%, plus local tax of 0.7%, totalling 7%.

Additionally, those goods which are considered luxurious, such as gasoline and petroleum products, beverages, electronics, crystals, automobiles and motorcycles, batteries, precious stones, perfumes and cosmetics, carpets, animal skins, ozone-destructive agents, and the like, must also be subject to excise taxes. These rates vary according to different periods

¹ Derived from the words: Rasadorn (Citizen) plus Akorn (Tax), representing a tax levied on the citizens.

discretionary under the Notification of the Ministry of Finance in each period. However, there are goods that are subject to 0% (Article 80/1) rate namely: 1. export of goods by registered entrepreneur, 2. provision of services based on categories determined by the Director General, including ocean-sailing ships fixing, disaster insurance abroad or export insurance of goods abroad (Notification of Director General No. 105), 3. internal courier service by air/sea conducted by a corporate, 4. selling of goods and services to public sector or public enterprises sponsored by foreign loans, grants or transfers, 5. selling of goods and services to United Nations organisations, specialised agencies, embassies, consulates or consulate generals. There are also exceptions to selling the goods domestically, namely: 1. fresh agricultural products, 2. fresh meat, 3. fertilizers, 4. dried fish and meat, 5. pesticides, 6. newspapers, magazines and books, 7. education service, 8. services of arts and culture, 9. medical services and other professional services, 10. research and educational services, 11. library services and museum 12. contract labour services, 13. amateur sport services, 14. public shows, upon approval of the Director-General and the Minister, and 15. transportation service within the kingdom and others as detailed in Articles 81, 81/1-81/3.

III. International Literature on Consumption Tax Theory

The concept of consumption taxation (theoretically, the so-called ‘commodity taxation’) at a level that is socially optimal originates from the earlier seminal essay presented in 1927 by Frank Plumpton Ramsey (1903-1930). The main objective follows the rationale that, when government aims to raise revenue by taxing consumption from the gained income of the citizen, there are various tax rates in general. The major question here is how to determine tax rate so as to minimise the negative impact on social welfare.²

The major point made by Ramsey in calculating optimal tax is efficiency, excluding the issue of equity or redistribution. Henceforth, the research activities tend to focus mostly on the

² Ramsey (1927): “If a given revenue is to be raised by proportionate taxes on some or all uses of income...being possible at different rates, how should these rates be adjusted in order that the decrement of utility may be a minimum?”

issue of efficiency rather than equity as indicated in Atkinson and Stiglitz (1980, Chapters 12 and 14). The reason for this is that most of the papers originate from developed countries where most of the distribution of income and wealth has been executed by the direct taxation. However, in under-developed or developing countries, there is a lack of proper and efficient system of direct taxation. Therefore, there is a necessity to rely on indirect taxation to assist in the role of income redistribution as a tool. Moreover, the problem of indirect taxation in these countries does not only relate to the fundamental structure but also to the political limitations as well (Cnossen, 1977). For instance, in India, most of the national income come from agricultural sector. However, the fact that most of the landlords have strong influence on politicians makes tax collection from the agricultural sector relatively small as a proportion to the overall tax revenue (Bhargava, 1969). A report by Gulati (1994) indicates that during 1980, income tax contribute only 3.5% of the gross revenue.

Later years, Peter Diamond and James Mirrlees, in 1971, modify and develop Ramsey's theory to include the Many-Person Economy that employs the common social welfare function. The paper by Diamond and Mirrlees uses the same assumptions as those in Ramsey except that there are many persons (Atkinson and Stiglitz, 1972). The rationale begins that the government wishes to collect tax at the lowest cost possible (that is, least-cost). The government chooses tax rate, t , that maximises social welfare represented by a function of individual utility. Hence, the variable, t , depends on two major factors, namely: first, how the society perceive individual welfare or social equity, and second, what consumer prefers, that is the consumer preferences in the form of adopted demand function. In most of the literature, such assumed forms and assumptions have been widely accepted (Deaton, 1981). Furthermore, it has been theoretically proven that the variable t can be uniform if the following conditions hold: 1. Labour supply is completely inelastic or 2. consumption is weakly separable from leisure, and consumption indifference map is homothetic or Engel curves are linear, or an optimal non-linear income tax is allowed for so as to compensate.

Nevertheless, the uniformity result is only valid within a framework where people have identical preference and differ only in their earning power which consists of one factor. During the early 1980's, Dodgson (1983) and Sah (1983) analyse the role of indirect taxation in income redistribution in the United Kingdom. Their model is framed by the Additively Separable Linear Expenditure System (LES), implying that goods utility function is homothetical at all labour income level (that is, weak separability of labour supply).

At the later stage of literature development, there has been an increasing number of debates on the appropriate structure of demand function representing the society. At the end of 1980s and the beginning of 1990s, there exists a large body of literature (empirical evidences) suggesting that leisure is not weakly separable from goods. Moreover, Blundell and Ray (1982) assert that Engle curves are not linear. Additionally, Barten (1977) suggests that food utility function is not additively separable, far less homothetically so. For example, in India, there is evidence of non-homothetic and non-separable commodity demand function with non-linear Engel's curves (Ray, 1982, 1985). Kasekende and Ray (1984) provide further evidence of non-linear Engel curve on time series of national accounts data of other developing countries, which requires non-linear optimal income tax.

