

Indirect Tax Reform and Redistribution in Jordan

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Abstract

The method of testing the marginal tax reform on poverty has been developed rapidly in the last decade. Makdissi and Wodon (2002) first use the Consumption Dominance curve to test the impact of the marginal tax reform on poverty under the budget neutrality, which is unlimited to the ethical order of the restricted stochastic dominance. In this paper, I consider four combinations of hypothetical marginal tax reforms in Jordan. By utilizing estimators of normalized CD-curves and critical poverty lines, this paper tests whether these hypothetical marginal tax reforms in Jordan are socially improving using the data set from Jordan Household Expenditure and Income Survey 2002/2003. As a result, these four marginal tax reforms are socially improving under specific conditions.

KEYWORDS: MARGINAL TAX REFORM, CONSUMPTION DOMINANCE CURVE, CRITICAL POVERTY LINE, JORDAN

I. Introduction

As a critical issue in the field of income distribution analysis, testing the impact of indirect tax reforms on poverty is a regular subject of discussion among many scholars in the last decade. What is being debated is whether decreasing the tax on one good by increasing the tax on another good under the budget neutrality benefits the poor. Makdissi and Wodon (2002) first use the consumption dominance curve (CD-curve) to test the marginal indirect tax reform on poverty for any order of restricted stochastic dominance. Duclos, Makdissi and Wodon (2008) make an extension to the earlier paper and define the concept of social improvement. Furthermore, by utilizing the estimators of CD-curves, and critical poverty line thresholds, they test whether the indirect tax reform is socially improving. I will apply this method to do an empirical analysis using the data in Jordan. This methodology will answer that question.

I begin with the context of Jordan before turning to the theoretical literature. According to “IMF support to Jordan, 1989-2004” published by the IMF Independent Evaluation Office, tax reform is one of the structure reforms addressed by the IMF-supported program in Jordan. The main objectives were making government revenues buoyant and reducing the distortion nature of the tax system. The essence of the reforms was the reorientation of the tax system from one based on import to the one based on domestic consumption. In particular, a general sales tax (GST) with the features of a value-added tax (VAT) which is a kind of indirect tax replaced a series of existing narrowly based consumption tax. As the tax reform processed, the percentage

of GST in relation to the total tax revenue increased.

The primary objective of this applied paper is to test whether it is possible to find poverty reducing or socially improving tax reforms by estimating the normalized CD-curve and critical poverty line as do Duclos, Makdissi and Wodon (2008). To answer that question, I will draw the normalized CD-curve for the different pairs of goods at different ethical orders. Given these curves, I will obtain the critical poverty line. Furthermore, I will compute the confidence interval for each critical poverty line. Then I will draw the conclusion whether the tax reform is socially improving or poverty reducing.

This paper is organized as follows. Section II reviews the previous literatures on the field of marginal tax reform. Section III describes methodology to analyze the impact of the marginal tax reform on poverty. Section IV describes the background of the tax reform in Jordan and makes a simple description of the data from “Household Expenditure and Income Survey 2002/2003”. Section V analyzes the data in Jordan and reports the findings. Section VI presents a conclusion.

II. Background and previous literature.

According to Santoro (2007), there are three primary approaches to analyze marginal tax reform. The first method is the application and extension of Ahmad and Stern (1984)’s framework. The second is developed by Yitzhaki and his associates who propose the Dalton improving social indirect tax reform. The third is developed by Makdissi and Wodon (2002), who focus on the interpretation of the indirect tax reform as poverty reducing policies, which verifies whether the marginal tax reform is

poverty reducing or socially improving. Before applying the third method of analysis in this paper, I will put little weight on the former two methods.

2.1 Ahmad and Stern's approach.

Feldstein (1976) describes that the actual tax change is "slow and piecemeal". His paper focuses on the difference between optimal tax design and optimal tax reform. The author tries to construct a theory of tax reform. He suggests that researchers should shift their attention from optimal tax design to tax reform. Guesnerie (1977) agrees with Feldstein (1976)'s opinion in his paper which pays attention to the direction of tax reform which can be explained as "the characteristics of the small moves of taxes which are feasible and satisfactory" (Guesnerie (1977)). The topic of this paper is to search for directions of tax reform and requires the knowledge of comparing neighbor equilibria. In addition, this paper tries to address the following four issues: "(1) the characterization of second-best Pareto efficient (2) the computation of the desirable directions of tax reform (3) the inefficiencies issue (4) the implementation of finite changes of taxes" (Guesnerie (1977)). King (1983) presents a methodology of computing the distribution of gains and losses from a tax reform using the cross-sectional data in a large sample of households. The estimates are constructed based on the "equivalent income function". After defining a tax reform, the author calculates several measures of overall efficiency gain. In addition, the author computes the measures of "social" gain and inequality using an explicit welfare function. Finally, the author utilizes the estimated standard errors to construct the confidence interval of welfare measures.

Based on the papers discussed above, Ahmad and Stern (1984) extend the research on marginal tax reform. In this paper, the authors demonstrate that the directions of tax reforms may be found given the social welfare function. They defined the marginal cost in terms of social welfare. They also define marginal commodity tax reforms as vectors of welfare-improving and revenue-neutral small tax changes. One can reach the optimum of social welfare when the marginal costs in terms of social welfare are equal. If not, under the condition of budget neutrality, that is to say, one can increase the tax on a good with a lower marginal cost and reducing tax on a good with a higher marginal cost. In the inverse optimum problem, they use the first order condition (the marginal costs are equal) to obtain the social welfare weights. The negative welfare weights imply the utility possibility frontier at the initial point is upward sloping, which means that the Pareto improvement is possible. If the welfare weights are non-negative, the Minkowski-Farkas lemma can give us a solution to the inverse optimum. With this method one can find and calculate a social welfare function.

2.2 Dalton improving marginal tax reform

Does subsidizing on one commodity by increasing tax on another commodity increase the social welfare under the condition of budget-neutrality? To answer this question, Yitzhaki and Slemrod (1991) propose a methodology to identify whether a tax reform on commodities will improve the social welfare by analyzing a large class of social welfare functions. This methodology is inspired by the “second-degree stochastic dominance” coming from the finance literature which is used to rank

portfolios according to the expected utility. They name it welfare dominance after making some changes to the second-degree stochastic dominance. By comparing shifted concentration curves, they can resolve this question. They demonstrate that if one shifted concentration curve is above another shifted concentration curve, the higher one will dominate the lower one, which implies that if the government decreases the tax on the higher one and increases tax on the lower one, it will increase social welfare. This leads to the marginal conditional stochastic dominance rules (MCSD rules) which is “if and only if concentration curves do not intersect will all additive Pareto concave social-welfare functions show that the tax change increases welfare” (Yitzhaki and Slemrod (1991)). It must be noted that “dominate” in the last sentence means that one commodity has a higher marginal condition stochastic dominance than the other. They also give an illustration with Israeli data. The inspection suggests that these conditions are quite commonly observed in practice.

Yitzhaki and Thirsk (1990) propose a relatively new method to Yitzhaki and Slemrod (1991) for assessing the excise tax base. In relation to the earlier paper, they define “ α ” as the efficiency parameter which measures the change in the deadweight loss arising from a tax reform. However, they assume that the deadweight loss is unchanged when we use marginal conditional stochastic dominance (MCSD). Furthermore, they demonstrate that the welfare dominance never existed when one changes one tax base to another. In the empirical part of this paper, they apply the notion of welfare dominance to the design of excise taxation in the Cote d’Ivoire while assuming that there is no change in deadweight loss. Comparing with Ahmad

and Stern (1984), this method is less ambiguous and requires less information on the structure of social welfare functions.

To make an extension to marginal tax reforms with only 2 goods, Mayshar and Yitzhaki(1995) propose the Dalton-improving marginal tax reform in cases with multiple goods. According to Dalton's principle of transfers, a tax reform is welfare improving if it distributes from the higher ranking (the rich) to the lower ranking (the poor) without altering the rankings of the two individuals. It must be noted that the ranking is ordered by the consumption expenditure per adult. The authors define that it is Dalton improving if and only if the post-reform effective income distribution will dominate the initial distribution. If the marginal tax reform is Dalton improvement, it will improve social welfare for all social welfare functions that respect the Dalton's principle of transfers. This method avoids choosing a particular social welfare function arbitrarily. However, according to the paper, it has some limits. Comparing with Pareto improvement, it needs a social ranking of households. In comparison to the social welfare-function approach, it only deals with the marginal tax reform. In the rest of this paper, the authors illustrated the method to form a Dalton improving tax reform using the British data on household expenditures.

In relation to their earlier paper, Mayshar and Yitzhaki (1996) construct a two-dimension criterion for Dalton-improving tax reform, while there is a social approval to transfers from the more able to the less able and from the less needy to the more needy. In this two-dimension framework, if the tax reform makes the more able or less needy lose, the less able or the more needy will gain from this tax reform.

Furthermore, this two-dimension Dalton improving can be applied to any of the two kinds of household rankings. In the rest of the this paper, the application of the method is used for identifying the two-dimension Dalton improving tax reform using the same data as the earlier paper.

Yitzhaki and Lewis (1996) use the data of the energy sector of Indonesia to search for a Dalton-improving tax reform with the methodology developed by Yitzhaki and Slemrod (1991) and Mayshar and Yitzhaki (1995). In this article, besides the search for the Dalton-improving tax reform, they mention that this methodology can be used to test the impact of tax reform on poverty but only with the second degree dominance. In addition, they expand the tax base from two goods to three goods. Finally, they conclude that Indonesia may benefit from the present energy taxes.

