

Indirect Tax Reforms and Poverty in Iraq

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Abstract

This paper mainly uses the methodology of normalized consumption dominance curves to examine whether or not an indirect tax reform would reduce poverty and improve social welfare in Iraq. This methodology is first proposed by Makdissi and Wodon (2002) and then improved by Duclos, Makdissi and Wodon (2008). The analysis applies the dataset obtained from Iraq 2006—2007: Household Socio-Economic Survey from World Bank. We come to the conclusion that an indirect tax reform of increasing taxes on nonfood expenditures and providing subsidies for food expenditures will reduce poverty and improve social welfare in Iraq. Additionally, when comparing the normalized consumption dominance curves on nonfood expenditures, a marginal tax reform of taxing education and subsidizing health is beneficial.

Keywords: Indirect tax reform, Normalized consumption dominance curves, Poverty, Social welfare

I. Introduction

In many countries all over the world, especially in developing countries, governments are devoting their efforts to implement various kinds of policies and strategies to boost the development of their economies. One of the important objectives of governments' positive actions is to raise revenues and narrow the poverty gap between the poor people and the rich in those countries. Specifically, some governments will control the prices of goods and services and impose taxation on commodities which contain both domestic and international products. They will also impose high tariffs on imported commodities to protect their domestic producers. However, the taxation on national goods will definitely make their sales prices high, which has an adverse impact on the consumers of their countries. Then the purpose of reducing poverty and improving social welfare will be hardly attained under such indirect taxation systems.

Over the last few decades, many economists and analysts focus on the adjustment of tax structures of a country so as to guarantee the social efficiency of the taxation system on poverty and social welfare. Martin Feldstein (1975) first pointed out that the knowledge of optimal taxes may be useless for practical purposes since actual changes are 'slow and piecemeal'(Santoro 2007) . Then Ahmad and Stern (1984) studied the marginal commodity tax reforms which are defined as vectors of welfare-improving and revenue-neutral small tax changes (Santoro 2007). However, they have difficulty in computing the implicit taxes which include import duties and excise taxes. Later, Yitzhaki and Slemrod (1991) introduced the method of Daltonian tax reform which is restricted only to the second order of stochastic dominance. Then based on the results from Yitzhaki and Slemrod (1991), Mayshar and Yitzhaki (1995) made an improvement to this method and introduced "Dalton-improving tax reforms". Makdissi and Wodon (2004) generalize this approach to all orders of stochastic dominance by introducing the concept of consumption dominance curves at any order.

This paper mainly uses the methodology of normalized consumption dominance curves which is first proposed by Makdissi and Wodon (2002) and then improved by Duclos, Makdissi and Wodon (2008). In this paper, this method is used in our study to check if we can find potential marginal tax reforms that would be deemed socially improving in Iraq. Using the dataset from Household Socio-Economic Survey of Iraq in 2006—2007, we will make comparisons between normalized consumption dominance curves on food items and nonfood items at the first, second, and third order of stochastic dominance, respectively. Here, “nonfood items” is regarded as a whole. After comparing food and nonfood commodities, we will make separate comparisons between the normalized consumption dominance curves on food and the important components of nonfood items respectively and these components are housing, utilities, health and education. Furthermore, the comparison between health and education will also be described. Apart from this, the concept of the critical poverty line is also applied in this paper.

This paper is organized as follows. Section 2 gives the background of the country Iraq we are studying and the objective of this study.

Section 3 illustrates the theoretical framework for the indirect tax reforms and the methodology implemented in these reforms. The methodology of the normalized consumption dominance curve originates from Makdissi and Wodon (2002) and then is further improved by Duclos, Makdissi and Wodon (2008).

Section 4 focuses on the application of the methodology of normalized consumption dominance curves in the marginal tax reforms in Iraq based on the dataset from Household Socio-Economic Survey of Iraq in 2006—2007 from World Bank. Through the comparison of the normalized consumption dominance curves on food commodities and nonfood commodities, a conclusion could be obtained that an indirect tax reform of increasing taxes on nonfood expenditures and subsidizing food expenditures is of great benefits to poor people. Besides, the normalized consumption

dominance curves for health and education has also been compared and the result exhibits a socially-improving tax reform. Additionally, the analyses above are also incorporated with the critical poverty lines.

Section 5 gives a conclusion of our whole study on the indirect tax reforms in Iraq and presents the effects of these reforms.

II. Country Background and the Objective of the analysis

Since Iraq is a country rich in oil resources, its economy is dominated by the petroleum sector and 95% of its foreign exchange earnings come from oil. However, because of the fight against Iran in the 1980s and the fight against the United States after 1991, especially the 2003 invasion, Iraq's economic growth suffered from a detrimental blow. Even so, oil production is still Iraq's primary economic activity. The lack of development in other sectors leads to a result of 18%–30% unemployed and a depressed per capita GDP of \$4,000¹.

The demographic situation in Iraq is such that the total population is 34,322,000 according to an estimate in 2011². And of its population, there are several major ethnic groups. About 75%-80% people of the population are the Arabs, 15%-20% are Kurds, and the remaining 5% are the Assyrians, the Iraqi Turkmen and others³. Referring to the religions in Iraq, the major religion is Islam, which is followed by 97% of the population. Islam has two categories which are Shia Islam and Sunni Islam. Around 65% of Muslims follow Shia Islam and around 35% Muslims follow

¹ CIA World FactBook-Iraq's Economy

² See International Monetary Fund. Retrieved 2011-04-21

³ CIA World Factbook

Sunni Islam. Besides, the remaining 3% of the total population are Christians or those follow other religions⁴.

In this paper, we put emphasis on the study of the indirect tax reforms in Iraq. Firstly, let us have a look at the background information in this country. Iraq became a middle-income country in the 1970s with good infrastructure, well-performing education and healthcare systems. However, over the past 25 years, dictatorship, wars and international sanctions have undermined the country's institutions and crippled its economy; in 2003, Iraq's GDP fell by 41%. The economy rebounded in 2004, but annual growth slowed over the next two years. As oil prices fell, Iraq's overall growth fell, but oil production and prices are projected to increase in the future.⁵

After 2003, Iraq took positive actions to recover its economy and tried to emerge into the international economic environment. In February 2010, Iraq's two-year Stand-By Arrangement with the IMF and the World Bank's Fiscal Sustainability Development Policy Loan (DPL) was permitted and DPL gave support to the structural reforms in budget management, the social protection system and the financial sector⁶.

Although Iraq's economy has developed a lot, there are still many deficiencies in the current situation for poverty. The Government continues to give subsidies for food, fuel and utilities. In November 2009, the Cabinet approved a new National Strategy for Poverty Reduction (2010-2014). Efforts are also underway to reform Iraq's

4 CIA World Factbook

5 and 6 : the Country Brief of Iraq on the World Bank website, <http://web.worldbank.org>

Public Distribution System (PDS), the country's largest safety net program for the poor⁷.

In this paper, the approach of normalized consumption dominance curves will be used to analyze the impact of an indirect tax reform in Iraq, that is, whether or not the reform can reduce poverty and improve social welfare without reducing the government's revenues in this country. We will use the dataset of Household Socio-Economic Survey from Iraq 2006—2007 from World Bank and then compare the normalized consumption dominance curves obtained from the dataset on food and nonfood commodities at different order of stochastic dominance.

III. Methodology

In order to measure whether or not a tax reform is socially improving, we will use the methodology of consumption dominance curves. To have access to the definition of stochastic dominance curve, we will first pay attention to the evolution of this theory. Duclos and Makdissi (2004) pointed out that some of the stochastic dominance curves have first been introduced in the financial literature to rank distributions of portfolios returns. According to Atkinson (1998), the theoretical literature is not of full help in answering whether general links can be formally established between the measurements of poverty, inequality and social welfare since most of the existing papers have been written either on poverty or on inequality, but rarely on both topics simultaneously. Then Duclos, Makdissi and Wodon (2008) defined the classes of poverty indices and social welfare indices.

To analyze the effect of an indirect tax reform on poverty reducing and social welfare

⁷ the Country Brief of Iraq on the World Bank website, <http://web.worldbank.org>

improving, firstly, from the mathematical perspective, the additive poverty indices can be expressed as follows according to Duclos, Makdissi and Wodon (2008),

$$P(z) = \int_0^a p(y, z) dF(y),$$

where $P(z)$ in this expression is an additive poverty index, and z represents the poverty line that is defined in real income space. $p(y, z)$ shows the amount of contribution of a consumer to total poverty where y means the real income of a consumer. Additionally, $p(y, z) = 0$ for all $y > z$. Meanwhile, $F(y)$ represents the cumulative distribution of real incomes within the range of 0 and a .

Consider the classes of aggregated poverty indices $P(z) \in \Pi^s$, the expression is as follows,

$$\Pi^s(z) = \left\{ P(z) \left| \begin{array}{ll} p(y, z) = 0 & \text{if } y > z, p(y, z) \in \hat{C}^s(z), \\ (-1)^i p^{(i)}(y, z) \geq 0 & \text{for } i = 0, 1, \dots, s, \\ p^{(i)}(z, z) = 0 & \text{for } i = 0, 1, \dots, s-2 \text{ when } s \geq 2 \end{array} \right. \right\}$$

Where $\hat{C}^s(z)$ is the set of functions that are s -time piecewise differentiable in the range between 0 and z ⁸.

Meanwhile, a special type of additive poverty indices we will refer to is Foster, Greer and Thorbecke (1984) subclass and it can be defined as follows,

When $\alpha \geq 0$,

$$FGT^\alpha(z) = \int_0^z \left(\frac{z-y}{z} \right)^\alpha dF(y).$$

⁸ See details in Duclos, Makdissi and Wodon (2008)

When $\alpha = 0$, $FGT^0(z)$ develops the most frequently used poverty index, which is named poverty headcount and when $\alpha = 1$, $FGT^1(z)$ shows the second mostly used index of poverty, that is, the poverty gap. Here we need to notice that, $FGT^\alpha(z) \subset \Pi^s(z)$ in the interval of $\alpha \geq s-1$.

Secondly, we put emphasis on the social welfare indices. From the mathematical view, the social welfare function is $U = \int_0^a u(y)dF(y)$. Duclos and Makdissi (2004) defined the classes Ω^s of social welfare indices as for $s = 1, 2, \dots$

$$\Omega^s = \left\{ U \mid u(y) \in C^s(\infty), (-1)^{i+1} u^{(i)}(y) \geq 0 \text{ for } i = 1, 2, \dots, s, \right\}$$

Then we will focus on the explanations of different classes of poverty indices and social welfare indices. More specifically, when $s = 1$, both the first-order classes of indices of poverty and social welfare obey the Pareto principle of transfers, that is, indices are Paretian and symmetric which can reduce poverty weakly since $p^1(y, z) \leq 0$ and increase social welfare slightly for the reason that $u^{(1)}(y) \geq 0$ when a consumer's income y increases. According to Duclos, Makdissi and Wodon (2008), when two individuals interchange their incomes, the poverty and social welfare indices remain unchanged. Pen (1971) pointed out that ordering two distributions of living standards over the first-order classes of indices is equivalent to making the living standards "parade" simultaneously alongside each other, and verifying if one parade weakly dominates the other⁹. As a result, the first-order welfare-improving tax reforms can be regarded as "Pen-improving tax reforms".

When $s = 2$, the second-order classes of poverty indices are convex since $p^2(y, z) \geq 0$ and the second-order classes of social welfare indices are concave since

⁹ Pen (1971): "Income Distribution: Facts, Theories, Policies"

$-u^{(2)}(y) \leq 0$. They must comply with the Pigou-Dalton principle of transfers¹⁰. For this principle, a mean-preserving transfer of income from an individual with higher income to an individual with lower income can reduce poverty and increase social welfare, that is, it is socially improving. Therefore, this kind of indirect tax reform can be called “Dalton-improving tax reforms”.