Due to the severe constraints on direct taxes in many developing countries, "optimal" commodities taxes will almost certainly be non-uniform. Thus, this constitutes one of the motivations for analyses of non-uniform commodity tax in developing countries. Additionally, some papers suggest using a combination of tax and tax reform in a package. Atkinson and Stiglitz (1972), Harris and Mackinnon (1978) and Ahmad and Stern (1984) use additively separable utility functions, for instance, those corresponding to direct addilog system, linear expenditure system or its homothetical specialisation, the Cobb-Douglas system.

Ray (1986a), for simplicity, employs a strict assumption on "optimality", referring to the given price and observed expenditure at a particular time. He tries to generalise and provide extension to the existing literature several aspects. First, the analysis concerns with how sensitive the estimated "optimal" tax rates are to the demand specification. However, it is important to

note here that for taxes to be strictly “optimal”, the calculations must allow for the dependence of expenditure and price levels on taxes via a simulation algorithm which simultaneously arrives at the optimal value of all these variables. Second, the analysis looks at how sensitive the optimal tax rates are to variation in the government’s “inequality aversion”. The third inquiry looks for what redistribute impact are and how they can be compared across demand specification and inequality aversion. The forms of the demand function employed include non-linear Engel curves, non-separable preferences and restricted non-linear preferences system (RNLPS). Moreover, it is also assumed that there is weak separability between goods and leisure. This is because of the absence of wage and earning data made it impossible to mention about labor supply.

The later publications by Majumder (1988) and Ray (1986b) solve for welfare maximising tax rates under different estimated demand systems. General observation shows that these rates are sensitive to the consumer preference structure assigned. Most of the general results such as in Sah (1983) and Ray (1986a) show that when using Ramsey Rule to determine tax rates, there is limited role in securing redistribution from the rich to the poor. However, even the limited role in redistribution may not have been fully performed. For the case of Thailand, there has not yet been a study to determine optimal tax under the existing conditions and, hence, this will be an exercise in Section V of this research paper.

IV. Rationale for Consumption Taxation and the Standard Methodology

One of the early questions concerning taxation was as simple as this: the government requires a certain level of revenue which could only be acquired through commodity taxation, how can tax be administered at the minimum cost to the society? If a social welfare function could represent the state’s preferences, then it only requires that the government chooses the commodity tax rates that maximise social welfare subject to revenue constraint. As observed in reality, collecting lump-sum taxes from the population may not be feasible in practice due to the requirement of information on preferences and endowments. These kinds of information are

private and there is a high tendency that they may not be truly revealed by households. Hence, it is assumed for simplicity in this session that lump-sum tax cannot be employed in the model. The employment of consumption taxes, on the other hand, requires only the information on trades in goods and services.

Only linear taxes are considered in the analysis, which complies with the standard methodology. Thus, by means of commodity taxation, the post-tax price of good i can be either expressed as: $p_i + t_i$ or $p_i(1 + t_i)$. Expressed in either form does not alter the conclusion. The theoretical procedures toward obtaining the optimal solution are simply as follows: (1) maximisation of social function with respect to tax rates, (2) manipulation of first order conditions to obtain a qualitative description of the optimal tax system and (3) consideration of the efficiency and equity criteria embodied in a social welfare function. The basic assumptions for Ramsey rule include: competitive economy, general equilibrium framework, n consumption goods, single form of labour which is the only factor of production, each industry produces a single output, production uses constant returns to scale technology, with single household or, equivalently, a population of identical households (preferences are represented by an indirect utility function).

Since there is one household, it follows that there need not be equity consideration so that the results obtained represent an *efficient* tax system. Competitive assumption ensures that the pre-tax price of good i is given in equation (1)

$$p_i = c^i w, \quad i = 1, \dots, n \quad (1)$$

where: c = coefficient of labour input required to produce 1 unit of good i .

w = wage rate

In congruent with the normalisation rule in Mirrlees (1976), labour is chosen as a numeraire and wage rate is fixed at a constant value w . Hence, these conditions give a set of effectively fixed pre-tax, or producer, prices for consumption goods.

Post-tax, or consumer, prices are equal to the pre-tax prices plus the taxes. This is presented in (2).

$$q_i = p_i + t_i, \quad i = 1, \dots, n \quad (2)$$

subject to the revenue requirement in (3).

$$R = \sum_{i=1}^n p_i t_i x_i \quad (3)$$

This revenue raised is used to purchase a quantity of labour equivalent to the value of R . It is to note that R labour is used for certain purpose, which does not produce any tangible good circulated in the economy. Real world examples for this would be defence and “exported charity”, et cetera.