Lundin (2001) uses the method proposed by Mayshar and Yitzhaki (1995, 1996) to assess whether any welfare-improving tax reform, including CO2 tax is possible. The advantage of this methodology is that one only needs to make a social ranking of households. In this paper, household total expenditure is used as a proxy for ability, while household size is used as a proxy for needs. Furthermore, the author constructs a three-dimension Dalton improving tax reform in which he adds the factor of geographical residence of households. In this paper the author suggests that incorporating the direct value of lower emissions of carbon dioxide does not explicitly expand the set of Dalton-improving reforms. He also concludes that when the ranking of households shifts from two-dimensions to three-dimensions, there can no longer be

a Dalton-improving tax reform any more. This means that location is an essential factor that affects the CO₂ tax reform, so it is possible to find that the rich do not gain when the tax reform hurts the poor and the poor do not gain at the expense of large households. It is impossible to find any reforms at the same time that does not hurt the households living outside urban areas.

2.3 Testing impact of marginal tax reform on poverty

Makdissi and Wodon (2002) present a new methodology for testing the impact of marginal tax reform on poverty. We know Dalton-improving tax reform eliminates the need for choosing a specific social welfare function, but it only applies to the second degree dominance. In contrast, this methodology is used to test the impact for any order of restricted stochastic dominance. In this article, the authors set up two assumptions. The first is that there is an additive index of poverty. The second requires that the poverty measure be an s -time piecewise continuous differentiable function. The second assumption implies that the tax reform is poverty reducing if a transfer respects the Pen principle at the first order; it is poverty reducing if the transfer respects the Pigou-Dalton principle at the second order; and it is poverty reducing if the transfer respects the Kolm-principle at the third order. Based on these two crucial assumptions, the authors define the economic efficiency ratio which represents the cost of raising one dollar of public funds by taxing one good and using the proceeds to subsidize the second good. Then they define the consumption dominance curve (CD-curve). The authors state that the advantage of the CD-curve can be used to test for stochastic dominance of any order. Furthermore, the authors

draw an essential conclusion that a tax reform will decrease poverty for a class of poverty indices if the two CD-curves associated with the index are not intersecting under a critical poverty line. In the rest of this paper, the authors use the data in Bolivia to make an illustration and draw a conclusion on the tax reform in Bolivia.

Liberati (2003) extends the correspondence between poverty reducing tax reforms and the consumption dominance curve. Based on Makdissi and Wodon (2002)'s work, he derives the Sub-Group Consumption Dominance curve (SGCP-curve) and gives a proposition which is similar to Makdissi and Wodon (2002)'s, which details that the tax reform will reduce poverty if the two SGCP-curves associated with poverty measures do not intersect before the maximum poverty line. The advantage of this method is that it is easier for policy-makers to obtain detailed information on the population subgroups. In the rest of this paper, the author uses the data of Belarus in 1997 to make an illustration.

In comparison to their earlier paper, Duclos, Makdissi and Wodon (2008) propose a new methodology for testing the impact of marginal tax reform on poverty. They make progress on the derivation of normalized consumption dominance curve (\overline{CD} curve). They construct two assumptions on the additive poverty indices and utilitarian social welfare functions respectively. If both poverty indices and social welfare functions satisfy the two assumptions, they will respect the Pen-improving at the first order; the Dalton-improving at the second order; and the Kolm-improving at the third order, and so on. After defining an s-order stochastic dominance, they use the normalized CD-curve to test the poverty and social welfare improvement of tax

reform. Then, they prove two theorems. The first theorem shows a necessary and sufficient condition for a marginal tax reform to be *s*-ordered poverty reducing. The second is a sufficient condition for a marginal tax reform to be *s*-ordered welfare improving. It must be noted that both the two theorems are based on the two assumptions and the normalized CD-curve. Furthermore, by comparing the distributive benefit of taxing good *j* relative to taxing good *l* and the economic efficiency ratio of taxing good *j* relative to good *l*, they define the concept of the social improvement. Then they show a method to obtain the critical upper poverty line given that the first theorem holds. In this paper, they derive the conditions for *s*-order poverty indices and social welfare improving by comparing the two normalized CD-curves. In particular, they prove the results of the Yitzhaki and Slemrod (1991) by an alternative method. In addition, they give a relation between the economic efficiency ratio and the critical poverty line. They demonstrate that as order increases, the economic efficiency ratio becomes less constraining which implies that the critical economic efficiency ratio will increase. They also use the data in Mexico to make an illustration of how to use this new methodology to do empirical analysis on poverty.

III. The methodological framework

It must be noted that the method in this part closely follows the Duclos, Makdissi and Wodon (2008).

3.1 Notation and definitions.

Consider there are *K* kinds of goods with prices denoted by vector *q*. For expositional simplicity, we set producer prices constant and equal to 1. We assume

that the variation of the prices of goods (dq) depends on the variation of the tax (dt). Then we have $q=1+t$. After totally differentiating this equation, we obtain $dq_k = dt_k$, where q_k and t_k respectively represent the price of good k and the tax rate on good k . Let y and θ respectively denote the nominal income and consumer's preferences. Then the indirect utility function is expressed as $v(y, \theta, q)$. We use q^R and y^R to respectively denote the vector of reference prices and the real (or equivalent) income of the post-reform. y^R is defined by both the implicit function $v(y^R, \theta, q^R) = v(y, \theta, q)$ and the real income function $y^R = \rho(y, \theta, q, q^R)$, where

$$(1) \quad \rho(y, \theta, q, q^R) \equiv v(y, \theta, q).$$

We aim to test how the consumer welfare is affected by a marginal change in tax rates. Let $x_k(y, \theta, q)$ be the consumption of good k which is a function of income y , preference θ and the price of good q . Using Roy's identity and setting reference prices (q^R) be equal to pre-reform prices(q), we obtain

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

Based on the distribution function $F(y, \theta)$, we suppose that the preferences θ and nominal income y are jointly distributed. Then $F(\theta|y)$ denotes the conditional distribution of θ given that y and $F(y)$ denotes the marginal distribution of nominal income. Let the preferences θ belong to a set Θ and assume y to be distributed over $[0, a]$. The expected consumption of good k is expressed as

$$(3) \quad x_k = E[x_k(y, \theta, q)] = \int_{\Theta} x_k(y, \theta, q) dF(\theta | y).$$

Suppose that $X_k(q)$ is the per capita consumption of the k th good. Then we can express it as $X_k(q) = \int_0^a x_k(y, q) dF(y)$. According to equation (2), $X_k(q)$ is the

average cost of increasing the price of good k . Thus the consumption of good k with price q and income y as a proportion of per capita consumption can be written as $\bar{x}_k(q) = x_k(y, q)/X_k(q)$.

In this paper, we suppose that pre-reform nominal and real incomes are the same since we let reference prices be equal to pre-reform prices. Define the nominal income function $y = \eta(y^R, \theta, q, q^R)$. Then the indirect utility function is expressed as $v(y^R, \theta, q^R) \equiv v(\eta(y^R, \theta, q, q^R), \theta, q)$.

Now we focus on the government commodity tax revenue. Consider per capita commodity tax revenues $R(q)$ which is expressed as $R(q) = \sum_{k=1}^K t_k X_k(q)$. We assume that the government subsidizes good l by increasing the tax on good j without changing commodity tax revenues. The condition of the revenue neutrality of tax reform can be written as

$$(4) \quad dR(q) = \left[X_j(q) + \sum_{k=1}^K t_k \frac{\partial X_k(q)}{\partial q_j} \right] dq_j + \left[X_l(q) + \sum_{k=1}^K t_k \frac{\partial X_k(q)}{\partial q_l} \right] dq_l = 0$$

Define the economic efficiency ratio γ_{lj} which can be expressed as

$$(5) \quad \gamma_{lj} = \frac{\frac{X_l + \sum_{k=1}^K t_k \frac{\partial X_k}{\partial q_l}}{X_l}}{\frac{X_j + \sum_{k=1}^K t_k \frac{\partial X_k}{\partial q_j}}{X_j}}$$

The numerator represents the inverse of the marginal economic efficiency cost of funds (MECF_l) from taxing good l . The denominator represents the inverse of the marginal economic efficiency cost of funds (MECF_j) from taxing good j . Therefore γ_{lj} is called the economic efficiency ratio which is expressed as $\gamma_{lj} = \text{MECF}_j / \text{MECF}_l$.

Then equation (4) can be rewritten as

$$(6) \quad dq_j = -\gamma_{lj} \left(\frac{X_l}{X_j} \right) dq_l$$

which converts dq_j into a revenue-neutral proportion of dq_1 .

3.2 Measuring poverty and social welfare.

Consider an additive poverty index such that

$$(7) \quad P(z) = \int_0^a p(y, z) dF(y),$$

where $P(z)$ is an additive poverty index, z is the poverty line, y is income and $p(y, z)$ is the contribution to total poverty which is function of income y and poverty line z . We assume that poverty indices defined above belong to set Π^s which can be expressed as

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

where \widehat{C}^s is a set of functions that are s -time piecewise differentiable over $[0, z]$ and “ s ” represents the ethical order.

We also consider a particular additive poverty index developed by Foster et al. (1984) named the normalized-FGT index which is defined as

$$(8) \quad FGT^\alpha(z) = \int_0^z \left(\frac{z-y}{z} \right)^\alpha dF(y).$$

It is a headcount index when α is equal to zero and it's a normalized average poverty gap when α is equal to one. It must be noted that $FGT^\alpha(z)$ belongs to Π^s for $\alpha \geq s-1$.