When $s = 3$, the third-order classes of poverty indices and social welfare indices must be sensitive to favorable composite transfers. According to Kolm (1976), these transfers are such that a beneficial Pigou-Dalton transfer within the lower part of the distribution, accompanied by an adverse Pigou-Dalton transfer within the upper part of the distribution, will add to social welfare, provided that the variance of the distribution is not increased¹¹. Therefore, the third-order welfare-improving tax reforms can be seen as “Kolm-improving tax reforms”.

Additionally, Atkinson’s social welfare function is a special example for which $\omega(p) = 1, \forall p \in [0, 1]$:

$$W(\varepsilon) = \int_0^1 U(Q(p); \varepsilon) dp$$

where

$$U(Q(p); \varepsilon) = \begin{cases} \frac{Q(p)^{1-\varepsilon}}{(1-\varepsilon)}, & \text{when } \varepsilon \neq 1 \\ \ln Q(p), & \text{when } \varepsilon = 1 \end{cases}$$

Consider the aggregate poverty indices again, in a marginal tax reform, taking the first-order partial derivative of the poverty indices with respect to good i and j , we can get:

$$dp(y, z) = p'_i(y, z) \frac{\partial y}{\partial t_i} + p'_j(y, z) \frac{\partial y}{\partial t_j} \quad (1)$$

¹⁰ See Pigou (1912) and Dalton (1920).

¹¹ See Kolm (1976)

Then consider a vector q of K consumer prices. According to Mayshar and Yitzhaki (1995), for simplicity, producer prices are set to 1 and assumed to be constant and do not vary with changes in t , which is the vector of K tax rates. Then we will have $q = 1 + t$ and $dq_k = dt_k$, where q_k and t_k are the prices of good k and the tax rate on good k , respectively. Therefore, the change in the consumer price of good k is equivalent to the change in the tax rate of good k .

Let y be the nominal income of an individual and assume income to be distributed in the range between 0 and a . Let α be the consumer preference parameter and Ω be the set of preferences. Denote the real post-reform income as y^R and it is evaluated on the basis of q^R , which is reference price. y^R is explicitly defined as $y^R = \rho(y, \alpha, q, q^R)$. Let $x_k(y, \alpha, q)$ be the consumption of good k of an individual whose income is y , preference is α , and price is q . Suppose that the vector of prices before a tax reform is equal to the vector of reference prices, $q = q^R$, when adopting Roy's identity, Besley and Kanbur (1988) find that the first-order differential in real income with respect to a marginal change in its own tax rate is equivalent to the negative of the demand for good i ,

$$\left. \frac{\partial \rho(y, \alpha, q, q^R)}{\partial t_k} \right|_{q=q^R} = -x_k(y, \alpha, q^R). \quad (2)$$

This equation indicates the effect of a marginal change in tax rates on consumer welfare.

Concerning the government's revenue neutrality, total tax revenues are given by the equation $R(q) = \sum_{k=1}^K t_k x_k(q)$, where $x_k(q)$ is the per capita consumption of good k , that is, $x_k(q) = \int_0^a x_k(y, q) dF(y)$. Since the government has to keep a balanced budget, revenue neutrality is guaranteed by $dR(q) = 0$. And Yitzhaki and Slemrod (1991) assumed that a marginal tax reform leads to no change on the government tax revenue. Given the premise that $dq_k = dt_k$, mathematically, this equation can be written as

follows:

$$dR(q) = \left[X_j(q) + \sum_{k=1}^K t_k \frac{\partial X_k(q)}{\partial q_j} \right] dq_j + \left[X_i(q) + \sum_{k=1}^K t_k \frac{\partial X_k(q)}{\partial q_i} \right] dq_i = 0 \quad (3)$$

Now we turn to the definition of γ . γ could be defined as the economic efficiency cost of taxing j relative to that of taxing i. (Duclos, Makdissi and Wodon, 2008)

$$\gamma = \frac{X_i + \sum_{k=1}^K t_k \frac{\partial X_k}{\partial q_i}}{X_j + \sum_{k=1}^K t_k \frac{\partial X_k}{\partial q_j}} \quad (4)$$

As shown in equation (4), the denominator represents the marginal tax revenue of a marginal increase in the price of commodity j and the numerator shows the marginal tax revenue of a marginal increase in the price of commodity i. Then substitute equation (4) into equation (3), we can obtain the simplified expression for revenue neutrality, $dq_j = -\gamma \left(\frac{X_i}{X_j} \right) dq_i$.

Since the additive poverty indices are as follows,

$$p_F(z) = \int_0^z p(y, z) dF(y),$$

where F is an income distribution function and it is non-decreasing, continuous and onto.

$$p(y, z) \geq 0 \text{ if } y \leq z$$

$$p(y, z) = 0 \text{ if } y > z$$

Duclos and Makdissi (2004) defined two sets of stochastic dominance curves:

$$D_F^1(y) = F(y) \text{ and } D_F^s(y) = \int_0^y D_F^{s-1}(u) du \text{ for all } s \geq 2$$

based on two income distribution functions F and G. Then the stochastic dominance curve $D_G^s(y)$ is also

defined in the same way as $D_F^s(y)$. Thus, we can compare the two distributions of income in terms of poverty and social welfare. Firstly, according to Duclos and Makdissi (2004), they observed the difference in the two distributions of income from F to G if there is no increase in poverty, we have

$$\Delta P_{FG} = \int_0^a p(y, z) dG(y) - \int_0^a p(y, z) dF(y) \leq 0$$

And they developed a proposition in which “a necessary and sufficient condition for $\Delta P_{FG} \leq 0$ for any poverty line $z \in [0, z^+]$ and any absolute poverty index $p \in \prod$, is $D_F^s(y) - D_G^s(y) \geq 0 \forall y \leq z^+$ ”.

Then consider the social welfare function again,

$$U_F = \int_0^a u(y) dF(y)$$

$$\text{Classes } \Omega^s = \left\{ U \mid u(y) \in \hat{C}^s \text{ and } (-1)^i \frac{d^i u(y)}{dy^i} \leq 0 \forall i = 1, 2, \dots, s \right\}$$

Then there is no decrease in social welfare if moving from distribution F to G the following condition holds

$$\Delta U_{FG} = \int_0^a u(y) dG(y) - \int_0^a u(y) dF(y) \geq 0$$

According to Duclos and Makdissi (2004), a sufficient condition for welfare improvement for all $U \in \Omega^s$ is

$$D_F^s(y) - D_G^s(y) \geq 0 \forall y \in [0, a] \text{ and, if } s \geq 3,$$

$$D_F^i(a) - D_G^i(a) \geq 0 \forall i \in \{2, \dots, s-1\}$$

It is noteworthy that when $s=1$ and 2 , the dominance conditions of reducing poverty and improving social welfare are the same if $z=a$.

According to Duclos , Makdissi and Wodon (2008), it should be noted that \overline{CD} curves could be used to estimate if an indirect tax reform can reduce poverty or improve social welfare by examining the effect of price changes on commodities. Given the assumption that the vector of reference prices is equal to the vector of pre-reform prices, Duclos , Makdissi and Wodon (2008) put emphasis on the theorem “ a necessary and sufficient condition for a marginal tax reform , $dq_j = -\gamma \left(\frac{X_l}{X_j} \right) dq_l > 0$, to be s-order poverty improving ,that is ,to decrease poverty weakly for all $z \in [0, z^+]$ and for a given $s \in \{1, 2, 3, \dots\}$, is that $\overline{CD}_i^s(y) - \gamma \overline{CD}_j^s(y) \geq 0, \quad \forall y \in [0, z^+]$.” (5) They also stated that “a necessary and sufficient condition for a marginal tax reform , $dq_j = -\gamma \left(\frac{X_l}{X_j} \right) dq_l > 0$, to be s-order welfare improving ,that is ,to increase social welfare weakly for all $W \in \Omega^s$ and for a given $s \in \{1, 2, 3, \dots\}$, is that $\overline{CD}_i^s(y) - \gamma \overline{CD}_j^s(y) \geq 0, \quad \forall y \in [0, \infty)$.” (6)

Moreover, Duclos, Makdissi and Wodon (2008) gives the definitions of critical poverty lines and critical efficiency ratios. Firstly, economic efficiency ratios are defined as $\delta^s(z) = \frac{\overline{CD}_i^s(z)}{\overline{CD}_j^s(z)}$. This ratio of normalized consumption dominance curves can be interpreted as the distributive benefit of taxing j instead of i¹³. However, we should notice that if $\overline{CD}_j^s(z) = 0$, the relative distributive benefit of taxing j tends to be infinite, and as a result, $\delta^s(z)$ should be equal to γ^{++} . Then the distributive benefit ratios can be written as follows,

¹³ See Duclos, Makdissi and Wodon (2008)

As a consequence, when the stochastic dominance curves at s^{th} -order satisfy the two sufficient conditions above, then moving from the income distribution F to G not only can reduce poverty, but also can improve social welfare.

Fishburn (1976) shows that stochastic dominance curves can also be written as

$$D^s(z) = \frac{1}{(s-1)!} \int_0^z [z-y]^{(s-1)} dF(y)$$

According to Duclos, Makdissi and Wondon (2008), dominance curves are sums of powers of poverty gaps. Consequently, it is of great importance to think about the impact of changes in prices on the dominance curves. Then take the first-order derivative of the dominance curves with respect to the tax rate on good k:

$$\left. \frac{\partial D^s(z)}{\partial t_k} \right|_{q=q^R} = \begin{cases} x_k(z, q^R f(z)) & \text{if } s=1 \\ \frac{1}{(s-2)!} \int_0^z x_k(y, q^R) (z-y)^{s-2} dF(y) & \text{if } s=2,3,\dots, \end{cases}$$

Where $f(z)$ is the density of income at z.

By taking the first-order derivative, we can deduce the consumption dominance curves

$$CD_k^s(z) = \frac{\partial D^s(z)}{\partial t_k}, \quad s=1,2,\dots$$

As mentioned before by Duclos, Makdissi and Wodon (2008), consumption dominance curves measure changes in ethically weighted cost of taxing k. However, we mainly use the normalized consumption dominance curves, which are the consumption dominance curves for commodity k normalized by the average consumption of that commodity. Then the normalized consumption dominance curves

can be expressed as $\overline{CD}_k^s(z) = \frac{CD_k^s(z)}{X_k(q)}$. $\overline{CD}_k^s(z)$ gives the ethically weighted cost of

taxing k as a proportion of the average welfare cost¹².

¹² See Duclos, Makdissi and Wodon (2008)

$$\delta^s(z) = \begin{cases} \frac{\overline{CD}_i^s(z)}{\overline{CD}_j^s(z)} & \text{if } \overline{CD}_j^s(z) \neq 0 \\ \gamma^{++} & \text{if } \overline{CD}_j^s(z) = 0 \end{cases}$$

Notice that γ is the economic efficiency cost of taxing j relative to that of taxing i.

According to Duclos, Makdissi and Wodon (2008), a tax reform is s-order socially improving if its distributive benefit exceeds its economic cost over a range of alternative poverty lines. Thus, evaluating the relationship between distributive benefit $\delta^s(z)$ and the economic efficiency cost γ is of great importance to check whether or not a marginal tax reform can decrease poverty and improve the living standards of the poor.