Household preferences are given in the form of indirect utility function in (4).

$$U = V(q_1, \dots, q_n, w, I) \quad (4)$$

Note that w decomposes into those in the production and those in the state use.

Moreover, $I = O$, since I is lump-sum income and is different from M , the total income. By constant returns to scale and perfect competition assumption, firms earn zero profit, which leads to no profit income. Therefore, household’s lump-sum income, I , equals zero.

The optimal tax problem includes the following equations:

1. $\max_{\{t_1, \dots, t_n\}} V(q_1, \dots, q_n, w, I), s.t. R = \sum_{i=1}^n p_i t_i x_i \quad (5)$

2. Putting (5) into Lagrangean function in (6)

$$L = V(q_1, \dots, q_n, w, I) + \lambda \left[\sum_{i=1}^n p_i t_i x_i - R \right] \quad (6)$$

3. Solving for first order condition in (6) with respect to t_k , tax rate on good k , leads to (7)

$$\frac{\partial L}{\partial t_k} \equiv \frac{\partial V}{\partial t_k} + \lambda \left[x_k + \sum_{i=1}^n p_i t_i \frac{\partial x_i}{\partial q_k} \right] = 0, \quad (7)$$

By employing the identities in (8), holding the fact that we assumed labour being numeraire and wage rate as fixed:

$$\frac{\partial V}{\partial q_k} \equiv \frac{\partial V}{\partial t_k} \quad \text{and} \quad \frac{\partial x_i}{\partial q_k} \equiv \frac{\partial x_i}{\partial t_k}, \quad (8)$$

the optimal consumption taxation is equivalent to the public sector pricing. Rearranging (7) gives the solution in (9).

$$\frac{\partial V}{\partial q_k} = -\lambda \left[x_k + \sum_{i=1}^n p_i t_i \frac{\partial x_i}{\partial q_k} \right] \quad (9)$$

The expression in (9) applies to all n goods in the economy. It may be interpreted as this: For all goods, the utility cost of raising tax rate on good k should be the same proportionally to the marginal government revenue raised by the tax increase. Hence, it requires that any tax rate chosen should give the same tax revenue per unit of utility foregone.

From Roy's Identity:

$$\frac{\partial V}{\partial q_k} = \frac{-\partial V}{\partial I} x_k = -\alpha x_k \quad (10)$$

where

$$\alpha = \text{Marginal Utility of Income}$$

Substituting (10) into (9) gives (11) and (12).

$$\alpha x_k = \lambda \left[x_k + \sum_{i=1}^n p_i t_i \frac{\partial x_i}{\partial q_k} \right] \quad (11)$$

$$\sum_{i=1}^n t_i \frac{\partial x_i}{\partial q_k} = - \left[\frac{\lambda - \alpha}{\lambda} \right] x_k \quad (12)$$

Recalling Slutsky Equation:

$$S_{ik} = \frac{\partial x_i}{\partial q_k} + x_k \frac{\partial x_i}{\partial I} \quad (13)$$

$$\frac{\partial x_i}{\partial q_k} = S_{ik} - x_k \frac{\partial x_i}{\partial I}$$

Substituting (13) into (12) leads to (14) and (15).

$$\sum_{i=1}^n t_i p_i \left[S_{ik} - x_k \frac{\partial x_i}{\partial I} \right] = - \left[\frac{\lambda - \alpha}{\lambda} \right] x_k \quad (14)$$

$$\Rightarrow \sum_{i=1}^n t_i p_i S_{ik} = - \left[\frac{\lambda - \alpha}{\lambda} \right] x_k + \sum_{i=1}^n p_i t_i x_k \frac{\partial x_i}{\partial I} \quad (15)$$

$$\Rightarrow \sum_{i=1}^n t_i p_i S_{ik} = - \left[1 - \frac{\alpha}{\lambda} - \sum_{i=1}^n t_i p_i \frac{\partial x_i}{\partial I} \right] x_k \quad (16)$$

Since $S_{ik} = S_{ki}$ according to Young's Theorem;

$$\sum_{i=1}^n t_i S_{ik} = -\theta x_k \quad (17)$$

or, alternatively, $\sum_{i=1}^n \Delta x_k^s = -\theta x_k$,

where

$$\theta = \left[1 - \frac{\alpha}{\lambda} - \sum_{i=1}^n t_i \frac{\partial x_i}{\partial I} \right] > 0, 0 < \frac{\alpha}{\lambda} < 1, 0 < \sum_{i=1}^n t_i \frac{\partial x_i}{\partial I} < 1$$

θ is the difference between social costs and revenue of reducing individual's (lump-sum) income. Equation (17) describes a system of optimal commodity taxes, which holds for all goods, $k = 1, \dots, n$ and is independent of the particular good. Multiplying both sides of (17) by t_k and summing over k gives (18).

$$\sum_{k=1}^n \sum_{i=1}^n t_i t_k S_{ki} = -\theta R \quad (18)$$

Initially, before the introduction of commodity tax, the Slutsky's equation can be expressed as in (19).

$$S_{ki} = \frac{\partial h_k}{\partial q_i} \quad (19)$$

where h_k is the Hicksian or compensated demand for good k . Upon the introduction of tax on good i , equation (20) represents a first order approximation of the change in compensated demand for good k .

$$t_i S_{ki} = t_i \frac{\partial h_k}{\partial q_i} \quad (20)$$

where t_i is the change in tax rate on good i .