Now we focus on social welfare functions. Similarly, consider a utilitarian social welfare function which can be expressed as

$$(9) \quad U = \int_0^a u(y) dF(y).$$

Likewise, we let social welfare functions belong to the set Ω^s which is expressed as

$$(10) \quad \Omega^s = \left(U \mid u(y) \in C^s(\infty), (-1)^{i+1} u^{(i)}(y) \geq 0 \text{ for } i = 1, 2, \dots, s, \right)$$

For ethical order $s=1$, poverty indices are non-increasing while social welfare

functions are non-decreasing. Furthermore, poverty indices and social welfare functions respectively belong to Π^1 and Ω^1 . These indices are Paretian indices which respect the symmetric and anonymity axiom¹. To compare poverty indices, the range of poverty lines must be over $[0, z]$. The first order welfare improving tax reform is named Pen-improving tax reform.

When the ethical order $s=2$, poverty indices and social welfare functions respect the Pigou-Dalton principle of transfers². Poverty indices and social welfare functions respectively belong to Π^2 and Ω^2 . The second-order welfare improving tax reforms are called Dalton-improving tax reforms.

When the ethical order $s=3$, poverty indices and social welfare functions respectively belong to Π^3 and Ω^3 . These poverty indices and social welfare functions are sensitive to favorable composite transfers³. We call them Kolm-improving tax reforms.

3.3 Identifying socially improving tax reforms

Under the condition that $q=q^R$, the stochastic dominance at different orders can be defined as

$$(11) D^S(z) = \frac{1}{(s-1)!} \int_0^z [z - y]^{(s-1)} df(y).$$

It implies that dominance curves are in the form of the sum of powers of poverty gaps which can be interpreted as ethically weighted sums of individual deprivation. The weights on the largest poverty gaps will increase as the value of the ethical order s

¹ Symmetry or anonymity axiom: interchanging any two individuals' incomes leaves unchanged the poverty and social welfare indices.

² It implies that a mean-preserving transfer of income from a higher order individual to a lower order individual ranked by income constitutes a social improvement that will increase welfare or reduce poverty.

³ Suppose a beneficial Pigou-Dalton transfer at the lower part of distribution and an adverse Pigou-Dalton transfer within the upper part of the distribution, this composite will increase welfare or reduce poverty given the variance of distribution is not increased.

increases.

$$\text{And } D^s(z) = \begin{cases} F(y) & \text{for } s = 1 \\ \int_0^z D^{s-1}(y)dy & \text{for } s = 2, 3, \dots, s \end{cases}$$

Based on equation (2) and equation (11), we can show that

$$(12) \quad \left. \frac{\partial D^s(z)}{\partial t_k} \right|_{q=q^R} = \begin{cases} x_k(z, q^R)f(z) & \text{if } s = 1 \\ \frac{1}{(s-2)!} \int_0^z x_k(y, q^R)(z-y)^{s-2}dF(y) & \text{if } s = 2, 3, \dots, \end{cases}$$

where $f(z)$ is the density function of income at z . Then we define the consumption dominance curve(CD-curve):

$$(13) \quad CD_k^s(z) = \frac{\partial D^s(z)}{\partial t_k}, \quad s=1, 2, \dots,$$

Additionally, we define the normalized CD-curve:

$$(14) \quad \overline{CD}_k^s(z) = \frac{CD_k^s(z)}{X_k(q)}$$

where \overline{CD} curves are ethically weighted cost of taxing good k in terms of the average welfare cost.

For ethical order $s=1$, $\overline{CD}_k^1 = \frac{x_k(y)}{X_k}$ can be interpreted as the ratio of consumption of good k for a consumer with income y to the aggregate consumption of that good. For $s=2$, $\overline{CD}_k^2 = \int_0^y C_k^1(u)dF(u)$ can be interpreted as the consumption of good k consumed by the consumers with income lower than y in terms of the total consumption. For the higher order s , we can obtain the normalized consumption dominance curve by integrating the \overline{CD} curves at order $s-1$. \overline{CD} curves are used to test whether tax reforms are poverty reducing or welfare improving which is shown in

detail in the following two theorems.

Theorem I (Duclos Makdissi and Wodon(2008)): A necessary and sufficient condition for a marginal tax reform, $dq_j = -\gamma_{lj} \left(\frac{x_l}{x_j} \right) dq_l > 0$, to be s-order poverty reducing, that is to say, to be decrease poverty weakly for all $P(z) \in \Pi^s$, for all $z \in [0, z^+]$ and for a given $s \in \{1,2,3, \dots\}$, is that

$$(15) \quad \overline{CD}_l^s(y) - \gamma_{lj} \overline{CD}_j^s(y) \geq 0, \quad \forall y \in [0, z^+], \text{ where } \gamma \text{ is the same as equation (5).}$$

Theorem II (Duclos Makdissi and Wodon(2008)): A sufficient condition for a marginal tax reform, $dq_j = -\gamma_{lj} \left(\frac{x_l}{x_j} \right) dq_l > 0$, 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

$$(16) \quad \overline{CD}_l^s(y) - \gamma_{lj} \overline{CD}_j^s(y) \geq 0, \quad \forall y \in [0, \infty), \text{ where } \gamma \text{ is the same as equation (5).}$$

Theorem I implies that when $\gamma = 1$ the tax reform will be poverty-reducing if the \overline{CD} curve of good l is everywhere above the \overline{CD} curve of good j for any poverty line under a critical poverty line z^+ for all poverty indices belong to Π^s . This means that if the \overline{CD} curve of good l and the \overline{CD} curve of good j do not intersect at order $s=1, s=2, s=3$, the tax reform will be poverty-reducing at order $s=1, s=2, s=3$ respectively. If the \overline{CD} curve of good l and the \overline{CD} curve of good j have intersections and the first intersection is larger than the critical poverty line, the tax reform will be poverty-reducing at order $s=1, s=2, s=3$ respectively. For $\gamma \neq 1$, we should convert the \overline{CD} curve of good j into the one which is multiplied by the economic efficiency

ratio. Then the tax reform is poverty reducing if the \overline{CD} curve of good l is everywhere above the \overline{CD} curve of good j with an economic efficiency ratio for any poverty line under the critical poverty line z^+ for all poverty indices belong to Π^s . If the \overline{CD} curve of good l and \overline{CD} curve of good j with an economic efficiency ratio do not have an intersection at order $s=1, s=2, s=3$, the tax reform will be poverty-reducing at order $s=1, s=2, s=3$ respectively. If the \overline{CD} curve of good l and \overline{CD} curve of good of j with an economic efficiency ratio have intersections and the first intersection is larger than the critical value of poverty line, the tax reform will be poverty-reducing at order $s=1, s=2, s=3$ respectively.

Theorem II implies that the tax reform is respectively Pen-improving, Dalton-improving, Kolm-improving if the \overline{CD} curve of good l is everywhere above the \overline{CD} curve of good j under any poverty line when $\gamma = 1$ at the ethical order $s=1, s=2, s=3$ respectively. This implies that the tax reform is respectively Pen-improving, Dalton-improving, Kolm-improving if the \overline{CD} curve of good l and \overline{CD} curve of good j do not intersect at ethical order $s=1, s=2, s=3$ respectively. If $\gamma \neq 1$, we should convert the \overline{CD} curve of good j into the one which is multiplied by the economic efficiency ratio. Likewise, the tax reform is respectively Pen-improving, Dalton-improving, Kolm-improving, if the \overline{CD} curve of good l is everywhere above the \overline{CD} curve of good j with an economic efficiency ratio under any poverty line. This implies that tax reform is respectively Pen-improving, Dalton-improving, Kolm-improving if the \overline{CD} curve of good l and \overline{CD} curve of good j with an economic efficiency ratio do not intersect at the ethical order $s=1, s=2, s=3$ respectively.

In a word, the conditions for poverty-reducing tax reforms are less demanding than for welfare-improving tax reforms.

3.4 Critical poverty line, critical efficiency ratio and distributive benefit.

After giving the definition of the economic efficiency ratio, we now define the distributive benefit (δ) of subsidizing good l by taxing good j in the form of the ratio of \overline{CD} curves ($\overline{CD}_l^s(z)/\overline{CD}_j^s(z)$) which can be written as

$$(17) \quad \delta^s(z) = \begin{cases} \frac{\overline{CD}_l^s(z)}{\overline{CD}_j^s(z)} & \text{if } \overline{CD}_j^s(z) \neq 0 \\ \gamma^{++} & \text{if } \overline{CD}_j^s(z) = 0 \end{cases}$$

Actually δ is infinite when $\overline{CD}_j^s(z) = 0$. We denote it as γ^{++} for easy tractability. Consequently, a tax reform is s -ordered socially improving if its distributive benefit is larger than the economic efficiency ratio for any poverty line under a critical poverty line z^+ for all poverty indices belong to Π^s . In summary, Theorem I and II can be interpreted as comparing the distributive benefit to the economic efficiency ratio. If the former is larger, we can obtain the same results.

Suppose a given value γ_0 such that

$$(18) \quad \overline{CD}_l^s(z) - \gamma_0 \overline{CD}_j^s(z) \geq 0, \forall z \in [0, z^+]$$

It is obviously that equation (18) holds for all $\gamma \leq \gamma_0$. It is complicated when $\gamma > \gamma_0$. If there exists a $\gamma^{++} \forall z \in [0, z^+]$, equation (18) will hold. However, if there is a critical value γ^+ for all $z \in [0, z^+]$, beyond which equation (18) will not hold,

we could define the γ^+ as

$$(19) \gamma_s(z^+) = \inf \{\delta^s | z \in [0, z^+]\}$$

Then γ_s is a function of z^+ . Given the critical value z^+ , let $\overline{CD}_1^s(z)$ and $\gamma \overline{CD}_j^s(z)$ intersect at $z=z^+$. Then we obtain the upper bound of the economic efficiency ratio beyond which equation (18) does not hold.