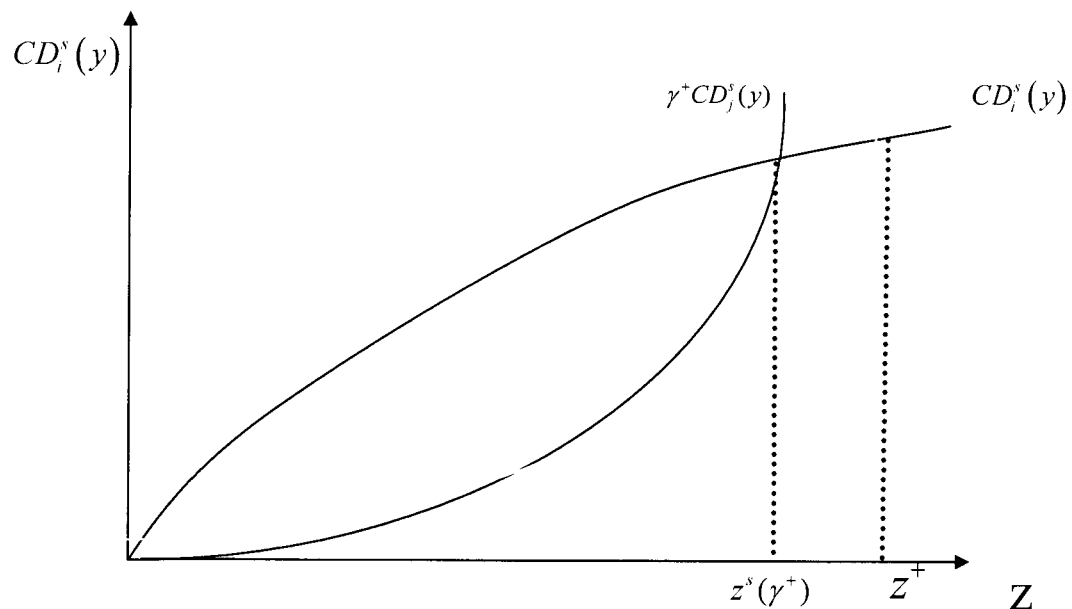


Figure 1. CD curves and Critical social efficiency parameters

Suppose there are two consumption dominance curves $CD_i^s(y)$ and $CD_j^s(y)$ which satisfy the condition that $CD_i^s(y) - \gamma^+ CD_j^s(y) \geq 0$ for all incomes $y \in [0, z]$. From this figure, we can see that $\overline{CD}_i^s(z)$ and $\gamma^+ \overline{CD}_j^s(z)$ cross at a critical poverty line where $z < z^+$. If we want to achieve the goal of social improvement for $z = z^+$, that is, in this region, the condition for social improvement can also hold, there are two

possible methods to achieve this goal. Firstly, we can increase the order of the two consumption dominance curves. Secondly, we can restrict the range of the value of z^+ and define the restricted value of z^+ as $z^s(\gamma^+)$ so that we can get $z^s(\gamma^+) = \sup\{z \mid CD_i^s(y) - \gamma^+ CD_j^s(y) \geq 0 \forall y \in [0, z]\}$. By doing so, the condition $CD_i^s(y) - \gamma CD_j^s(y) \geq 0$, for all $y \in [0, z]$ can be satisfied. Through the above methods, social improvement is achieved.

IV. Empirical Analysis

4.1 Dataset

In this empirical analysis, we use the IHSES 2007- household level data (constructed) in the Household Socio-Economic Survey in Iraq: 2006—2007 from World Bank. From the dataset, we can see that there are 17822 households which are investigated in Iraq. Moreover, the official poverty line we will observe in this dataset is 76.89574. In the empirical analysis, we use the following normalization: we divide all per capita income by the official poverty line. This means that at income level 1, the household has a per capita income equal to the official poverty line. At income level 2, the household has a per capita income equal to twice the poverty line. The range of the income per capita per month in our analysis is set from 0 to 3. At the same time, the main variables “food expenditures” and “nonfood expenditures” observed in this analysis are obtained from adjusting the existing variables by dividing the total poverty line in the dataset. The variable “food expenditures” represents the household expenditure on food per capita per month and the variable “nonfood expenditures” represents the household expenditure on nonfood expenditures per capita per month. For the nonfood expenditures, we mainly pay attention to four categories in this dataset, which are composed of housing, utilities, health and education. “Housing” is

a variable which shows the per capita expenditure on housing per month at the household level; “utilities” is a variable implying the Iraqi household’s per capita expenditure on various kinds of utilities per month; “health” is a variable of showing the expenditure on health care and “education” is a variable which expresses the monthly per capita expenditure on education at the household level.

In order to analyze the figures and tables obtained from the dataset, we need to apply the methodology of normalized consumption dominance curves to observe and compare the data on food and nonfood expenditures at the household level. Then the government will decide which kind of commodities should be taxed and which kind should be subsidized for the purpose of reducing poverty and improving social welfare while keeping its revenue balanced.

4.2 Food vs Non Food

We will mainly analyze the indirect tax reform in which the government increases taxes on expenditures of non-food commodities and gives subsidies for food commodities. Suppose the economic efficiency cost $\gamma=1$ which means that there is no economic efficiency cost advantage for taxing non-food commodities relative to that of taxing food commodities.

Figure 1.1 shows the normalized consumption dominance curves of the first order on food commodities and nonfood commodities with the assumption of $\gamma=1$. As shown in Table 1, when $\gamma=1$, in the range of the income per capita between 0 and 3, the two normalized consumption dominance curves $\overline{CD}_{food}^1(z)$ and $\overline{CD}_{nonfood}^1(z)$ cross at the intersection $z_1(1)=2.239$ which is the maximum value of the poverty line, and this is also the first-order critical poverty line $z_1(\gamma)$ which is listed in Table 1 for $\gamma=1$. At the same time, the standard error of the sampling distribution of $z_1(\gamma)$ is estimated to

be 0.075, so this indicates that the true value of $z_1(\gamma)$ at a 95% confidence level when $\gamma=1$ will be in the range between 2.092 ($2.239-0.075*1.96=2.092$) and 2.386 ($2.239+0.075*1.96=2.386$). From Figure 1.1, we can see that the normalized consumption dominance curve $\overline{CD}_{food}^1(z)$ is always above the normalized consumption dominance curve $\overline{CD}_{nonfood}^1(z)$ for any poverty lines below the maximum poverty line. Thus we can come to the conclusion that increasing taxes on nonfood expenditures and decreasing taxes on food expenditures can reduce poverty in Iraq in this range. Hence, if $\gamma=1$, increasing taxes on non-food commodities and reducing taxes on food commodities for any poverty line below 2.092 at the 95% confidence level is first-order poverty improving, which means that the indirect tax reform can reduce poverty slightly while holding constant the government's revenues. Since we get the result that the two consumption dominance curves do intersect at a critical poverty line which means that we can find a maximum value of the poverty line for the first order of dominance, the first-order indirect tax reform is not Pen-improving when $\gamma=1$ according to Pen (1971). To be specific, increasing taxes on non-food commodities and decreasing taxes on food commodities will not improve social welfare at the first order of dominance when $\gamma=1$.

Figure 1.2 demonstrates the normalized consumption dominance curves of the second order on food commodities and nonfood commodities given the assumption that $\gamma=1$. As shown in Figure 1.2, $\overline{CD}_{food}^2(z)$ always lies above $\overline{CD}_{nonfood}^2(z)$ in the range of the income per capita between 0 and 3. There is no crossing between the normalized consumption dominance curves $\overline{CD}_{food}^2(z)$ and $\overline{CD}_{nonfood}^2(z)$. As a result, we have the conclusion that increasing taxes on nonfood commodities and decreasing taxes on food commodities of the indirect tax reform is always second-order poverty improving. In other words, an indirect marginal tax reform can reduce poverty for any

poverty lines at the second order of dominance. This indirect tax reform conforms to the Pigou-Dalton principle of transfers¹⁴. Specifically, a transfer of income from an individual with a higher income to an individual with a lower income can reduce poverty slightly. Additionally, the tax reform at the second order of dominance will improve social welfare, that is, increasing taxes on nonfood items and decreasing taxes on food items will increase social welfare for the reason that the normalized consumption dominance curves $\overline{CD}_{food}^2(z)$ and $\overline{CD}_{nonfood}^2(z)$ do not have intersection at the second order. Consequently, this marginal tax reform can be regarded as a Dalton-improving tax reform¹⁵.

Figure 1.3 exhibits the normalized consumption dominance curves of the third order on food commodities and nonfood commodities given the assumption that $\gamma=1$. Since the two normalized consumption dominance curves at the second order do not intersect, we increase the order of dominance to the third order. As shown in Figure 1.3, the normalized consumption dominance curve $\overline{CD}_{food}^3(z)$ is everywhere above $\overline{CD}_{nonfood}^3(z)$ in the range of the income per capita between 0 and 3 when $\gamma=1$. Same as the result of Figure 1.2, there is also no intersection between the normalized consumption dominance curves $\overline{CD}_{food}^3(z)$ and $\overline{CD}_{nonfood}^3(z)$. Therefore, if the government increases the tax rate on nonfood commodities and gives a subsidy for food commodities, this kind of indirect tax reform will reduce poverty. According to Kolm (1976), increasing taxes on nonfood expenditures and reducing taxes on food expenditures is viewed as Kolm-improving tax reform. And this kind of tax reform is sensitive to favorable composite transfers. As Kolm(1976) mentioned, consider a beneficial Pigou-Dalton transfer within the lower part of the distribution and an adverse Pigou-Dalton transfer within the upper part of the distribution, these two

¹⁴ See Pigou (1912) and Dalton (1920)

¹⁵ See Mayshar and Yitzhaki (1995)

transfers together will improve social welfare. As a consequence, increasing taxes on nonfood commodities and subsidizing food commodities at the third order of dominance will also improve social welfare while keeping the government's revenue balanced.

Having analyzed the three figures for food and non-food commodities of three different orders of dominance, now we focus on the critical poverty lines $z_s(\gamma)$ obtained from different economic efficiency cost γ ($\gamma=0.5, 1.0, 1.5$, respectively) which are listed in Table 1.

From the data in Table 1, we can get the result that an indirect tax reform is s^{th} -order poverty-improving for any poverty lines that are below $z_s(\gamma)$. To get more information, we can see that, in Table 1, when $\gamma=0.5$, the first-order critical poverty line $z_1(\gamma)$ exists and its value is 6.461 with a standard error of 0.357 at a 95% confidence level. This result implies that an indirect tax reform of taxing non-food commodities and subsidizing food commodities will lead to a reduction in poverty up to a poverty line of 6.461. Yet, From Table 1, when $\gamma=0.5$, the second order and third order critical poverty lines do not exist and this result comes from the situation in which the normalized consumption dominance curves for food commodities $\overline{CD}_{food}^s(z)$ and nonfood commodities $\overline{CD}_{nonfood}^s(z)$ do not intersect when $s=2$ and 3 . Also from Figure 1.2 and Figure 1.3, $\overline{CD}_{food}^2(z)$ always lies above $\overline{CD}_{nonfood}^2(z)$ and $\overline{CD}_{food}^3(z)$ is above $\overline{CD}_{nonfood}^3(z)$ in the range of income per capita from 0 to 3. Combining the curves in Figure 1.2 and 1.3 with the data in Table 1, we can have the conclusion that increasing the tax rate of nonfood expenditures and decreasing the tax rate of food expenditures is Dalton-improving when $s=2$ and is Kolm-improving when $s=3$ for any poverty lines in the whole range of the income per capita.