This is a good approximation if taxes are small. For the entire set of tax, it follows that (21) represents the approximation of compensated demand for good k with the introduction of the tax system.

$$\sum_{i=1}^n t_i S_{ki} \quad (21)$$

Note that this only represents the effects on demand. Since both utility and price change when tax is introduced, the *actual* change in demand is given in (22).

$$h_k(p, U^0) - h_k(q, U^1) \quad (22)$$

where

U^0 = initial utility level before the introduction of commodity taxes

U^1 = final utility level after taxation is introduced

Recalling that R and θ are positive, the Ramsey Rule in (17) can be written as in (23).

$$\frac{\sum_{i=1}^n p_i t_i S_{ki}}{x_k} = -\theta, \quad k = 1, \dots, n \quad (23)$$

Alternatively, it may be expressed as:

$$\frac{\Delta x_k^s}{x_k} = -\theta$$

The interpretations for the Ramsey Rule may be summarised as follows:

1. To maximise utility (or minimise excess burden), consumption taxes should be set in such a way that the relative change in compensated demand in response to the imposition of tax would be the same for all goods.

2. Alternatively, it can be expressed as this: To attain optimal tax system, compensated demand after tax introduced for each good should reduce in the same proportion relative to its pre-tax position.

3. By the identities shown in (8), the duality property of Marshallian and Hicksian demand shows that the optimal tax system should raise the prices of all goods by the same proportion in order to minimise the distortion caused by the introduction of tax system. However, the third point of interpreting Ramsey rule has not been emphasised. Ramsey emphasised more on *quantities* since it is the consumption that actually determines welfare. Price only determines demand and it can only be determined by normalisation in the classical model. Hence, with the emphasis on quantities, we define the proportional reduction in demand in (24) and call it the “index of discouragement” as in Mirrlees (1976).

$$d_k = \frac{\sum_{i=1}^n t_i S_{ki}}{x_k} \quad (24)$$

4. From (24), the tax system is optimal when the index of discouragement, d_k , is equal for all goods.

Ramsey Rule implies that, by accepting the approximation, the proportional reduction in compensated demand must be the same for all goods. This implication leads to the expectation that goods with unresponsive demand, that is, inelastic demand, to price changes must bear higher taxes. Technically, *if* $\Delta x_j^s < \Delta X_i^s$, *then* $t_j > t_i$ such that $d_j = d_i$. However, this conclusion must be conditional that all cross-price effects between the taxed goods are checked. Alternatively, we must assume that there are no cross-price effects between the taxed goods. The second major implication is that goods with inelastic demand such as food and clothing are necessities and, hence, by Ramsey Rule, bear heavily on taxes. As a result, proportionally low-income households would have to pay higher taxes on their consumption. Vice versa for the rich households, they would bear lower tax rates on luxuries (see Deaton’s (1981) weak separability preferences). This implication shows that optimisation only considers the *efficiency* aspect, not *equity*. Thus, the solutions obtained from optimising commodity taxation is second-best whilst that of lump-sum is first-best. Generally, commodity taxes leads to distortion in household’s optimal choices and losses in efficiency. It is through Ramsey Rule that these losses are minimised.

In the case of many-household model, all the other assumptions mentioned previously still hold except that there are now more than one household which are non-identical. Thence, *equity* consideration is now determined (see Diamond and Mirrless, 1971). Based on the optimal tax rule, it is assumed that there are now H households, each h has a utility function in (25).

$$U^h = V^h (q_1, \dots, q_n, w, I^h) \quad (25)$$

Subject to:

$$R = \sum_{i=1}^n \sum_{h=1}^H p_i t_i x_i^h \quad (26)$$

We use social welfare function (Bergson – Samuelson social welfare function) in (27) defined as the vector of indirect utilities.

$$w = w (V^1 (.), \dots, V^H (.)) \quad (27)$$

Equation (28) shows the maximisation of social welfare function with respect to optimal set of commodity taxes.

$$\max_{(t_1, \dots, t_n)} W(V^1 (.), \dots, V^H (.)), \text{ s.t. } \sum_{i=1}^n \sum_{h=1}^H p_i t_i x_i^h = R \quad (28)$$

There are two presentations for the solution to (28), namely: 1. Diamond and Mirrlees (1971)- the efficiency and equity aspects and 2. Ramsey Rule Aspect - the basis for numerical implementation

Maximising (28) from the Lagrangean gives the first order condition in (29).

$$\sum_{h=1}^H \frac{\partial W}{\partial V^h} \cdot \frac{\partial V^h}{\partial q_k} + \lambda \left[\sum_{h=1}^H x_k^h + \sum_{i=1}^n \sum_{h=1}^H p_i t_i \frac{\partial x_i^h}{\partial q_k} \right] = 0 \quad (29)$$