Likewise, we define a critical upper poverty line of $z_s(\gamma^+)$. Given $\gamma = \gamma^+$, equation (18) holds for all poverty lines under z^+ . Thus, equation (18) holds for any $z > z^+$, since the intersection of $\overline{CD}_1^s(z)$ and $\gamma \overline{CD}_j^s(z)$ is larger than the critical value z^+ . We hope that the critical poverty line is as large as possible. The larger the critical poverty line is, the less demanding on the choice of the poverty line. Then we obtain

$$(20) z_s(\gamma^+) = \sup \{z | \delta^s(y) \geq \gamma^+, y \in [0, z], z \leq z^{++}\}$$

Therefore equation (19) implies that we could obtain the upper bound of economic efficiency ratio $\gamma_s(z^+)$ given z^+ . Equation (20) implies that we could also obtain the critical poverty line $z_s(\gamma^+)$ given γ^+ . Hence, if the tax reform to subsidize good I by taxing good j is socially improving, the poverty line and the economic efficiency ratio must be below the thresh hold respectively.

IV. The background of the tax reform in Jordan, the data set and the variables.

Jordan has 5.7 million inhabitants and is notably resource-poor, with limited

agricultural land, no oil resources, and considerably scarce water. Its only natural resources are potash and phosphate. The population is urbanized at around 80 percent. The Jordanians are sensitive to poverty and unemployment prior to the economic collapse⁴. The economic collapse dumped 17 percent of the Jordanians into poverty and caused 20 percent of labor force unemployment in 1989.

To tackle the major macroeconomic challenges, the government started a series of fiscal structural reforms. Tax reform addressed by the IMF was one of the structural reforms. In this paper, we try to find poverty reducing or socially improving tax reforms. Thus, we discuss the general sale tax (GST) in Jordan which features a value-added tax to replace the existing narrowly based consumption tax. As the tax reform in Jordan progressed, the GST coverage expanded over time. Initially, the GST replaced the consumption tax that was just levied on imported goods, domestic manufacturing sector output, and a few selected services. The basic rate was 7 percent in 1993. Then the basic rate increased gradually in the following ten years from 7 percent to 16 percent in 2003. The base of GST was also expanded to the sale of goods at retail level and a wider range of services. By the end of the tax reform program addressed by the IMF, the composition of the tax revenues had changed dramatically. The share of GST had risen from approximately one quarter at the beginning of the tax reform to over half in 2004, and GST had been the main source of the tax revenues. I will consider some hypothetical marginal tax reforms in Jordan

⁴ The reasons of the economic collapse were the unsustainable expansion of the public sector and the collapse of oil prices in the mid-1980s. Jordan is vulnerable to the price of oil indirectly through worker remittance inflows from Jordanian workers in oil-rich countries.

and test the impact of these tax reforms on poverty in Jordan.

In this paper, I use data from the “Household Expenditure and Income Survey 2002/2003” (HEIS 2002/2003). The HEIS is a nationally representative household survey. The sample consists of 9999 households. The questionnaire has information on household’s consumption. More details on the variables can be found in the Appendix A.

According to the last poverty assessment in Jordan published by the World Bank, the official poverty line is JD 392 per capita per year in Jordan. This will be used later in the empirical analysis.

V. The empirical analysis.

I will analyze four combinations of hypothetical tax reforms and test the impact of the implementation of these tax reforms on poverty. Based on the methodology we discussed above, and the variables from the HEIS 2002/2003, we could make some illustrations to test hypothetical marginal tax reforms on poverty under the budget neutrality. According to graphs of CD-curves, we could identify whether these hypothetical tax reforms improve the social welfare or reduce poverty. If so, it will demonstrate that these hypothetical tax reforms are worth implementing.

Figure 1 provides the rationale for the tax reform which includes the \overline{CD}^1 curve of food and the \overline{CD}^1 curve of transportation at different income levels when $\gamma=1$. Table 1 presents estimated critical poverty lines $\hat{z}_s(\gamma)$ at different levels of economic

efficiency ratios γ^5 , and different ethical orders s about the tax reform on food and transportation under a neutral budget. Since \overline{CD}^1 curves of food and transportation cross at $\hat{z}_1(1)=559.81$, with standard error of sampling distribution of the estimated critical poverty line $\hat{z}_s(\gamma)$ estimated to be 20.49, the 95% confidence interval for the estimated critical poverty line $\hat{z}_1(1)$ is $[519.72, 599.97]^6$. This implies that with unit economic efficiency ratio, if we were to select a poverty line below 519.72, we will be 95% certain that the tax reform, which subsidizes food expenditures by increasing tax on the transportation under a neutral budget, is first-order poverty-reducing. Since \overline{CD}^1 curves of food expenditure and transportation have an intersection, for any poverty line larger than the intersection with unit economic efficiency ratio, theorem II will not be satisfied. Thus the tax reform, which subsidizes the food expenditure by taxing the transportation under the budget neutrality, is not Pen-improving tax reform.

Figure 2 provides the rationale for the tax reform which presents the \overline{CD}^2 curve of food and the \overline{CD}^2 curve of transportation at different income levels when $\gamma=1$. There is no critical poverty line of the tax reform since \overline{CD}^2 curves of food and transportation do not cross. This implies that for any poverty line with unit economic efficiency ratio, the tax reform, which increases tax on transportation and decreases tax on food expenditure under the budget neutrality, is poverty reducing at the second order and is also Dalton-improving.

⁵ $\gamma_j=0.5$ means that the ratio of marginal economic efficiency cost of funds from taxing good j to the marginal economic efficiency cost of funds from taxing good l is 0.5.

$\gamma_j=1$ means that the ratio of marginal economic efficiency cost of funds from taxing good j to the marginal economic efficiency cost of funds from taxing good l is 1. I call it unit economic efficiency ratio.

$\gamma_j=1.5$ means that the ratio of marginal economic efficiency cost of funds from taxing good j to the marginal economic efficiency cost of funds from taxing good l is 1.5.

⁶ This confidence interval is calculated with level of significance $\alpha=0.05$ and t-ratio $t=1.96$.

Figure 3 presents the \overline{CD}^3 curve of food and the \overline{CD}^3 curve of transportation at different income levels when $\gamma=1$. Similarly, there is no critical poverty line of the tax reform since \overline{CD}^3 curves of food and transportation do not intersect. This implies that for any poverty line with unit economic efficiency ratio, the tax reform, which increases tax on transportation and decreases tax on food expenditure under the budget neutrality, is poverty reducing at the third order and is also Kolm-improving.

From Table 1, we can obtain estimated critical poverty lines $\hat{z}_s(\gamma)$ at different levels of economic efficiency ratios γ and different ethical orders s . When the economic efficiency ratio $\gamma=0.5$, we should make the \overline{CD} curve of transportation be multiplied by 0.5. Since there is no critical poverty line at the first order with $\gamma=0.5$, the tax reform, which increases tax on transportation and decreases tax on food expenditure, reduces poverty at the first order and is Pen-improving. Since there is no intersection of these two \overline{CD}^2 curves, this tax reform reduces poverty at the second order and is Dalton-improving. Similarly, \overline{CD}^3 curves of transportation and food expenditures do not have an intersection, which implies that, the tax reform at the third order with $\gamma=0.5$ is poverty reducing and Kolm-improving.

With $\gamma=1.5$, which means that we should make the \overline{CD} curve of transportation be multiplied by 1.5, we can obtain the estimated critical poverty line $\hat{z}_1(1.5) = 257.26$ with standard error $e=24.61$ since \overline{CD}^1 curves of transportation and food expenditure cross at per capita income level 257.26. The 95% confidence interval is [209.02, 305.50]. This implies that with $\gamma=1.5$, if we were to select a poverty line below 209.02,

we will be 95% certain that the tax reform, which subsidizes food expenditures by increasing tax on the transportation under neutral budget, reduces poverty at the first order. Since the \overline{CD}^1 curves of food expenditure and transportation have an intersection, this tax reform is not Pen-improving tax reform. Since \overline{CD}^2 curves of the transportation and food expenditures intersect at per capita income level 382.97, the estimated critical poverty line is $\hat{z}_2(1.5) = 382.97$ with standard error $e=33.61$. The 95% confidence interval is [317.09, 448.85]. This implies that with $\gamma=1.5$, if we were to select a poverty line below 317.09, we can be 95% certain that this tax reform under budget neutrality reduces poverty at the second order. This tax reform is not Dalton-improving since these two \overline{CD}^2 curves have an intersection. It is similar at the third order with $\gamma=1.5$. These two \overline{CD}^3 curves of transportation and food expenditure cross at per capita income level 527.26 which means that the estimated critical poverty line is $\hat{z}_3(1.5) = 527.26$ with standard error $e=67.26$, yielding a 95% confidence interval [395.43, 659.09]. This implies that if we were to select a poverty line under 395.43 with $\gamma=1.5$, we can be 95% certain that this tax reform under the budget neutrality reduces poverty. However, this tax reform subsidizing the food expenditure by taxing the transportation under a neutral budget is not Kolm-improving since \overline{CD}^3 curves have intersections.