Next, when $\gamma=1.0$, as analyzed above for $\gamma=0.5$, there are no critical poverty lines for the second and third order of dominance and only $z_1(\gamma)$ exists and $z_1(\gamma)=2.239$ with a standard error of 0.075. Then the indirect tax reform for which the government increases the tax rate on nonfood items and provides subsidies for food items is first-order poverty reducing below the critical poverty line $z_1(\gamma)=2.239$. But it is not Pen-improving due to the fact that the two normalized CD curves intersect. Since $\overline{CD}_{food}^s(z)$ and $\overline{CD}_{nonfood}^s(z)$ have no crossing point when $s=2$ and 3, there are no values for $z_2(\gamma)$ and $z_3(\gamma)$. Therefore, the absence of a maximum poverty line indicates that a tax reform would lead to a reduction in the poverty gap whatever the values of the poverty lines and the indirect tax reform of increasing taxes on nonfood commodities and decreasing taxes on food commodities is Dalton-improving at the second order and is Kolm-improving at the third order for poverty lines below the critical poverty line. And now we turn to observe $\gamma=1.5$. Table 1 shows that when $\gamma=1.5$, the critical poverty lines all exist for the three orders of dominance. Specifically, they are $z_1(\gamma)=0.958$ (with a standard error of 0.027), $z_2(\gamma)=1.227$ (with a standard error of 0.027) and $z_3(\gamma)=1.510$ (with a standard error of 0.047). Considering the fact that the existence of these critical poverty lines comes from the intersection of the normalized consumption dominance curves on food and nonfood expenditures, it can be concluded that a marginal tax reform can reduce poverty to increase the tax on nonfood expenditures and decrease the tax on food expenditures for any poverty lines below the critical poverty line in the income range but it cannot improve social welfare. Consequently, the first-order poverty-reducing reform is not Pen-improving, the second-order tax reform is not Dalton-improving tax reform and the third-order reform is not Kolm-improving.

4.3 Food vs Housing

Having analyzed the normalized consumption dominance curves of different orders for food commodities and non-food commodities, we will focus on the specified categories of non-food commodities which are composed of housing, utilities, health and education, that is, we will analyze four types of non-food commodities by comparing food commodities with housing, utilities, health and education, respectively.

We will first compare the normalized consumption dominance curves of three orders on food expenditures and housing expenditures. Figure 2.1 gives the normalized consumption dominance curves of the first order on food expenditures and housing expenditures for the assumption of $\gamma=1$. It is obvious that the two normalized consumption dominance curves $\overline{CD}_{food}^1(z)$ and $\overline{CD}_{housing}^1(z)$ cross at an intersection in the range of the income per capita between 0 and 3. As shown in Table 2, when $\gamma=1.0$, $\overline{CD}_{food}^1(z)$ and $\overline{CD}_{housing}^1(z)$ cross at $z_1(1)=2.514$ which is the first-order critical poverty line and shows the maximum value of the poverty line. Meanwhile, the standard error of the sampling distribution of $z_1(\gamma)$ is estimated to be 0.078. This demonstrates that the true value of $z_1(\gamma)$ at a 95% confidence level will be in the range from 2.361 to 2.667. As shown in Figure 2.1, the normalized CD curve $\overline{CD}_{food}^1(z)$ always lies above the normalized CD curve $\overline{CD}_{housing}^1(z)$ for any poverty line below the maximum poverty line. Hence, if $\gamma=1$, increasing taxes on housing expenditures and reducing taxes on food expenditures for any poverty line below 2.361 at a 95% confidence level is first-order poverty improving, which means that the indirect tax reform can reduce poverty slightly while keeping the government's revenue balanced. Therefore a conclusion can be obtained that an indirect tax reform of increasing taxes on housing expenditures and subsidizing food expenditures can reduce poverty in Iraq. However, the first-order marginal tax reform is not

Pen-improving since the two normalized consumption dominance curves cross at a critical poverty line when $\gamma=1$. To be specific, taxing housing expenditures and providing subsidies for food expenditures will not improve social welfare at the first order of dominance when $\gamma=1$.

Figure 2.2 explains the second-order normalized consumption dominance curves for food commodities and housing assuming $\gamma=1$. From this figure, the normalized consumption dominance curve $\overline{CD}_{food}^2(z)$ is everywhere above the normalized consumption dominance curves $\overline{CD}_{housing}^2(z)$ for any poverty lines throughout the horizontal axis of the income per capita from 0 to 3. So the two curves do not intersect in this range. But by observing the data in table 2, we can see that when $\gamma=1$, $z_2(\gamma)=18.557$, which is larger than the maximum value of the income range we analyze. Then when marginally increasing taxes on the lower curve of housing expenditures and marginally decreasing taxes on the higher curve of food expenditures, this marginal tax reform will reduce poverty and also improve social welfare at the second order of dominance in the income range between 0 and 3. As a consequence, it is regarded as a Dalton-improving tax reform.

Table 2 listed the critical poverty lines at different orders of dominance due to different critical economic efficiency cost γ . When $\gamma=0.5$, only $z_1(\gamma)$ exists. Then the tax reform is first-order poverty improving up to a poverty line of 5.923 with a standard error of 0.137 at the 95% confidence interval. The absence of $z_2(\gamma)$ and $z_3(\gamma)$ tells us that the two normalized consumption dominance curves do not intersect at the second and third order. There is no doubt that the second-order and third-order marginal tax reform is Dalton-improving and Kolm-improving to increase taxes on housing expenditures and decrease taxes on food expenditures, respectively. Then

when $\gamma=1.0$, there are critical poverty lines for the first and second order but not the third order. To be more specific, $z_1(\gamma)=2.514$ with a standard error of 0.078 at a 95% confidence level and $z_2(\gamma)=18.557$ with a standard error of 0.081 at the 5% critical interval. Then the indirect tax reform is both first and second-order poverty reducing up to the critical poverty lines of 2.514 and 18.557, respectively. However, 18.557 is not in the range of the income analyzed. Thus the first-order tax reform is not Pen-improving but the second-order tax reform is Dalton-improving in the per capita income range $[0, 3]$. Since we observe that $\overline{CD}_{food}^3(z)$ and $\overline{CD}_{housing}^3(z)$ have no crossing point, it is clear that $z_3(\gamma)$ does not exist. Due to the fact that $\overline{CD}_{food}^3(z)$ is always above $\overline{CD}_{housing}^3(z)$ on the whole horizontal axis, then increasing taxes on housing expenditures and decreasing taxes on food expenditures can improve poverty and social welfare for any poverty lines throughout the per capita income range. Therefore, it is a Kolm-improving tax reform. Finally, when $\gamma=1.5$, all the three critical poverty lines have values. Then the tax reform is poverty improving for all the three orders of consumption dominance curves but cannot improve social welfare.

4.4 Food vs Utilities

Then we will pay attention to the analysis of the normalized consumption dominance curves for food commodities and utilities at three different orders. Figure 3.1 exhibits the normalized first-order consumption dominance curves with the assumption that $\gamma=1$. Given the data in Table 3, when $\gamma=1$, the two normalized consumption dominance curves $\overline{CD}_{food}^1(z)$ and $\overline{CD}_{utilities}^1(z)$ cross at the point where $z_1(1)=1.831$ which is the value of the first-order critical poverty line and its standard error at a 95% confidence level is 0.160. Using these data, we can compute the true value of $z_1(1)$ and it will be in the range of $[1.517, 2.145]$. Then Figure 3.1 shows that $\overline{CD}_{food}^1(z)$ is above $\overline{CD}_{utilities}^1(z)$ for any poverty line below the first-order critical

poverty line. Then it can be summarized that it is first-order poverty reducing to implement a marginal tax reform of increasing taxes on utilities while decreasing taxes on food commodities for any poverty line below 1.517 at a 95% confidence level keeping the government's revenue neutral. However, this reform is not Pen-improving given the reason that the two normalized consumption dominance curves have an intersection when $\gamma=1$. Consequently, marginally reducing taxes on food commodities and marginally increasing taxes on utilities expenditures will not improve social welfare at the first order of dominance.

Then, Figure 3.2 reveals a Dalton-improving tax reform at the second order of dominance when the normalized consumption dominance curve $\overline{CD}_{food}^2(z)$ is always higher than $\overline{CD}_{utilities}^2(z)$ in the per capita income range between 0 and 3 given the assumption that $\gamma=1$. The absence of the critical poverty line is based on the fact that $\overline{CD}_{food}^2(z)$ and $\overline{CD}_{utilities}^2(z)$ do not cross. This kind of indirect tax reform must respect the Pigou-Dalton principle of transfers¹⁶. Then as analyzed before, when the government imposes taxes on commodities for utilities and reduces taxes on food commodities, this action not only can reduce poverty but also can improve social welfare and is seen as Dalton-improving.

For Table 3, it gives the critical poverty lines $z_s(\gamma)$ which are based on different critical economic cost γ . When $\gamma=0.5$, the tax reform is first-order poverty improving for any poverty line below 6.434 (with a standard error of 0.108). For the reason that $\overline{CD}_{food}^s(z)$ and $\overline{CD}_{utilities}^s(z)$, ($s=2, 3$) do not intersect, the critical poverty lines at the second and third order do not exist. Hence, the indirect tax reform is Dalton-improving when $s=2$ and Kolm-improving when $s=3$ for any poverty lines in the range of income per capita. And when $\gamma=1.0$, it leads to the same result. Since

¹⁶ See Pigou (1912) and Dalton (1920)

only $z_1(\gamma)$ has a value of 1.831 with a standard error of 0.160 at a 95% confidence level, the tax reform can narrow the poverty gap at the first order of dominance. And the normalized consumption dominance curves $\overline{CD}_{food}^s(z)$ and $\overline{CD}_{utilities}^s(z)$ (when $s=2, 3$, respectively) do not intersect, so there are no critical poverty lines for $s=2$ and 3 . Consequently, the second-order and third-order indirect tax reforms are poverty reducing and welfare improving no matter what the values of the poverty lines. When γ increases to 1.5, the critical poverty lines all exist for $s=1, 2, 3$, respectively. They are $z_1(\gamma)=0.750$ with a standard error of 0.072, $z_2(\gamma)=0.955$ with a standard error of 0.031 and $z_3(\gamma)=1.102$ with standard error of 0.083. Hence, when $\gamma=1.5$, the first-order, second-order and third-order indirect tax reform are all poverty reducing below the maximizing poverty lines but they cannot improve social welfare due to the existence of the intersections of the normalized consumption dominance curves.

4.5 Food vs Health

Now let us put emphasis on the analysis of the two normalized consumption dominance curves on food commodities and health expenses. Figure 4.1 demonstrates the normalized consumption dominance curves of the first order for food and health expenditures assuming $\gamma=1$. It shows that the two curves cross at an intersection. As the data listed in Table 1, we can obtain the information that $\overline{CD}_{food}^1(z)$ and $\overline{CD}_{health}^1(z)$ cross at $z_1(1)=2.378$, which is the first-order critical poverty line. And the standard error of $z_1(1)$ is estimated to be 0.102 at a 95% confidence level. Then the true value of $z_1(1)$ is in the range of [2.178, 2.578]. As shown in Figure 4.1, the normalized consumption dominance curve $\overline{CD}_{food}^1(z)$ is always above $\overline{CD}_{health}^1(z)$ for any poverty line below $z_1(1)$ in the range of income per capita between 0 and 3. Then a conclusion could be achieved that a balanced-budget tax reform of increasing

taxes on health expenditures and decreasing taxes on food expenditures for any poverty line below 2.178 at the 95% confidence level can reduce poverty weakly. Yet, the first-order marginal tax reform is not Pen-improving when $\gamma=1$ since $\overline{CD}_{food}^1(z)$ and $\overline{CD}_{health}^1(z)$ have an intersection.

Figure 4.2 illustrates the second-order normalized consumption dominance curves on food commodities and health expenditures assuming $\gamma=1$. As Figure 4.2 shows, $\overline{CD}_{food}^2(z)$ is always located higher than $\overline{CD}_{health}^2(z)$ throughout the range of income per capita from 0 to 3. Thus, the two curves do not have intersection in this range. However we notice that in Table 4, when $\gamma=1$, $z_2(\gamma)=18.564$, but it is out of the income range of our analysis. Thus an indirect tax reform of increasing taxes on health expenses and decreasing taxes on food expenditures can reduce poverty for any poverty lines in this range. Because $\overline{CD}_{food}^2(z)$ dominates $\overline{CD}_{health}^2(z)$ for any poverty line, the marginal tax reform can increase social welfare as well and it is regarded as a Dalton-improving tax reform.