By Roy's Identity:

$$\sum_{h=1}^H \frac{\partial W}{\partial V^h} \cdot \frac{\partial V^h}{\partial q_k} = - \sum_{h=1}^H \frac{\partial W}{\partial V^h} \alpha_k^h \quad (30)$$

$$\text{Let } \beta^h = \frac{\partial W}{\partial V^h} \alpha \quad (31)$$

β^h can be decomposed to: 1. the marginal social welfare of household's utility and 2. the marginal utility of income of household h . Hence, by Diamond and Mirrlees' (1971) standard, β^h is the "social marginal utility of income" for household h . Using β^h definition, (29) becomes (32).

$$\sum_{h=1}^H \beta^h x_k^h = \lambda \left[\sum_{h=1}^H x_k^h + \sum_{i=1}^n \sum_{h=1}^H t_i p_i \frac{\partial x_i^h}{\partial q_k} \right] \quad (32)$$

From Slutsky equation,

$$\frac{\partial x_i^h}{\partial q_k} = S_{ik}^h - x_k^h \frac{\partial x_i^h}{\partial I^h}, \quad (33)$$

and through rearranging, (32) becomes (34).

$$\frac{\sum_{i=1}^n \sum_{h=1}^H t_i S_{ki}^h}{\sum_{h=1}^H x_k^h} = \frac{1}{\lambda} \cdot \frac{\sum_{h=1}^H \beta^h x_k^h}{\sum_{h=1}^H x_k^h} - 1 + \frac{\sum_{i=1}^n \sum_{h=1}^H t_i \frac{\partial x_i^h}{\partial I^h} \cdot x_k^h}{\sum_{h=1}^H x_k^h} \quad (34)$$

The equation in (34) is the generalisation of discouragement index in (24).

As in the case of Ramsey Rule, we must keep in mind that this is the approximation of $\Delta x_h^s / x_x$. Hence, errors may arise with the approximations because 1. real income changes in moving to the system of optimal taxes, and 2. gradient of demand function is unlikely to be constant.

Re-expressing (34) to be closer to the standard Ramsey Rule leads to (35).

$$\sum_{i=1}^n \sum_{h=1}^H t_i S_{ik}^h = - \left[H \bar{x}_k - \frac{\sum_{h=1}^H \beta^h x_k^h}{\lambda} - \sum_{i=1}^n t_i \left[\sum_{h=1}^H \frac{\partial x_i^h}{\partial I^h} x_x^h \right] \right] \quad (35)$$

$$\text{where } \bar{x} = \frac{\sum_{h=1}^H x_k^h}{H} \quad (36)$$

is the mean level of consumption of good k across households.

The R.H.S. of the equation in (34) indicates that reduction in demand should be small under the following conditions:

1. β^h has high value (equity aspect). Hence, both α^h , the marginal utility of income, and the marginal social welfare of utility are large. If social welfare function is concave, that is, $\frac{\partial W}{\partial V^h} > 0$ and $\frac{\partial^2 W}{\partial V^{h2}} < 0$, then, given the government is concerned with households with low income, tax rates will be lower on the goods consumed by such households.

2. $\sum_{i=1}^n t_i \frac{\partial x_i^h}{\partial I^h}$ is high (efficiency aspect). That is, tax rate should be low on goods consumed by households whose tax payments are considerably responsive to the change in their income.

By imposing high tax rates on such households to meet quarter revenue target would lead to consumption distortion.

Now, consider (36) and its refinement gives (37):

$$b^h = \frac{\beta^h}{\lambda} + \sum_{i=1}^n t_i \frac{\partial x_i^h}{\partial I^h} \quad (37)$$

Where b^h is Diamond's (1975) "net social marginal utility of income" measured in terms of government revenue. Hence, b^h considers both the equity and efficiency effects. From (35), it could be rearranged as in (38).

$$\frac{\sum_{i=1}^n \sum_{h=1}^H t_i S_{ki}^h}{\sum_{h=1}^H x_k^h} = - \left[1 - \sum_{h=1}^H \frac{b^h}{H} \cdot \frac{x_k^h}{x_k} \right] \quad (38)$$

Equation (38) shows the reduction in Hicksian demand for k^{th} good upon the implementation of tax. Such demand should be inversely related to the connotation between b^h and x_k^h . That is, if b^h and x_k^h are high, the R.H.S. should be *less negative* and, hence, t_i should be low.

To put it non-technically, the reduction in demand, hence, tax rate, should be lower under the following conditions:

1. The good is consumed by households who have higher “appreciation” on an increase in consumption caused by an increase in income (equity aspect), and
2. The households’ consumption nature of that good is highly sensitive or reflexive to their income changes (efficiency aspect).