If the Jordanian government increases tax on recreation and decreases tax on personal care under a neutral budget, what is the impact of this marginal tax reform on poverty? Table 2 presents estimated critical poverty lines $\hat{z}_s(\gamma)$ at different levels of economic efficiency ratios γ and different ethical orders s about the tax reform under

the budget neutrality. Figure 4 provides the rationale for the tax reform under a neutral budget at order $s=1$ and economic efficiency ratio $\gamma=1$. We can obtain the estimated critical poverty line $\hat{z}_1(1)=887.16$ with standard error of the sampling distribution of the estimated critical poverty line $\hat{z}_s(\gamma) e=57.16$. This is due to the fact that \overline{CD}^1 curves of personal care and recreation intersect at 887.16 with unit economic efficiency ratio at the first order. The 95% confidence interval is [775.13, 999.19]. This implies that with unit economic efficiency ratio, if we were to select a poverty line below 775.13, we can be 95% certain that the tax reform subsidizing personal care by taxing the recreation under the budget neutrality reduces poverty at the first order. Since \overline{CD}^1 curves of personal care and recreation have intersections, this tax reform, which increases tax on recreation and decreases tax on personal care, is not Pen-improving.

Figure 5 shows \overline{CD}^2 curves of personal care and recreation with unit economic ratio at the second order. The tax reform, which increases tax on recreation by decreasing tax on personal care under the budget neutrality, is poverty reducing since these two \overline{CD}^2 curves do not intersect. In addition, this tax reform is Dalton-improving for the same reason.

Figure 6 provides \overline{CD}^3 curves of personal care and recreation with unit economic efficiency ratio at the third order. Since these two curves never have an intersection, which satisfies Theorem I and Theorem II, the tax reform subsidizing the personal care by taxing on the recreation in Jordan is poverty reducing at the third order and is

Kolm-improving.

From Table 2, we can obtain estimated critical poverty lines $\hat{z}_s(\gamma)$ at different levels of economic efficiency ratios γ and different ethical orders s . With $\gamma=0.5$, which means that we make the \overline{CD} curve of recreation be multiplied by 0.5, we could obtain the estimated critical poverty line $\hat{z}_1(0.5)=1527.27$ with the standard error $e=17.54$. The 95% confidence interval of the estimated critical poverty line is [1492.89, 1561.65] with $\gamma=0.5$ at the first order. This implies that with economic efficiency ratio $\gamma=0.5$, if we were to select a poverty line below 1492.89, we can be 95% certain that the tax reform subsidizing the personal care by taxing on the recreation under the budget neutrality is poverty-reducing at the first order. Because of \overline{CD}^1 curves of personal care and recreation intersected, this tax reform under a neutral budget is not Pen-improving. At the second order, the tax reform is poverty reducing for any poverty line, which is due to the fact that \overline{CD}^2 curves of personal care and recreation do not cross. In addition, the tax reform subsidizing the personal care by increasing tax on recreation is Dalton-improving. At the third order with economic efficiency ratio $\gamma=0.5$, the tax reform reduces poverty since \overline{CD}^3 curves of personal care and recreation do not have an intersection. As a result, this tax reform under the budget neutrality is Kolm-improving.

When the economic efficiency ratio $\gamma=1.5$, we could obtain the estimated critical poverty line $\hat{z}_s(1.5)$ at different levels of per capita income and different ethical orders s . When at the first order, we could obtain the estimated critical poverty line

$\hat{z}_1(1.5)=327.90$ with the standard error of the sampling distribution of the estimated critical poverty line $e=41.93$, since \overline{CD}^1 curves of personal care and recreation cross at per capita income level 327.90. The corresponding 95% confidence interval is [245.72, 410.08]. This implies that we can be 95% certain that the tax reform decreasing the tax on personal care and increasing tax on recreation under the budget neutrality reduces poverty for any poverty line below 245.72. This tax reform is not Pen-improving, since these two \overline{CD}^1 curves have intersections. When at the second order, the estimated critical poverty line $\hat{z}_2(1.5)=453.50$ with standard error $e=41.93$, since \overline{CD}^2 curves of personal care and recreation have an intersection at the per capita income level 453.50. Then we could obtain a confidence interval for $\hat{z}_2(1.5)$ [371.32, 535.68]. The explanation is that the tax reform under the budget neutrality is poverty reducing at the second order for any poverty line below 371.32. Due to the fact that these two \overline{CD}^2 curves have intersections, this tax reform is not Dalton-improving. When at the third order, the estimated critical poverty line is 586.61 with standard error $e=92.53$ and so the 95% confidence interval is [405.25, 767.97] for the estimated critical poverty line $\hat{z}_3(1.5)$. Thus if we were to choose a poverty line under 405.25, the tax reform, which is to subsidize personal care by increasing tax on recreation, reduces poverty. In addition, this tax reform is not Kolm-improving with economic efficiency ratio $\gamma=1.5$, since \overline{CD}^3 curves of personal care and recreation have intersections.

What will be the impact of the tax reform on poverty if the Jordanian government decreases the tax on food expenditure and increases tax on cloth under a neutral

budget? The following analysis will answer this question. Table 3 provides estimated critical poverty line $\hat{z}_s(\gamma)$ at different levels of economic efficiency ratio γ and ethical orders s for the marginal tax reform subsidizing food expenditure by increasing tax on cloth under a neutral budget. According to Figure 7, \overline{CD}^1 curves of food expenditure and cloth cross at 551.58 with unit economic efficiency ratio at the first order which implies that we can be 95% certain that the tax reform under the budget neutrality reduces poverty for any poverty line below 495.76 at the first order and is not Pen-improving. Similarly, according to Figure 8, this tax reform under a neutral budget is poverty reducing and also Dalton-improving since these two \overline{CD}^2 curves of food and cloth do not intersect. Likewise, \overline{CD}^3 curves of the food expenditure and cloth never cross which implies that this tax reform is poverty reducing at the third order and is Kolm-improving.

When the economic efficiency ratio $\gamma=0.5$, this tax reform under the budget neutrality reduces poverty at the first order and is Pen-improving, since \overline{CD}^1 curves of the food expenditure and cloth do not intersect. Because of the same reason, this tax reform is poverty reducing for any poverty line and is Dalton-improving; is poverty reducing for any poverty line at the third order and is Kolm-improving.

With the economic efficiency ratio $\gamma=1.5$, because \overline{CD}^1 curves, \overline{CD}^2 curves and \overline{CD}^3 curves of the food expenditure and cloth are not intersected respectively in the three sub cases. This tax reform, which subsidizes food expenditure by increasing tax on food with economic efficiency ratio $\gamma=1.5$, is poverty reducing and Pen-improving,

Dalton-improving and Kolm-improving respectively.

If the Jordanian government subsidizes housing by increasing tax on supplies under the budget neutrality, what's the impact of such a marginal tax reform on poverty? Table 4 shows estimated critical poverty lines $\hat{z}_s(\gamma)$ at different levels of economic efficiency ratio γ and ethical orders s for this marginal tax reform under the budget neutrality. Based on Figure 10, we can draw the conclusion that for any poverty under 443.60, we could be 95% certain that this tax reform is poverty reducing at the first order with unit economic efficiency ratio and is not Pen-improving. Similarly, we conclude that if we were to select a poverty line below 569.89, we could be 95% certain that this tax reform reduces poverty at the second order and is not Dalton-improving. Based on Figure 12, it is easy to conclude that this tax reform is poverty reducing at the third order and is Kolm-improving.

When the economic efficiency ratio $\gamma=0.5$, we could be 95% certain that the tax reform is poverty reducing for any poverty line under 1800.34 at the first order and is not Pen-improving. For the second and third order, for any poverty line, the tax reform is poverty reducing. Also, it is Dalton-improving and Kolm-improving.

For the economic efficiency ratio $\gamma=1.5$, we could find that \overline{CD} curves of housing and supplies never have an intersection at all the three orders from Table 4. This implies that the tax reform decreasing tax on housing by increasing tax on supplies under the budget neutrality is poverty reducing for any poverty line at the first order and is Pen-improving; reduces poverty for any poverty line at the second order and is

Dalton-improving; and is poverty reducing for any poverty line at the third order and is Kolm-improving.

VI. Conclusion.

This major paper utilizes the Consumption Dominance curve and the critical poverty line to test the impact of marginal tax reform on poverty. We use the data from the Household Expenditure and Income Survey 2002/2003 to make an empirical analysis in Jordan. With these graphical tools we can choose the ethical order and the economic efficiency ratio for any additive poverty index and any social welfare function. We analyze some hypothetical marginal tax reforms to test whether these tax reforms are socially improving, which I summarize in Appendix B.

If the Jordanian government increases tax on transportation by subsidizing food expenditure under a neutral budget, this tax reform is socially improving at the second and third order with unit economic efficiency ratio; is socially improving at all the first three orders with economic efficiency ratio $\gamma=0.5$; is not socially improving at all the first three orders if the economic efficiency ratio $\gamma=1.5$.

If the government increases tax on recreation and decreases tax on personal care under budget neutrality, the tax reform is socially improving at the second and the third order with unit economic efficiency ratio; is socially improving at the second and the third order with economic efficiency ratio $\gamma=0.5$; is not socially improving at all the first three orders with economic efficiency ratio $\gamma=1.5$.

If the government increases tax on cloth by subsidizing food expenditure under a neutral budget, this tax reform is socially improving at the second and the third order with unit economic efficiency ratio; is socially improving at all the first three order with both economic efficiency ratio $\gamma=0.5$ and $\gamma=1.5$.