Table 4 provides us with the critical poverty lines under different critical economic efficiency cost γ . Firstly when $\gamma=0.5$, only $z_1(\gamma)$ appears. The tax reform in which the government increases taxes on health expenditures and gives subsidies for food commodities is beneficial and is first-order poverty improving but not Pen-improving for any poverty line below $z_1(\gamma)=9.004$ during the per capita income range starting from 0 to 3. In contrast, the absence of the critical poverty lines for $s=2$ or higher is due to the fact that $\overline{CD}_{food}^s(z)$ and $\overline{CD}_{health}^s(z)$ ($s \geq 2$) do not have intersections. As shown in Figure 1.2, $\overline{CD}_{food}^2(z)$ always lies above $\overline{CD}_{health}^2(z)$ for any poverty line in the range of income per capita between 0 and 3. As a result, a conclusion can be deduced that when marginally taxing health expenditures and marginally subsidizing food expenditures at the second and third order of dominance will lead to a reduction

in the poverty gap and improve social welfare as well with the values of z ignored. Secondly, when γ increases to 1.0, both $z_1(\gamma)$ and $z_2(\gamma)$ exist while $z_3(\gamma)$ disappears. To be more specific, $z_1(\gamma)=2.378$ with a standard error of 0.102 and $z_2(\gamma)=18.564$ with a standard error of 0.044. However, $z_2(\gamma)$ is not in the income range used in this analysis. So the first-order tax reform is beneficial for any poverty line below the first-order critical poverty line $z_1(\gamma)=2.378$ during the income per capita range $[0, 3]$ but it is not Pen-improving for the reason that the two normalized CD curves intersect. Meanwhile, the second-order tax reform is also beneficial for any poverty line in the income range between 0 and 3 and it is Dalton-improving since the second-order CD curves do not intersect in the income range $[0, 3]$. The absence of $z_3(\gamma)$ indicates that the two normalized consumption dominance curves have no crossing point at the third order. Then it is Kolm-improving to implement a third-order tax reform without considering the value of the poverty line. Finally, when $\gamma=1.5$, all the three critical poverty lines at the three different orders exist. They are $z_1(\gamma)=0.621$ with a standard error of 0.072, $z_2(\gamma)=0.781$ with a standard error of 0.028 and $z_3(\gamma)=1.033$ with a standard error of 0.372. Then the existence of the critical poverty lines implies that the normalized consumption dominance curves for food commodities $\overline{CD}_{food}^s(z)$ is higher than the normalized consumption dominance curves for health expenditures $\overline{CD}_{health}^s(z)$ up to the s^{th} -order critical poverty line for $s=1, 2, 3$, respectively. Then the s^{th} -order indirect tax reform of increasing taxes on health expenditures and decreasing taxes on food expenditures is poverty reducing for any poverty line below the critical poverty line when $s=1, 2, 3$, respectively. However, because the two normalized CD curves at three different orders all have intersections, the first-order indirect tax reform is not Pen-improving, the second-order tax reform is not Dalton-improving and the third-order tax reform is not Kolm-improving.

4.6 Food vs Education

After analyzing the normalized consumption dominance curves for food and health expenditures, we will proceed to make the comparison between two normalized consumption dominance curves of food commodities and education expenses. Figure 5.1 describes the two first-order normalized consumption dominance curves on food and education given the assumption of $\gamma=1$. As this figure shows, the first-order normalized consumption dominance curves for food and education $\overline{CD}_{food}^1(z)$ and $\overline{CD}_{education}^1(z)$ cross at an intersection and from the data shown by Table 1 when $\gamma=1$, we can see that $\overline{CD}_{food}^1(z)$ and $\overline{CD}_{education}^1(z)$ cross at the first-order critical poverty line $z_1(1)=2.323$ within the range of income per capita from 0 to 3. And the standard error of $z_1(1)$ is estimated to be 0.053 at a 95% confidence level. Thus, the true value of $z_1(1)$ is shown in the range of [2.219, 2.427]. Furthermore, $\overline{CD}_{food}^1(z)$ is always higher than $\overline{CD}_{education}^1(z)$ for any poverty line below $z_1(1)$. Then the indirect tax reform of decreasing taxes on the upper $\overline{CD}_{food}^1(z)$ and increasing taxes on the lower $\overline{CD}_{education}^1(z)$ for any poverty line below 2.219 at the 95% confidence level is poverty reducing while keeping the government's revenue balanced. Since the two normalized CD curves have an intersection, according to Pen (1971), this first-order tax reform is not Pen-improving which cannot improve social welfare in Iraq.

Figure 5.2 demonstrates the two normalized consumption dominance curves on food and education at the second order assuming that $\gamma=1$. As shown by this figure, $\overline{CD}_{food}^2(z)$ lies above $\overline{CD}_{education}^2(z)$ in the income range between 0 and 3. So the two normalized consumption dominance curves do not intersect within this range. Accompanied by the data in Table 5, when $\gamma=1$, the two curves intersect at the critical poverty line $z_2(\gamma)=12.910>3$, which is outside the range of the income per capita in

our analysis. Therefore, a budget-balanced tax reform at the second order is Dalton-improving which can reduce poverty and improve social welfare when increasing taxes on education and decreasing taxes on food expenditures for any poverty line within the income range $[0, 3]$.

Correspondingly, Table 5 gives the values of the critical poverty lines at different orders according to different critical economic efficiency cost γ . Specifically, when $\gamma=0.5$, for the three orders, only $z_1(\gamma=0.5)$ exists and its value is 5.234 with a standard error of 0.078 at a 95% confidence level. $z_2(\gamma)$ and $z_3(\gamma)$ do not exist.

Consequently, at the first-order, $\overline{CD}_{food}^1(z)$ and $\overline{CD}_{education}^1(z)$ intersect at $z_1(\gamma)=5.234$ and the marginal tax reform is first-order poverty reducing up to a poverty line 5.234 with a standard error of 0.078. The absence of $z_2(\gamma)$ and $z_3(\gamma)$

comes from the fact that the two curves do not intersect. Then a tax reform can reduce poverty by taxing education and providing a subsidy for food commodities at the second and third order. At the same time, since $\overline{CD}_{food}^2(z)$ does not intersect

with $\overline{CD}_{education}^2(z)$, the second-order tax reform is Dalton-improving which can increase social welfare as well. Then same as the second-order tax reform, because

$\overline{CD}_{food}^3(z)$ has no intersection with $\overline{CD}_{education}^3(z)$, the third-order tax reform is

Kolm-improving. Next, when γ increases to 1.0, from Table 5 we can see that there are critical poverty lines for $s=1$ and 2. Specifically, they are $z_1(\gamma=1)=2.323$ (with a

standard error of 0.053) and $z_2(\gamma=1)=12.910$ (with a standard error of 0.191). The

value of $z_3(\gamma=1)$ does not exist. Then when $\gamma=1$, the indirect tax reform when $s=1$

is poverty-improving but not Pen-improving to increase taxes on education expenditures and subsidize food for any poverty line below 2.323. At the same time,

the tax reform to tax education and subsidize food when $s=2$ can reduce poverty.

However, we should notice that although $\overline{CD}_{food}^2(z)$ and $\overline{CD}_{education}^2(z)$ cross

through the second-order critical poverty line, the value of $z_2(\gamma=1)$ which is 12.910 is greater than the maximum value of the range of income per capita in this case. So the second-order indirect tax reform is Dalton-improving for any poverty line within the income range $[0, 3]$. Since $\overline{CD}_{food}^3(z)$ does not cross $\overline{CD}_{education}^3(z)$, the third-order tax reform is Kolm-improving which can reduce poverty and improve social welfare for any values of z . Finally, when $\gamma=1.5$, all the three critical poverty lines have values and they are $z_1(\gamma=1.5)=0.975$ (with a standard error of 0.072), $z_2(\gamma=1.5)=1.301$ (with a standard error of 0.116) and $z_3(\gamma=1.5)=1.682$ (with a standard error of 0.173). Obviously, the $\overline{CD}_{food}^s(z)$ and $\overline{CD}_{education}^s(z)$ when $s=1, 2$, and 3 have intersections. Then when $s=1$, the tax reform which increases taxes on education expenditures and gives subsidies to food is poverty reducing for any poverty line below 0.975, but it is not Pen-improving which cannot improve social welfare for the reason that the two normalized CD curves have an intersection. Similarly, the second-order tax reform is not a Dalton-improving tax reform because $\overline{CD}_{food}^2(z)$ and $\overline{CD}_{education}^2(z)$ has a crossing point. And although the third-order tax reform can reduce poverty for any poverty line below 1.682, for the same reason as the above two cases, it is not a Kolm-improving tax reform.

4.7 Health vs Education

Figure 6.1 describes the first-order normalized consumption dominance curves on health and education with the assumption of $\gamma=1$. Accompanied by the data shown by Table 6, it can be seen that the two normalized consumption dominance curves cross several times throughout the whole range of income per capita from 0 to 3. They firstly cross at the intersection $z_1(1)=1.388$ with a standard error of 0.086 at the 95% confidence interval. As a result, the true value of $z_1(1)$ ranges from 1.219 to 1.557.

Figure 6.1 shows that the normalized consumption dominance curve $\overline{CD}_{health}^1(z)$ is

always located above the normalized consumption dominance curve $\overline{CD}_{education}^1(z)$ for any poverty lines below the first crossing where $z_1(1)=1.388$. Then it could be concluded that increasing taxes on education and providing subsidies for health is a first-order poverty-improving tax reform for any poverty line below 1.219 at a 5% critical level. Since the two curves cross, then the tax reform cannot improve social welfare and is not Pen-improving.

Figure 6.2 analyzes the normalized CD curves for health and education when $s=2$ with the assumption that $\gamma=1$. Combining this figure with the data in Table 6, it is clear that the two normalized consumption dominance curves cross at $z_2(1)=1.853$ with a standard error of 0.363. $\overline{CD}_{health}^2(z)$ is higher than $\overline{CD}_{education}^2(z)$ for any poverty line below 1.853 within the income range. Then the second-order marginal tax reform of increasing taxes on education and reducing taxes on health is poverty improving in this range. Since the two curves have an intersection, this kind of tax reform is not Dalton-improving.

Then let us proceed to Table 6. In this table, it displays the critical poverty lines according to different values of the economic efficiency cost γ . When $\gamma=0.5$, only $z_1(0.5) = 7.934$ exists, which indicates that $\overline{CD}_{health}^1(z)$ is higher than $\overline{CD}_{education}^1(z)$ for any poverty line below 7.934 during the range of income per capita from 0 to 3. Hence, the first-order indirect tax reform is poverty reducing for any poverty line below the first-order critical poverty line but it is not Pen-improving for the reason that the two normalized consumption dominance curves on health and education cross. At the same time, we can observe that there are no critical poverty lines for $s=2$ or higher. Then we can conclude that the indirect tax reform can reduce poverty and improve social welfare when taxing education expenditures while subsidizing health expenditures for the poverty lines which are below $z_s(0.5)$ in the

income range at the order of dominance greater than two.

Furthermore, when $\gamma=1$, $z_1(1)=1.388$ (with a standard error of 0.086), $z_2(1)=1.853$ (with a standard error of 0.363) and $z_3(1)=3.320$ (with a standard error of 2.102). From this, we can see that the normalized consumption dominance curves $\overline{CD}_{health}^s(z)$ and $\overline{CD}_{education}^s(z)$ $s \in \{1, 2, 3\}$ have an intersection at the s^{th} -order critical poverty line. Then $\overline{CD}_{health}^s(z)$ is everywhere above $\overline{CD}_{education}^s(z)$ for any poverty lines below the critical poverty line $z_s(1)$. As a consequence, when increasing taxes on education expenses and reducing taxes on health expenditures can reduce poverty weakly for poverty lines below the s^{th} -order critical poverty line within the income range but cannot improve social welfare since the two normalized CD curves at any order of dominance always have intersection.