V. The Model Framework

The methodology adopted in this study involves solving the Ramsey first-order conditions at a given time period as a set of simultaneous equations, with the ‘optimal’ commodity tax rates being the unknown, estimable parameters. The exercise is carried out for alternative demand systems, and the corresponding sets of commodity tax rates compared. The following points are necessary for pre-requisites. First, for the reason of simplicity, the term ‘optimal’, as used in this paper, is strictly conditional upon the particular configuration of prices and expenditure levels observed at a particular time as employed in Ahmad and Stern (1984). Second, it is important to note that the analysis concerns with solving for tax rates, and not tax reforms. The distinction between the two is that sensitivity of the calculated ‘optimal’ tax rates to demand specification does not necessarily imply similar sensitivity of directions for tax reform. There has not been any thorough study in Thailand published in the literature up to date.

While there are existing studies which permit non-linear Engel curves and non-separable preferences via the Restricted Non-Linear Preferences System (RNLPS) demand system employed, the assumption of weak separability between goods and leisure is preserved in this study. In common with other studies, an income tax is ruled out by assumption, indirect taxes are passed on fully to consumer (that is, a 100% shifting) and all households face identical prices at a given point in time.

The framework begins with the Optimal Tax Rule, there are H households, each h has a utility function in (39).

$$U^h = V^h(q_1, \dots, q_n, w, I^h) \quad (39)$$

Subject to:

$$R = \sum_{i=1}^n \sum_{h=1}^H p_i t_i x_i^h \quad (40)$$

Then, the social welfare function (Bergson – Samuelson social welfare function) in (27) defined as the vector of indirect utilities is employed.

$$w = w(V^1(\cdot), \dots, V^H(\cdot)) \quad (41)$$

Through maximisation of the social welfare function with respect to optimal set of commodity taxes as shown in (28) along with the derivation from (29) to (31), we rewrite (32) in (42). By Diamond and Mirrlees' (1971) standard, β^h is the "social marginal utility of income" for household h .

$$\sum_{h=1}^H \beta^h x_k^h = \lambda \left[\sum_{h=1}^H x_k^h + \sum_{i=1}^n \sum_{h=1}^H t_i p_i \frac{\partial x_i^h}{\partial q_k} \right] \quad (42)$$

Employing the utility function in Atkinson (1970) in (43), with $\varepsilon \geq 0$ for concavity, and also representing the planner's 'inequality aversion', yields (44).

$$U^h(I) = \frac{\kappa I_h^{1-\varepsilon}}{1-\varepsilon}, \varepsilon \neq 1, \quad (43)$$

$$= \kappa \log I_h, \varepsilon = 1,$$

$$\beta^h = \frac{\partial U^h}{\partial I_h} = \kappa I_h^{-\varepsilon}$$

Let household 1 represent the poorest household in the sample. Through normalisation of the social marginal utility of income, $\beta^1 = 1$, (44) is obtained.

$$\beta^h = \left[\frac{I_1}{I_h} \right]^\varepsilon \quad (44)$$

Following Ray's (1986a) setting, the social marginal utility of income for the poor declines monotonically with an increase in household's income at a rate determined by ε , the degree of inequality aversion. The analysis is conducted on the commonly used Linear Expenditure System (LES) and its one-parameter generalisation, the Restricted Non-Linear Preferences System

(RNLPS). The price-expenditure elasticities are examined in both systems. LES assumes additive separability and linear Engel curves, whereas RNLPS allows for non-linear Engel curves and non-separable preferences via α . The obtained corresponding demand system in budget share form is represented by (45).

$$p_i x_i = \left(\frac{p_i}{I_i} \right)^\alpha b_i + a_i \left(1 - \sum \left(\frac{p_k}{I_k} \right)^\alpha b_k \right) \quad (45)$$

When $\alpha \neq 1$, the Engel curve is non-linear. Hence $\alpha = 1$ represents the special case of LES with a_i representing the marginal budget share and b_i representing the subsistence quantity.

Regarding the issue of redistribution impact as implied by the optimal tax rates, Sah (1983) is followed. That is, it is assumed that the government has a balanced budget and redistribution is measured through real income gain that goes to the poorest household. Let T_h represent the indirect taxes paid by household h , the budget constraint is given in (46).

$$\sum_h T_h = \sum_h \sum_i t_i x_i^h = 0 \quad (46)$$

Assigning $-T$ as the 'redistribution' to the poorest household with Income, I_1 , the proportional form in the LES, where $a_1 > 0$ can be represented in (47).

$$\frac{-T_1}{I_1} = \sum_i t_i^* a_1 \left(\frac{I}{I_1} - 1 \right), \quad (47)$$

where t^* is the optimal tax and I is the average income. Hence, the average-income households have neutral gain or loss, while those with above average income will experience net income loss.

As for the RNLPS, the corresponding redistribution is represented by (48).

$$\frac{-T_1}{I_1} = \sum_i t_i^* a_1 \left(\frac{I^*}{I_1} - 1 \right), \quad (48)$$

where $I^* = \frac{\sum I_h}{\sum I_h^{1-\alpha}}$. Hence, when $\alpha = 1$, (48) becomes identical to (47).