If the government increases tax on supplies and decreases tax on housing under a neutral budget, this tax reform is socially improving at the third order; is socially improving at the second and the third order with economic efficiency ratio $\gamma=0.5$; is socially improving at the all the first three orders with economic efficiency ratio $\gamma=1.5$.

Therefore, if the Jordanian government implements a tax reform which satisfies the conditions discussed above, it will be socially improving.

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Appendix A. Descriptions of variables used from the HEIS 2002/2003.

Variable	Description
yearly_income	the per capita annual income in Jordan Dinars which represents the standard living
hh_size	the numbers of members of a household in Jordan
weight	the weight the household should take in the sample
sweight	the sampling weight which is equal to the product of household size and the weight
personal_care	the personal expenditure on health or nutrition
transport_communication	the household expenditure on transportation
education	the households' expenditure on education
men_cloth	the household's expenditure on clothing for men
women_cloth	the household's expenditure on clothing for women
children_cloth	the household's cost on clothing for children
tailor_cost	the household's cost of clothing made by tailors in Jordan
footwear	the household's expenditure on footwear
furniture	the household's expenditure on furniture
appliance	the household's expenditure on appliance
utensils	the household's expenditure on utensils
clean_material	the household's expenditure on the materials for cleaning
yearly_exp_food	the yearly expenditure of each household on food
recreation	the household expenditure on amusement, personal collections, etc
cloth	the sum of "men_cloth", "women_cloth", "children_cloth", "tailor_cost" and "footwear" for each household representing the household's expenditure on clothing
supplies	the sum of "furniture", "appliance", "utensils" and "clean_materials" for each household representing the household expenditure on the house's supplies

Appendix B. Conclusions of tax reforms in Jordan.

B.1

increase tax on transportation and decrease tax on food expenditure

economic efficiency ratio γ	order s	Poverty reducing?	Welfare improving?
$\gamma=1$	s=1	if $z \leq 519.72$	not Pen-improving
	s=2	for any poverty line	Dalton-improving
	s=3	for any poverty line	Kolm-improving
$\gamma=0.5$	s=1	for any poverty line	Pen-improving
	s=2	for any poverty line	Dalton-improving
	s=3	for any poverty line	Kolm-improving
$\gamma=1.5$	s=1	if $z \leq 209.02$	not Pen-improving
	s=2	if $z \leq 317.09$	not Dalton-improving
	s=3	if $z \leq 395.43$	not Kolm-improving

B.2

increase tax on recreation and decrease tax on personal care

economic efficiency ratio γ	orders	Poverty reducing?	Welfare improving?
$\gamma=1$	s=1	if $z \leq 775.13$	not Pen-improving
	s=2	for any poverty line	Dalton-improving
	s=3	for any poverty line	Kolm-improving
$\gamma=0.5$	s=1	if $z \leq 1492.89$	not Pen-improving
	s=2	for any poverty line	Dalton-improving
	s=3	for any poverty line	Kolm-improving
$\gamma=1.5$	s=1	if $z \leq 245.72$	not Pen-improving
	s=2	if $z \leq 371.32$	not Dalton-improving
	s=3	if $z \leq 405.25$	not Kolm-improving

B.3

increase tax on cloth and decrease tax on food expenditure

economic efficiency ratio γ	orders	Poverty reducing?	Welfare improving?
$\gamma=1$	s=1	if $z \leq 495.76$	not Pen-improving
	s=2	for any poverty line	Dalton-improving
	s=3	for any poverty line	Kolm-improving
$\gamma=0.5$	s=1	for any poverty line	Pen-improving
	s=2	for any poverty line	Dalton-improving
	s=3	for any poverty line	Kolm-improving

$\gamma=1.5$	s=1	for any poverty line	Pen-improving
	s=2	for any poverty line	Dalton-improving
	s=3	for any poverty line	Kolm-improving

B.4

increase tax on supplies and decrease tax on housing

economic efficiency ratio $\gamma=1$	orders	Poverty reducing?	Welfare improving?
	s=1	if $z \leq 443.60$	not Pen-improving
	s=2	if $z \leq 569.89$	not Dalton-improving
$\gamma=0.5$	s=3	for any poverty line	Kolm-improving
	s=1	if $z \leq 1800.34$	not Pen-improving
	s=2	for any poverty line	Dalton-improving
$\gamma=1.5$	s=3	for any poverty line	Kolm-improving
	s=1	for any poverty line	Pen-improving
	s=2	for any poverty line	Dalton-improving
	s=3	for any poverty line	Kolm-improving

Appendix C. Tables and figures.

Table 1

Marginal Tax Reform For Food Expenditure Versus Transportation in Jordan			
Critical poverty line $z_s(\gamma)$ for different ratios of economic efficiency ratio γ and for different orders of dominance s			
	$\gamma=0.5$	$\gamma=1$	$\gamma=1.5$
$z_1(\gamma)$	–	559.81 (20.49)	257.26 (24.61)
$z_2(\gamma)$	–	–	382.97 (33.61)
$z_3(\gamma)$	–	–	527.26 (67.26)

Table 2

Marginal Tax Reform For Personal Care Versus Recreation in Jordan			
Critical poverty line $z_s(\gamma)$ for different ratios of economic efficiency ratio γ and for different orders of dominance s			
	$\gamma=0.5$	$\gamma=1$	$\gamma=1.5$
$z_1(\gamma)$	1527.27 (17.54)	887.16 (57.16)	327.90 (41.93)
$z_2(\gamma)$	–	–	453.50 (152.47)
$z_3(\gamma)$	–	–	586.61 (92.53)

Table 3

Marginal Tax Reform For Food Expenditure Versus Cloth in Jordan			
Critical poverty line $z_s(\gamma)$ for different ratios of economic efficiency ratio γ and for different orders of dominance s			
	$\gamma=0.5$	$\gamma=1$	$\gamma=1.5$
$z_1(\gamma)$	-	551.58 (28.48)	-
$z_2(\gamma)$	-	-	-
$z_3(\gamma)$	-	-	-

Table 4

Marginal Tax Reform For Housing Versus Supplies in Jordan			
Critical poverty line $z_s(\gamma)$ for different ratios of economic efficiency ratio γ and for different orders of dominance s			
	$\gamma=0.5$	$\gamma=1$	$\gamma=1.5$
z_1	185063 (25.66)	495.91 (26.69)	-
z_2	-	1076.22 (258.33)	-
z_3	-	-	-