Then from Table 6, the analysis of the critical poverty lines for $\gamma=1.5$ is the same as the situation when $\gamma=1$. Given the data that $z_1(1.5)=0.541$ (with a standard error of 0.096), $z_2(1.5)=0.695$ (with a standard error of 0.072) and $z_3(1.5)=0.902$ (with a standard error of 0.272), then the first-order tax reform of imposing taxes on education expenditures and giving subsidies to health expenditures can lead to a reduction in the poverty gap up to a poverty line of 0.541 within the income range, but it is not Pen-improving due to the fact that there is a crossing between $\overline{CD}_{health}^1(z)$ and $\overline{CD}_{education}^1(z)$. Similarly, the second-order tax reform is poverty improving for any poverty line below $z_2(1.5)=0.695$ within the range of the income per capita between 0 and 3, but it is not Dalton-improving since $\overline{CD}_{health}^2(z)$ and $\overline{CD}_{education}^2(z)$ intersects. Also, the indirect tax reform of taxing education and subsidizing health when $s=3$ is poverty reducing for poverty lines under

$z_3(1.5) = 0.902$, but it cannot improve social welfare because there exists an intersection between $\overline{CD}_{health}^3(z)$ and $\overline{CD}_{education}^3(z)$, that is, the tax reform is not Kolm-improving.

V. Conclusion

This analysis exhibits the application of the normalized consumption dominance curves at different order in assessing the social efficiency of an indirect marginal tax reform, that is, the impact of this tax reform on poverty and social welfare. According to the results of our analysis of the indirect tax reforms in Iraq in the third part, we can come to the conclusion that an indirect tax reform of increasing taxes on nonfood expenditures and providing subsidies for food expenditures will reduce poverty and improve social welfare in Iraq. Additionally, when comparing the normalized consumption dominance curves on nonfood expenditures, a marginal tax reform of taxing education and subsidizing health is beneficial. Finally, critical poverty lines are also implemented to examine whether or not the indirect tax reforms in Iraq is socially improving.

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Figure 1.1 Normalized Consumption Dominance curves for Food and Nonfood Expenditures, $s=1$

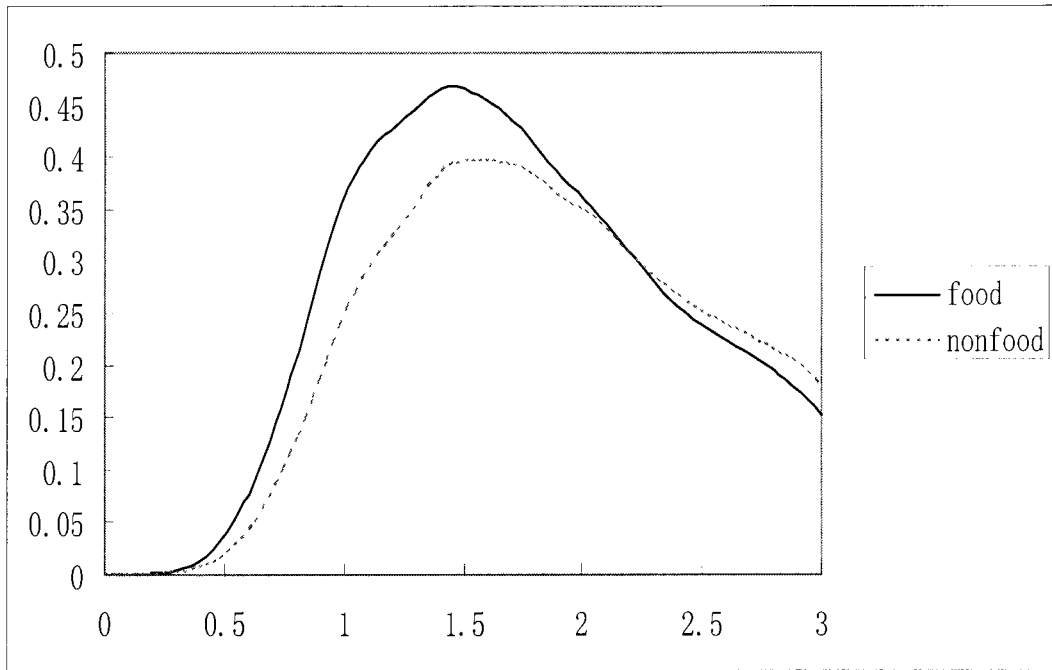


Figure 1.2 Normalized Consumption Dominance curves for Food and Nonfood Expenditures, $s=2$

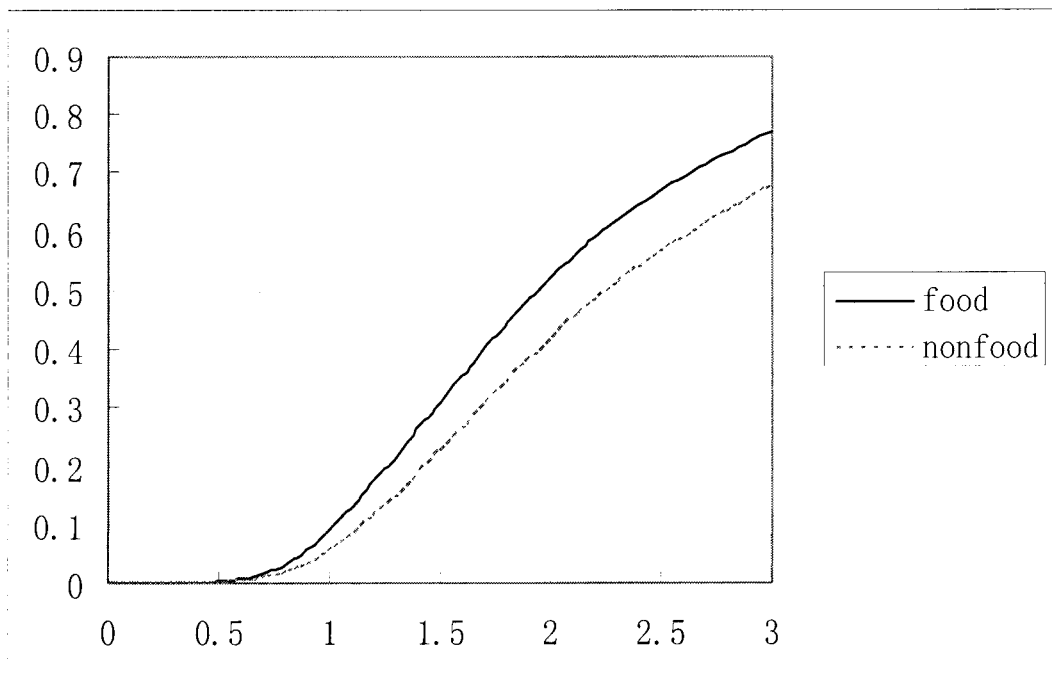


Figure 1.3 Normalized Consumption Dominance curves for Food and Nonfood Expenditures, $s=3$

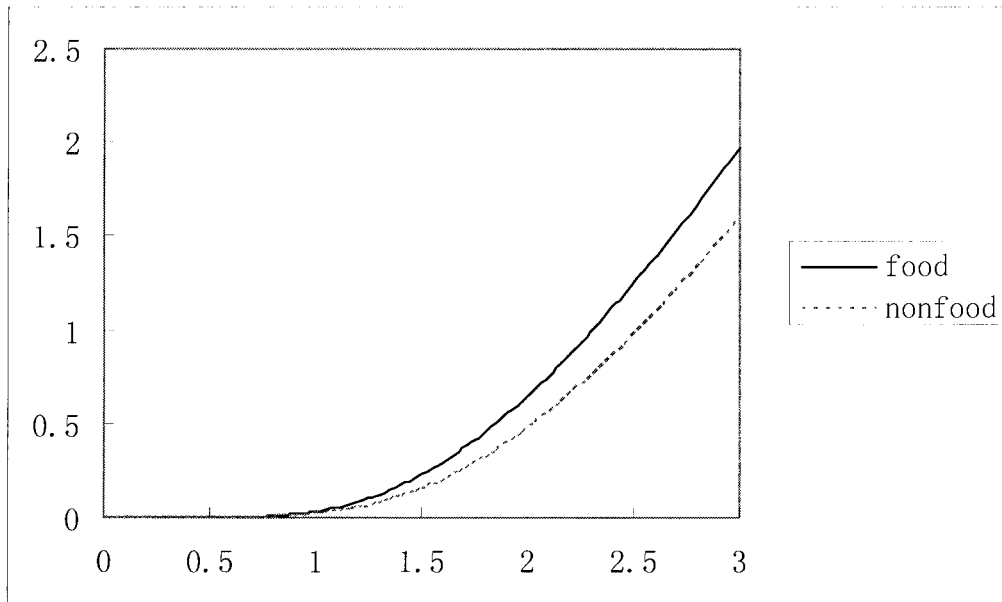


Figure 2.1 Normalized Consumption Dominance curves for Food and Housing Expenditures, $s=1$

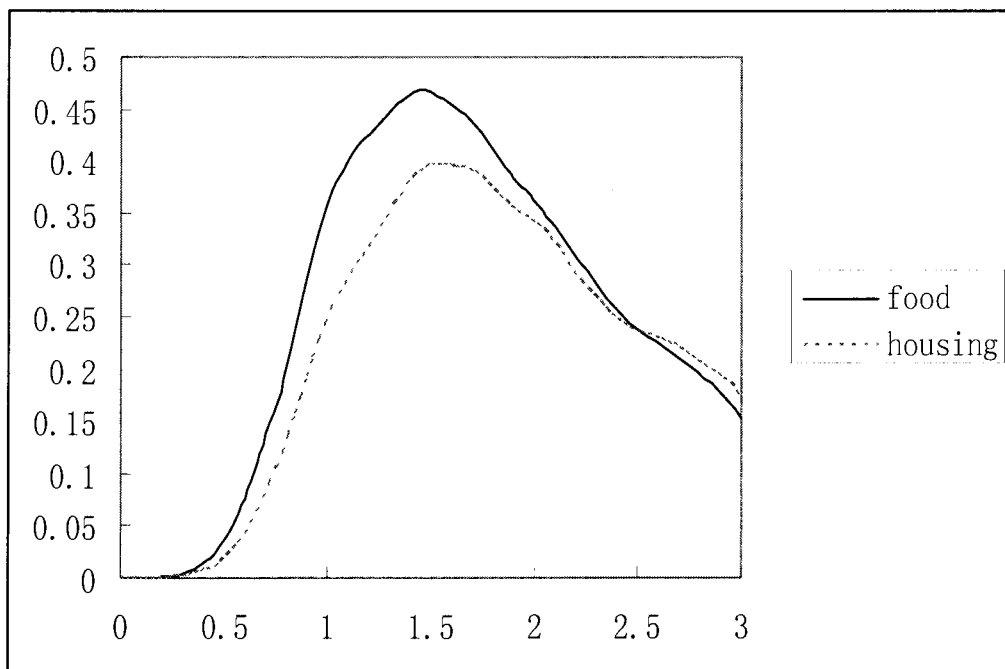


Figure 2.2 Normalized Consumption Dominance curves for Food and Housing Expenditures, $s=2$