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VI. Data and Estimation

The scope of the study covers the average cross-provincial household survey statistics in Thailand during the fiscal years 1990-2001 from the National Statistical Office of Thailand. The exercise is based on six commodity breakdown of aggregate expenditure as indicated in Table 2. The optimal consumption tax rates were solved through the first-order conditions as a set of simultaneous equations of the many-person Ramsey equations. Table 1 shows the parameter estimates for the two types of demand systems employed in the study, namely: LES and RNLPS.

Table 1: Parameter Estimates in the 6-item framework

Linear Expenditure System		Restricted Non-Linear Preference System	
Parameter	Estimate (t-value)	Parameter	Estimate (t-value)
a_1	-0.821239 (-104.0)	A_1	-0.226304 (-4.75)
a_2	-0.0617785 (-21.5)	A_2	-0.286576 (-2.46)
a_3	-0.0647677 (-11.5)	A_3	-0.0400846 (-1.707)
a_4	0.227305 (32.0)	A_4	0.162120 (1.59)
a_5	-0.874770 (-134.0)	A_5	0.303618 (2.42)
b_1	1.79143 (31.3)	B_1	0.886060 (32.0)
b_2	0.157593 (24.2)	B_2	0.08712 (42.7)
b_3	0.309243 (27.6)	B_3	0.061450 (3.3295)
b_4	-0.243676 (-12.0)	B_4	0.01884 (34.0)
b_5	1.57923 (24.1)	B_5	0.93152 (40.2)
b_6	-1.68249 (17.07060)	B_6	0.19674 (55.3)
α	1	α	0.163697 (1.65)
Number of free parameters	11	Number of free parameters	12

Table 2: Estimates of t_i and λ in the many-person case

Item	Parameter	Demand System	Alternative Degrees of Inequality Aversion \mathcal{E}			
			$\mathcal{E}=0.1$	$\mathcal{E}=1.5$	$\mathcal{E}=3.0$	$\mathcal{E}=5.0$
1. Food	T_1	<u>LES</u>	0.0073565	0.0395477	0.0816448	0.115545
		<u>RNLPS</u>	0.335069	0.290350	0.139679	-0.077833
		<u>Actual</u>	Actual rate of 7% in accordance with Article 80 in Tax Code			
2. Apparel & Shoes	T_2	<u>LES</u>	0.0659218	-0.821708	-0.235060	2.11179
		<u>RNLPS</u>	-0.0972185	0.0251448	0.138207	0.259765
		<u>Actual</u>	Actual rate of 7% in accordance with Article 80 in Tax Code			
3. Housing	T_3	<u>LES</u>	0.481537	0.329423	-0.340822	-1.64481
		<u>RNLPS</u>	-0.0933100	-0.096989	0.131164	0.498709 ³
		<u>Actual</u>	Actual rate of 7% in accordance with Article 80 in Tax Code			
4. Communication & Transportation	T_4	<u>LES</u>	0.204113	0.587270	1.14095	1.95465
		<u>RNLPS</u>	0.106769	0.237280	0.356616	0.485510
		<u>Actual</u>	Actual rate of 7% VAT plus excise taxes			
5. Medicine & Health Care	T_5	<u>LES</u>	0.00828723	0.160109	0.280744	0.400345
		<u>RNLPS</u>	0.0983877	0.0760637	0.0050829	-0.098872
		<u>Actual</u>	Actual rate for articles used in private health care plus excise duties for some items, Public and standard health services not taxed.			

³ Note that as inequality aversion gets higher, poor household may get free housing and so it may be possible that government tries to tax rich household buying new luxurious houses and distribute to the poor.

6. Others ⁴	T_6	<u>LES</u>	0.00172601	-0.090580	-0.176725	-0.264695
		<u>RNLPS</u>	0.181657	0.0329779	-0.135608	-0.353783
		<u>Actual</u>	Actual rate of 7% in accordance with Article 80 in Tax Code			
	λ	<u>LES</u>	1.04679	1.92657	3.23487	5.52950
		<u>RNLPS</u>	1.06598	1.90546	3.10975	5.13368

In order to consider the estimates in Table 1, it is important to recall the important assumptions. First, it is assumed that the demographic effects are insignificant. Second, taxes are fully shifted to consumers. Third, the tax is optimal upon the strong condition of the observed price and expenditure levels. Forth, the purpose of indirect taxation is solely to transfer spending power from the rich to the poor in the society. According to the FIML estimates of the parameters in Table 1, food, and medicine and healthcare ($i = 1, 5$) turns out to be the most ‘necessity’ under LES while the result is less assertive under RNLPS. However, it can be observed that the value of a_i ’s, which no longer represent marginal budget shares under the RNLPS, are rather sensitive to the non-separability and non-linear Engel curves assertion.