Figure 1

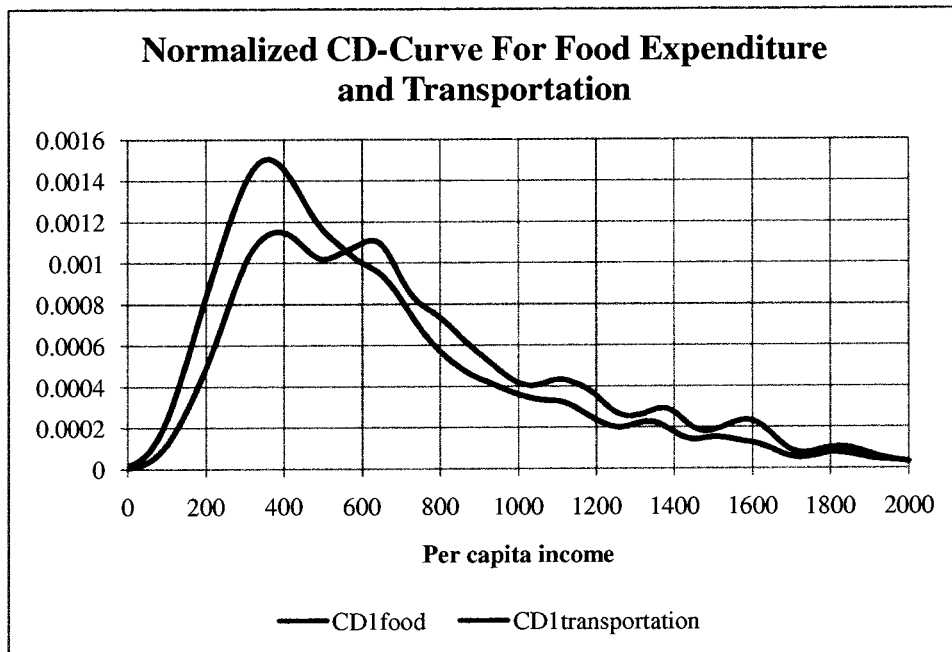


Figure 2

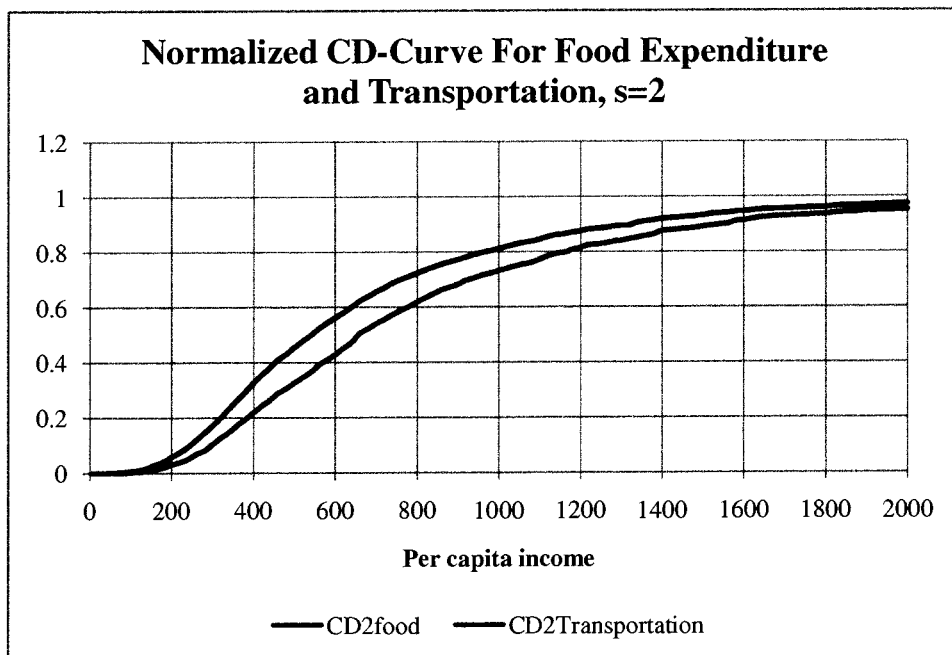


Figure 3

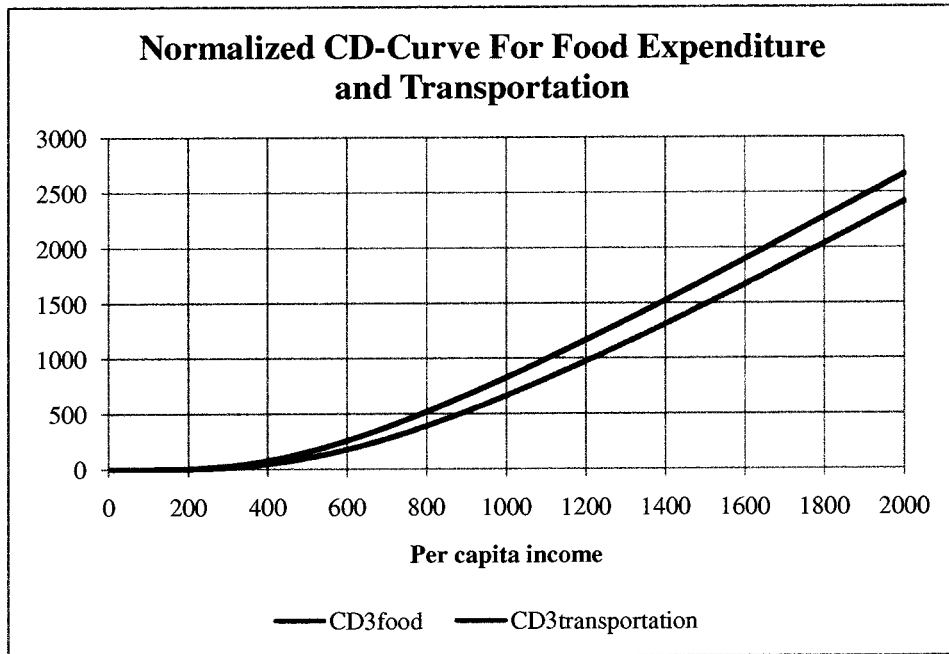


Figure 4

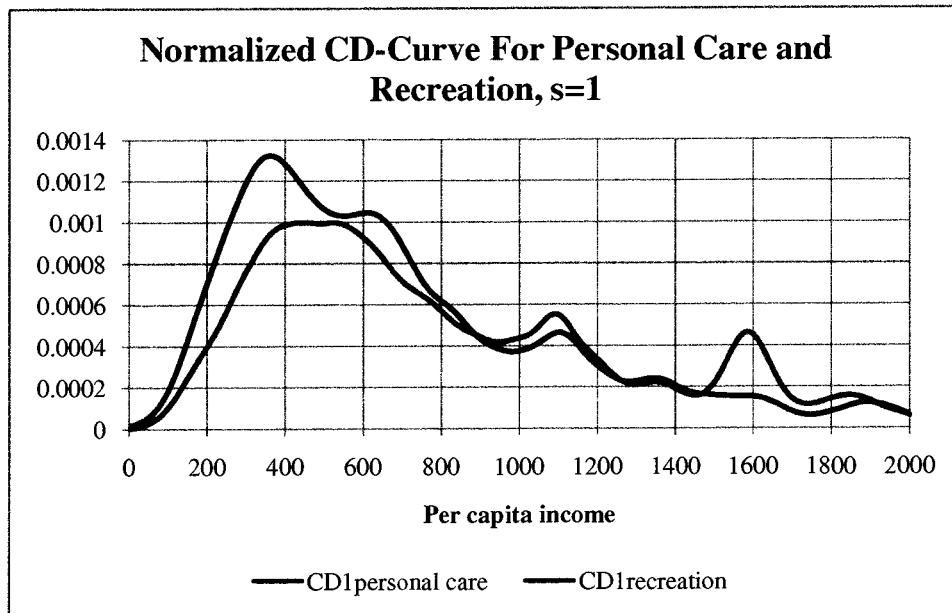


Figure 5

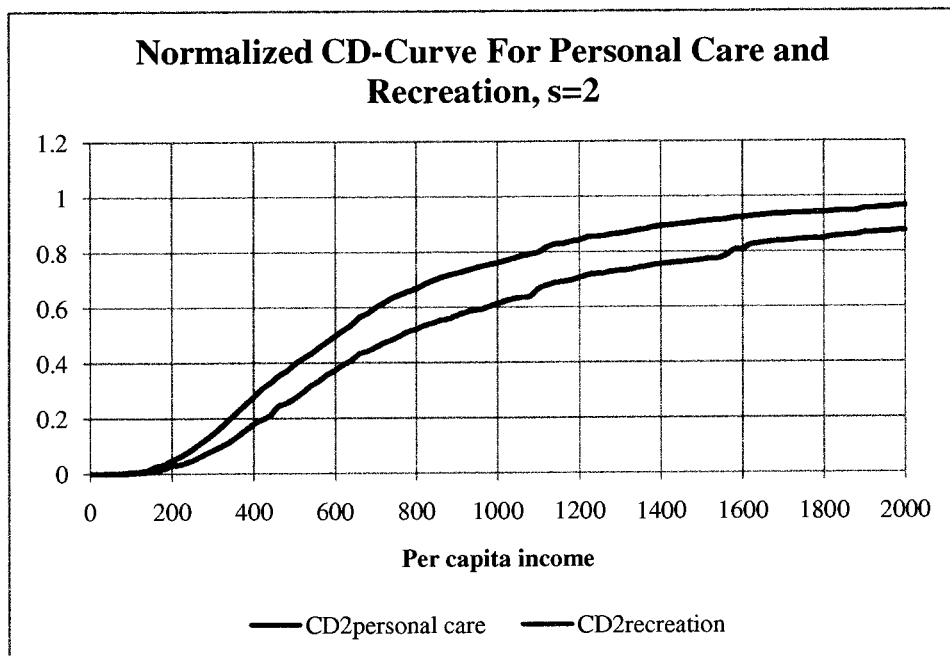


Figure 6

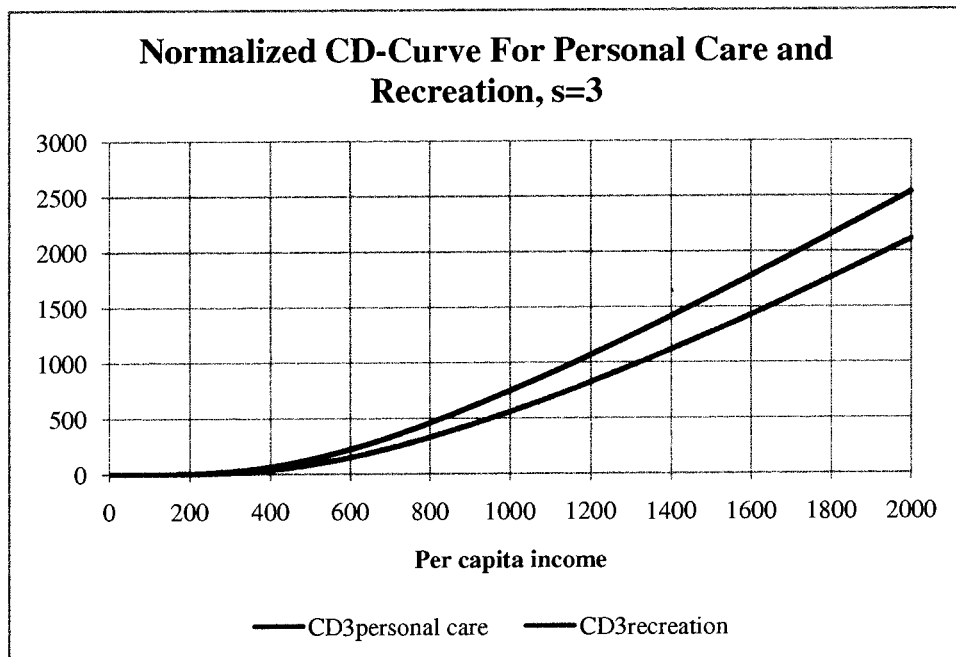