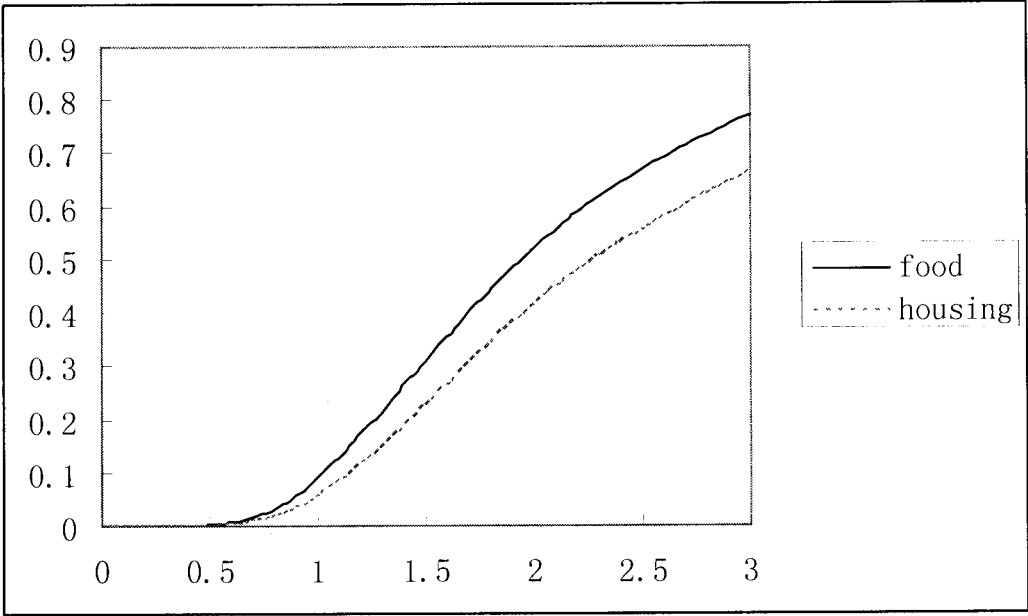


Figure 3.1 Normalized Consumption Dominance curves for Food and Utilities Expenditures, $s=1$

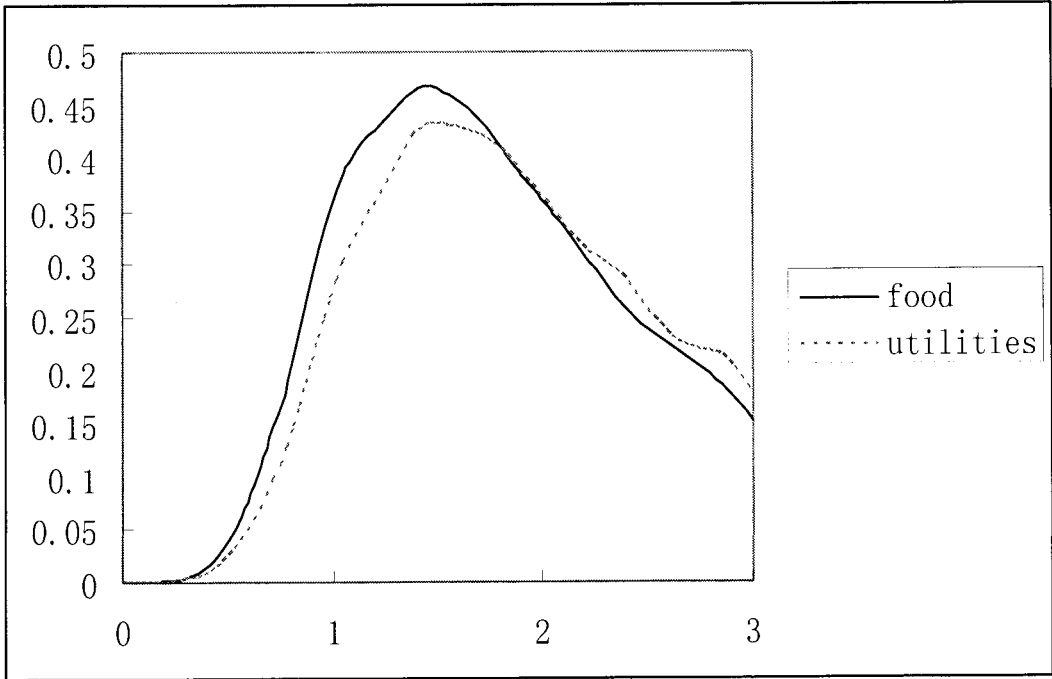


Figure 3.2 Normalized Consumption Dominance curves for Food and Utilities Expenditures, $s=2$

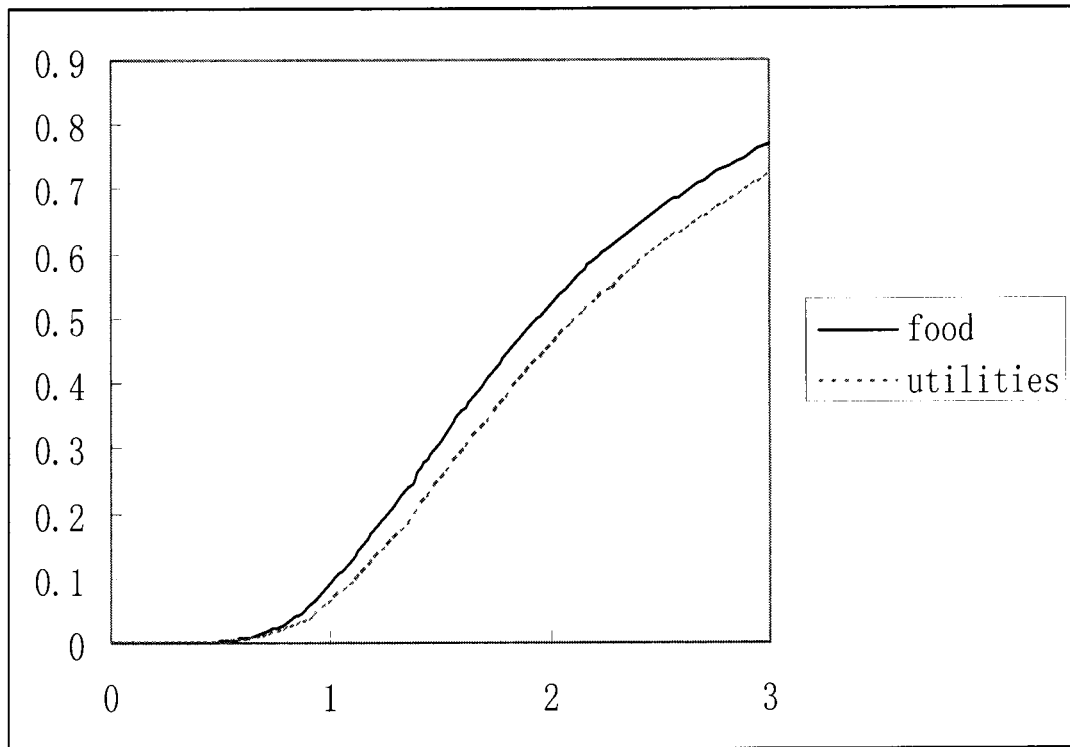


Figure 4.1 Normalized Consumption Dominance curves for Food and Health Expenditures, $s=1$

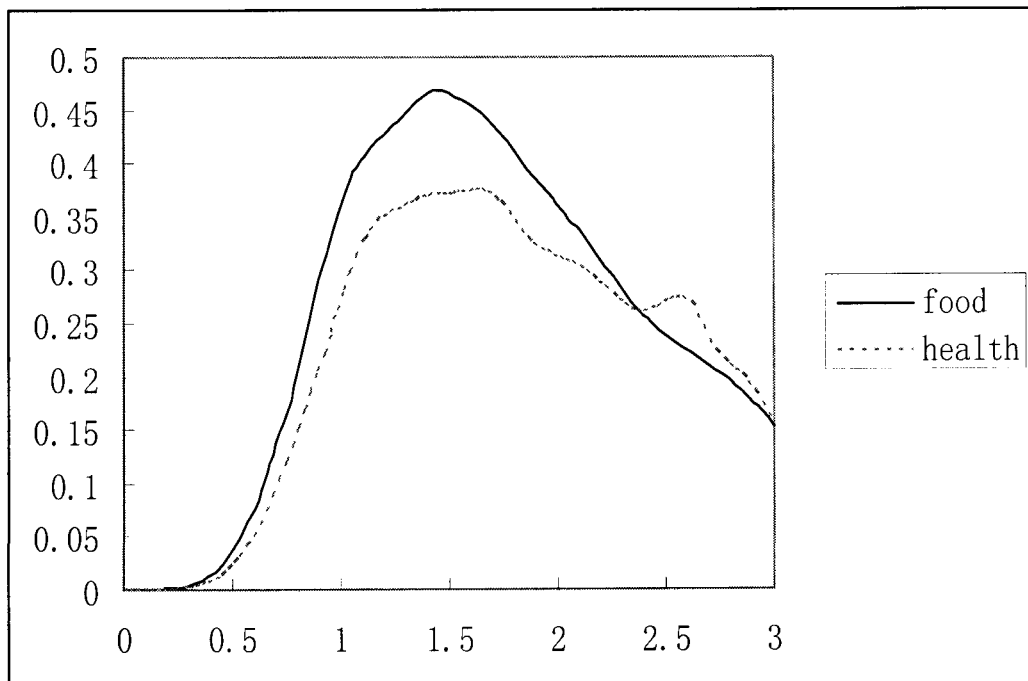


Figure 4.2 Normalized Consumption Dominance curves for Food and Health Expenditures, $s=2$

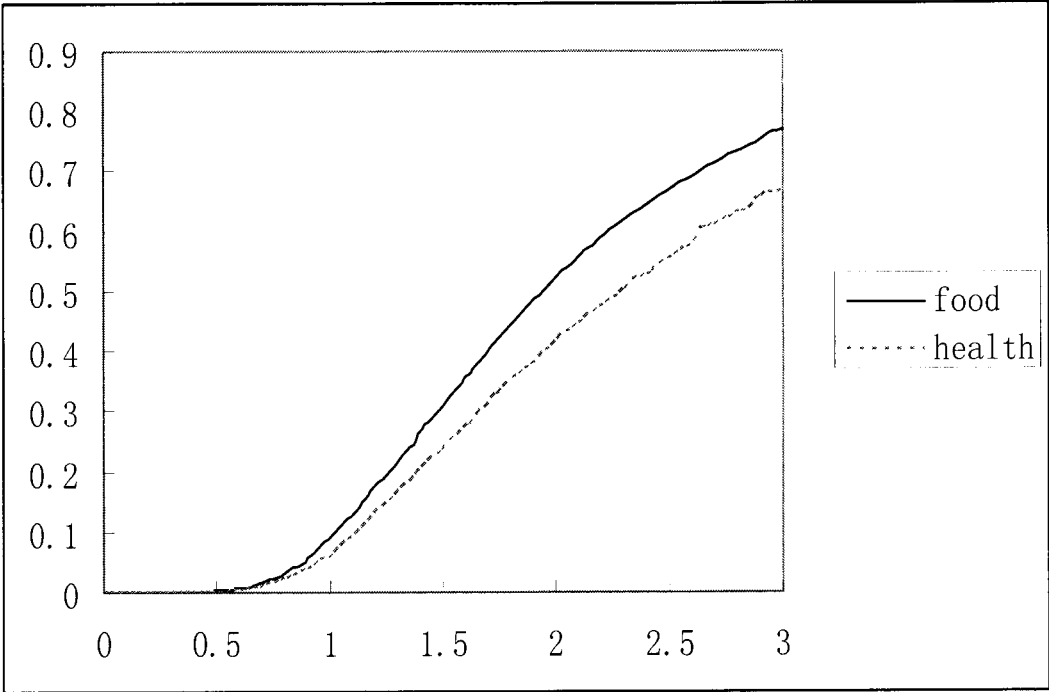


Figure 5.1 Normalized Consumption Dominance curves for Food and Education Expenditures, $s=1$