Table 2 presents the optimal tax rates calculated under the two demand systems, which varies according to the degrees of inequality aversion, \mathcal{E} . The tax rates under the two demand systems are closer to one another at the lower level of inequality aversion and differ greatly as the degree of aversion diverges. For many items, tax rates differ in magnitude as well as their signs. For instance, at $\mathcal{E} = 5.0$, the LES over-estimates the optimal tax rates of food and medicine and health care, when compared to the case of RNLPS, which shows that this item should be given subsidy. On the other hand, some other items gives implausible tax rates. This reflects the quality of the existing record of the population survey in the country.

It is also important to note that when the degree of inequality aversion is low, there is higher tendency for having tax uniformity. The rationale behind this is that when the authority

⁴ Includes other personal expenses such as ornaments, recreation, sports, holiday, etc

has less concern on inequality, relaxing of linearity or separability assumption is not so sensitive on the viewpoint of the authority that does not concern about redistribution, but only efficiency of the tax system. On the other hand, when the degree of inequality aversion is relatively higher, the sensitivity of price responses to demand systems will be reflected by the sensitivity of the tax estimates. For example, medicine and health care is ‘luxury’ in LES but not so in RNLPS.

Table 3: Redistributive impact of ‘optimal’ indirect taxes ($-T_1/I_1$)

Alternative degrees of inequality aversion (\mathcal{E}), Actual $(-T_1/I)_{(LES)} = -0.07765$, Actual $(-T_1/I)_{(RNLPS)} = -0.0920906$							
$\mathcal{E}=0.1$		$\mathcal{E}=1.5$		$\mathcal{E}=3.0$		$\mathcal{E}=5.0$	
LES	RNLPS	LES	RNLPS	LES	RNLPS	LES	RNLPS
-0.000311	-0.096777	-0.072988	-0.09988	-0.140892	-0.1055	-0.210824	-0.106483

$I_1 = \frac{1}{2} I$, where I = average expenditure

Table 3 presents the redistributive impact of optimal direct taxes obtained by solving equations (47) and (48). At lower degrees of \mathcal{E} , the redistribution in RNLPS is higher than in LES. However, at higher degrees of \mathcal{E} , the redistribution in LES is slightly higher. On the contrary to Ray’s (1986b) results for the case of India where there are much fewer households who gain under RNLPS but at a larger size, this study shows that both systems of demand show that the proportion or the number of households who gain is relatively similar. From Table 2, it can be observed that the tax structure in Thailand resembles those of the rates at the lower degree of \mathcal{E} , where the tax rates in most of the items are generally uniform. As a result, Table 3 shows that, despite the already limited role of indirect taxes in redistribution, the redistributive impacts of the actual tax structure in Thailand remains lower than the calculated optimal obtainable level.

VII. Conclusions and Future Research Implications

This research, unlike those previously conducted, does not intend to study about poverty in Thailand. Instead, it aims at assessing the role and potentials of indirect taxation, namely, the consumption tax, on the redistribution of income. Hence, the main exercises of this research paper include the following. First is to develop the theoretical framework of consumption tax on redistribution of income appropriated for Thailand's data. Up to date in Thailand, the literature in this context remains in insignificant amount. Second is to develop scientific theoretical framework so as to be applicable to the case of Thailand. Third is to assess of the role and potentials of consumption taxation in Thailand through the commonly used Linear Expenditure System (LES) and its one-parameter generalisation, the Restricted Non-Linear Preferences System (RNLPS). Forth is to employ the third objective as a basis for determination of tax rates and policy designs. Finally, the aim is to extend of the knowledge frontier for future researchers in Thailand and for application to the case of other countries.

It is also important to note that when the degree of inequality aversion is low, there is higher tendency of having tax uniformity. The rationale behind this is that when the authority has less concern on inequality, relaxing of linearity or separability assumption is not so sensitive on the viewpoint of the authority that does not concern about redistribution, but only efficiency of the tax system. On the other hand, when the degree of inequality aversion is relatively higher, the sensitivity of price responses to demand systems will be reflected by the sensitivity of the tax estimates. For example, medicine and health care is 'luxury' in LES but not so in RNLPS.

The results point out that at a lower degrees of inequality aversion, \mathcal{E} , the redistribution in RNLPS is higher than in LES. However, at higher degrees of \mathcal{E} , the redistribution in LES is slightly higher. It can be observed that the tax structure in Thailand resembles those of the rates at the lower degree of \mathcal{E} , where the tax rates in most of the items are generally uniform. As a result, Table 3 shows that, despite the already limited role of indirect taxes in redistribution, the redistributive impact of the actual tax structure in Thailand remains lower than the calculated optimal obtainable level. This suggests that it remains plausible for the adjustments of the tax

rates and subsidies structures in Thailand so as to move the redistributive impact level closer to the calculated optimal obtainable level.

As with all other studies, the present study is not without limitation. The following points proposes implications for further studies. First, there remains a wide range of possibilities to alternate the social welfare function of each society. Second, the whole tax structure might as well be considered in a heuristic approach. Third, there is a wider range of demand systems for selection in the analysis, which will alter the outcome. Lastly, there might be a further disaggregate of food data. However, the severe constraints of this is the lack of sophisticated data collection in Thailand.

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