Figure 7

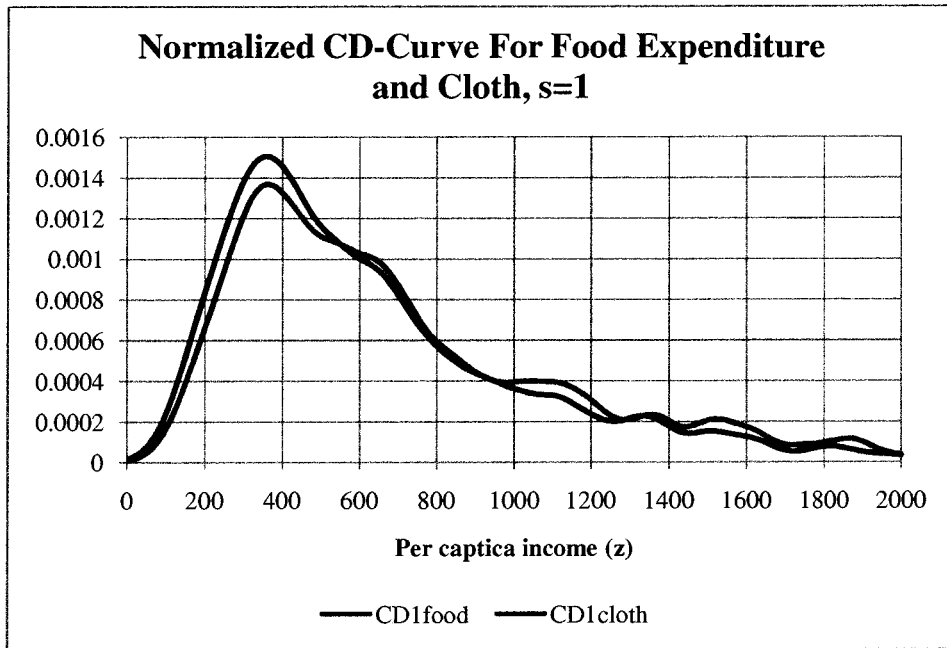


Figure 8

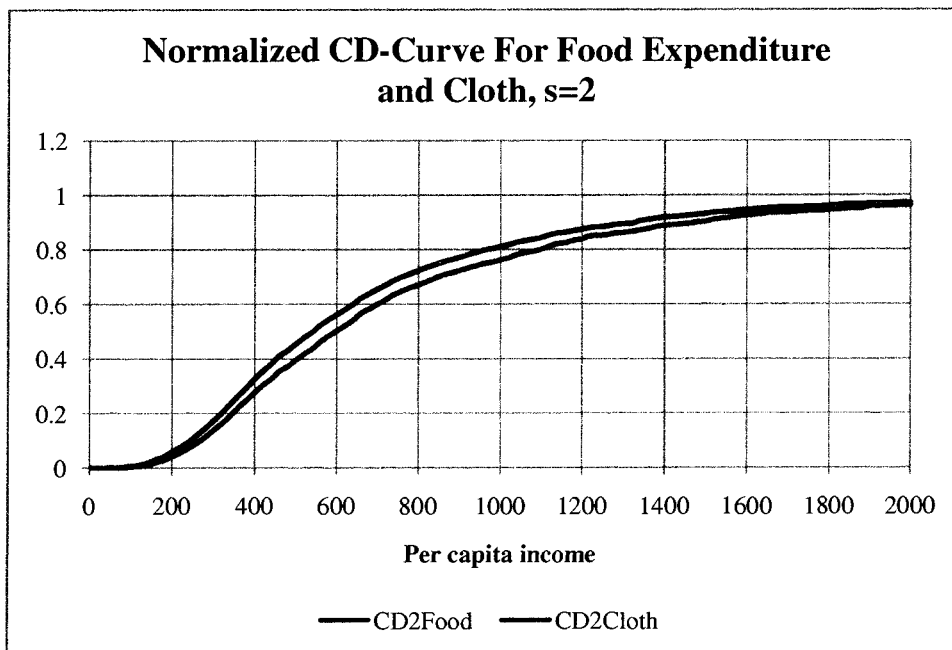


Figure 9

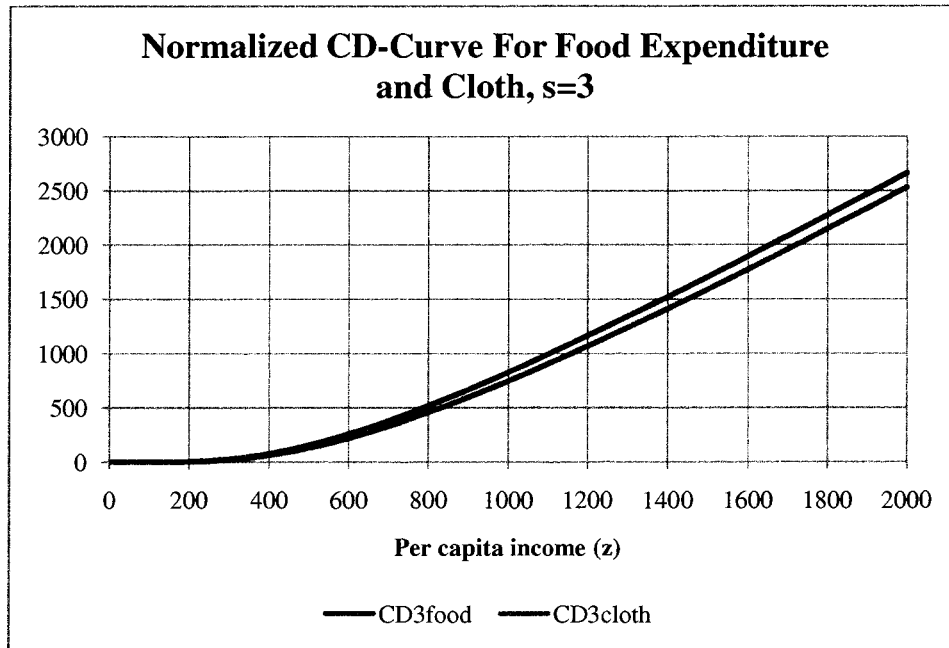


Figure 10

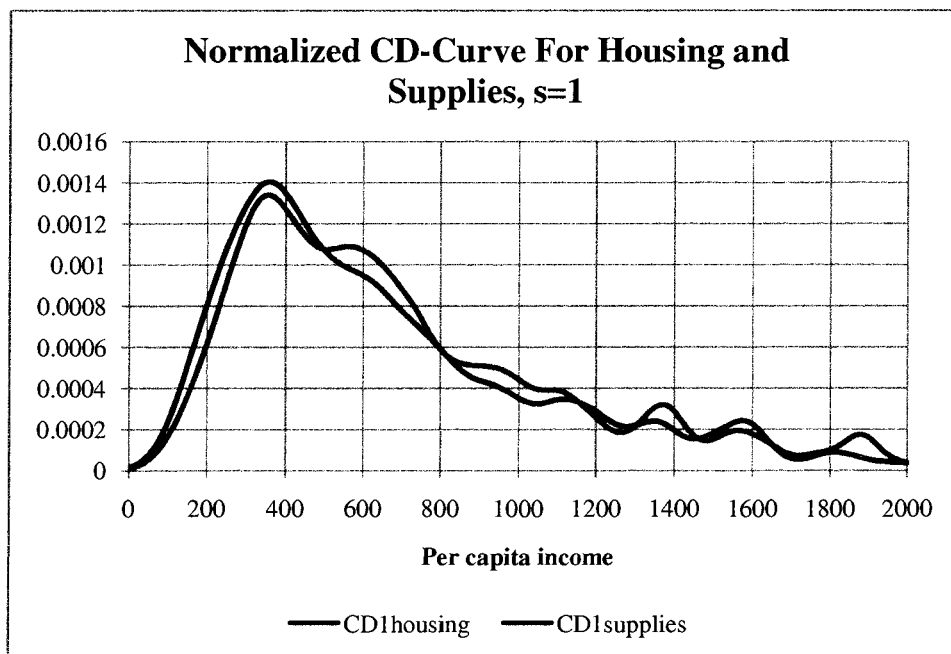


Figure 11

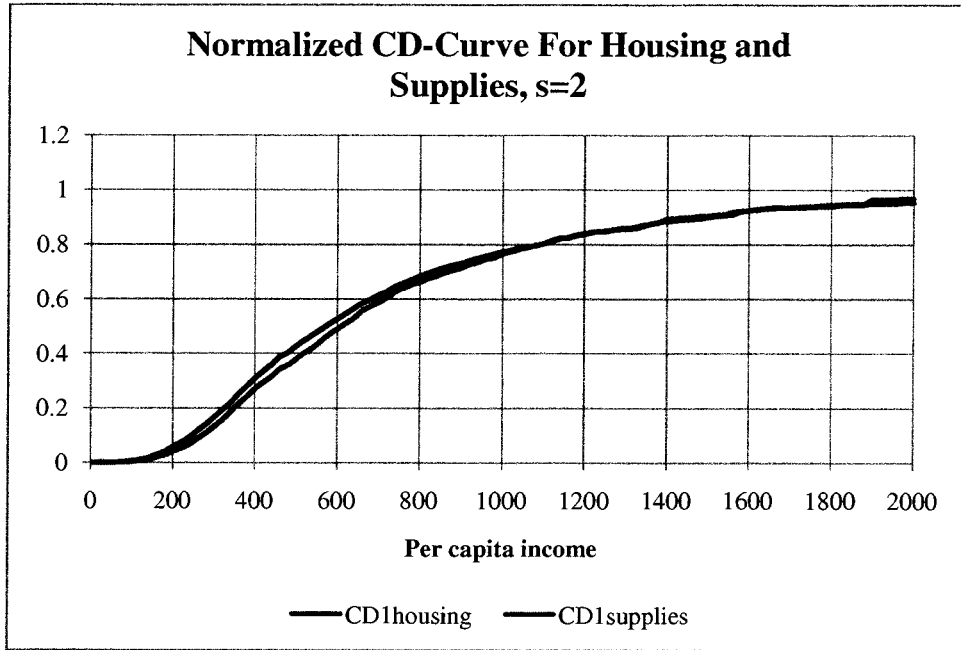


Figure 12