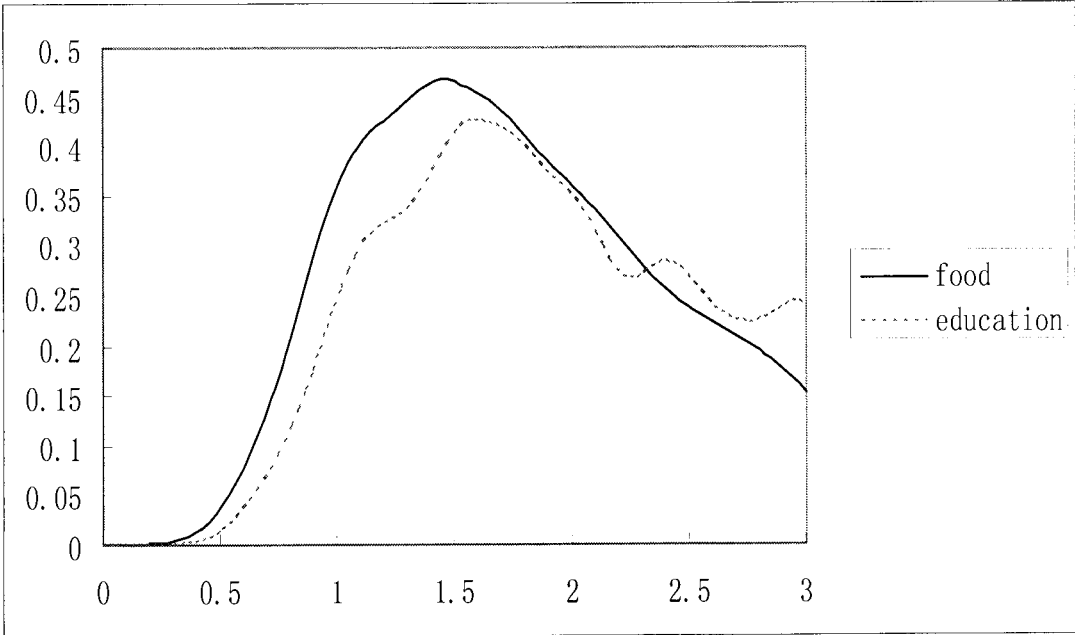


Figure 5.2 Normalized Consumption Dominance curves for Food and Education Expenditures, $s=2$

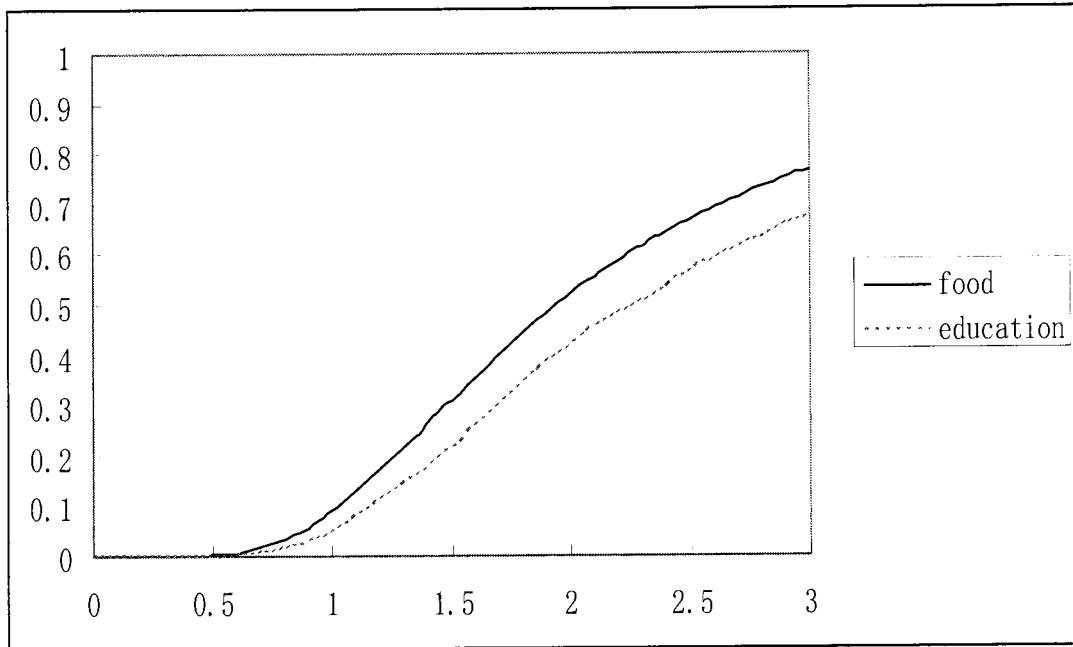


Figure 6.1 Normalized Consumption Dominance curves for Health and Education Expenditures, $s=1$

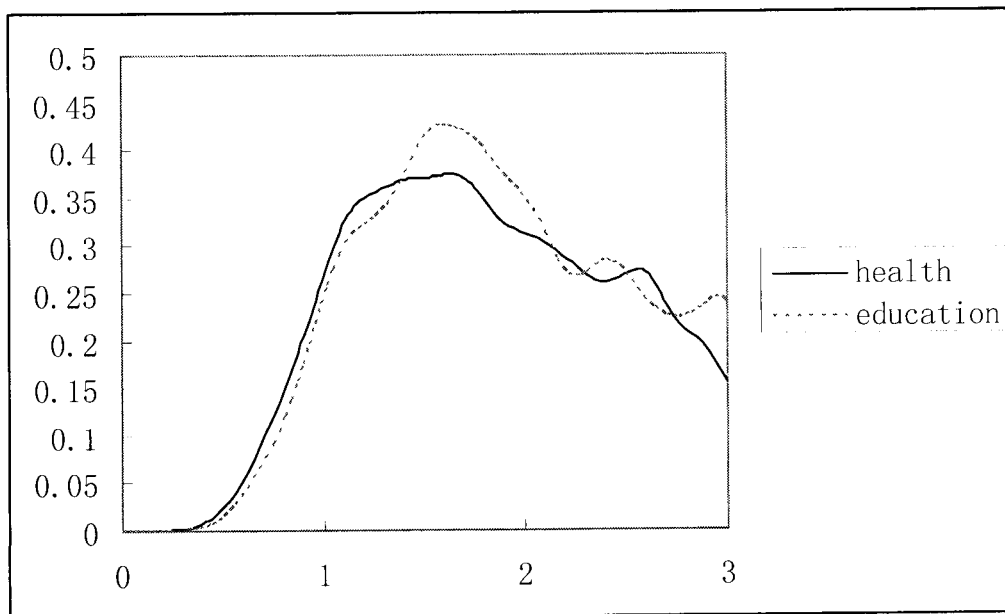


Figure 6.2 Normalized Consumption Dominance curves for Health and Education Expenditures,
 $s=2$

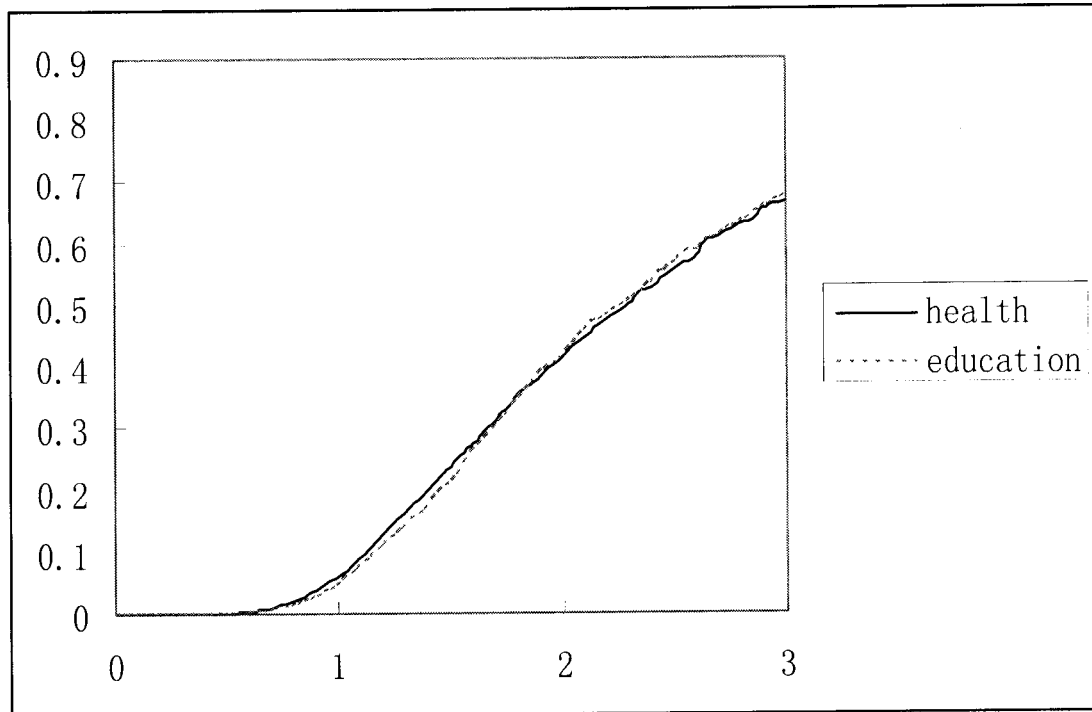


Table 1. Critical poverty lines $z_s(\gamma)$ for different ratios of economic efficiency costs γ and for different orders of dominance s (food vs nonfood).

	$\gamma = 0.5$	$\gamma = 1.0$	$\gamma = 1.5$
$z_1(\gamma)$	6.461 (0.357)	2.239 (0.075)	0.958 (0.027)
$z_2(\gamma)$	---	---	1.227 (0.027)
$z_3(\gamma)$	---	---	1.510 (0.047)

Note: (1) Dataset is 17822 households from IHSES 2007 - household level data (constructed).

(2) The numbers in the brackets are the standard error for the values of the critical poverty lines of the two normalized CD curves above them.

Table 2 Critical poverty lines $z_s(\gamma)$ for different ratios of economic efficiency costs γ and for different orders of dominance s (food vs housing).

	$\gamma = 0.5$	$\gamma = 1.0$	$\gamma = 1.5$
$z_1(\gamma)$	5.923 (0.137)	2.514 (0.078)	0.902 (0.046)
$z_2(\gamma)$	---	18.557 (0.081)	1.190 (0.026)
$z_3(\gamma)$	---	---	1.463 (0.063)

Table 3 Critical poverty lines $z_s(\gamma)$ for different ratios of economic efficiency costs γ and for different orders of dominance s (food vs utilities).

	$\gamma = 0.5$	$\gamma = 1.0$	$\gamma = 1.5$
$z_1(\gamma)$	6.434 (0.108)	1.831 (0.160)	0.750 (0.072)
$z_2(\gamma)$	----	----	0.955 (0.031)
$z_3(\gamma)$	----	----	1.102 (0.083)

Table 4 Critical poverty lines $z_s(\gamma)$ for different ratios of economic efficiency costs γ and for different orders of dominance s (food vs health).

	$\gamma = 0.5$	$\gamma = 1.0$	$\gamma = 1.5$
$z_1(\gamma)$	9.004 (0.054)	2.378 (0.102)	0.621 (0.072)
$z_2(\gamma)$	----	18.564 (0.044)	0.781 (0.028)
$z_3(\gamma)$	----	----	1.033 (0.372)

Table 5 Critical poverty lines $z_s(\gamma)$ for different ratios of economic efficiency costs γ and for different orders of dominance s (food vs education).

	$\gamma = 0.5$	$\gamma = 1.0$	$\gamma = 1.5$
$z_1(\gamma)$	5.234 (0.078)	2.323 (0.053)	0.975 (0.072)
$z_2(\gamma)$	----	12.910 (0.191)	1.301 (0.116)
$z_3(\gamma)$	----	----	1.682 (0.173)

Table 6 Critical poverty lines $z_s(\gamma)$ for different ratios of economic efficiency costs γ and for different orders of dominance s (health vs education).

	$\gamma = 0.5$	$\gamma = 1.0$	$\gamma = 1.5$
$z_1(\gamma)$	7.934 (0.364)	1.388 (0.086)	0.541 (0.096)
$z_2(\gamma)$	----	1.853 (0.363)	0.695 (0.072)
$z_3(\gamma)$	----	3.320 (2.102)	0.902 (0.272)