

Indirect Tax Reform in Tajikistan

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Major Paper presented to the

Department of Economics at University of Ottawa

In partial fulfillment of the requirements of the M.A. Degree

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Ottawa, Ontario

March 2011

Abstract

The Normalized Consumption Dominance Curves (CD-curves), which were first derived by Makdissi and Wodon (2002), are used to test the impact of marginal tax reform on poverty under the budget neutrality. In this paper, I consider four combinations of hypothetical tax reforms to test whether these marginal tax reforms in Tajikistan are welfare-improving and poverty-reducing by using the dataset from Living Standards Measurement Survey, Tajikistan 2009. Based on my tests, it was proven that these four marginal tax reforms are socially improving under specific conditions.

Keywords: Normalized Consumption Dominance Curve, Poverty line, Indirect tax reform, Welfare-improving.

1. INTRODUCTION

The problem of coping with poverty reduction is an important priority for a country. This problem has contributed to the development of the National Poverty Reduction Strategy. In recent years several countries have contemplated reforms of their indirect tax system in order to reduce poverty or improve social welfare. An indirect tax reform denotes the taxation of consumption rather than income. This means that the proceeds of tax increasing on one good are used to subsidize another good. Tax reforms have a significant impact on household resource allocation and, by extension, household welfare. Also, there has been a debating subject of whether a balance-neutrality indirect tax reform could help the poor. Makdissi and Wodon (2002) first introduce the Consumption Dominance Curve (CD-curve) to test the indirect tax reform on poverty alleviation for any order of stochastic dominance. This is the theoretical foundation of this paper.

The primary objective of this paper is to test whether an indirect tax reform would reduce poverty and improve social welfare in Tajikistan by applying the CD-curve theorem introduced by Makdissi and Wodon (2002). To achieve the goal, I will draw the CD-curve for the different pairs of goods at different ethical orders. Based on the drawing, I will be able to derive the critical poverty line. Furthermore, I will compute the confidence interval for each critical poverty line to test whether the tax reform is poverty reducing or socially improving.

This paper is organized in the following manner. Section II reviews the literature on

the analysis of poverty and inequality, as well as theories that relate to the study of marginal tax reform. Section III describes the normalized CD-curves methodology to analyze the impact of the marginal tax reform on poverty. Section IV presents the background of poverty in Tajikistan and makes a brief description of the data. Section V analyzes the data in Tajikistan and reports the findings. Finally, Section VI offers concluding remarks.

2. LITERATURE REVIEW

2.1 Poverty Concept and Measurement

Poverty is defined conceptually as the inability to afford basic human needs such as food, clothing, and shelter. In an economics context, poverty is usually defined by some method of comparison, either on an individual or household basis, between income and consumption. There are three primary components to consider when constructing a poverty measure.

First of all, it is necessary to choose the related indicator and dimension of well-being. Second, one has to select a poverty line, that is, a threshold below which a given individual or household will be classified as poor. Finally, one has to select a poverty measure which is used for reporting for a population subgroup only or for the population as a whole.

Income and consumption are two popular indicators of well-being for individuals and households. However, if the information on consumption is detailed enough, it is the

better indicator for the following reasons:

1. Consumption exhibit less seasonality than income, especially in rural areas and agrarian societies where income may not be stable due to harvest cycle and where income is not completely monetized due to the fact that household consume their own production.
2. The data collection of household income may be incomplete due to unregistered business and cover up of income resource on account of distrust of the survey.
3. Consumption directly measures well-being whereas income is an implicit measure. Barriers may exist when converting income to consumption, such as access to markets and availability of goods and services to consume.
4. Household income is more vulnerable to short time fluctuations compared to household consumption.

For the reasons mentioned above, the consumption index is more reliable given its stability and scope over an extended period. Therefore, consumption per capita is the preferred measure of poverty in the analysis presented in this paper.

2.2 Inequality Concept and Measurement

Inequality is a broader concept than poverty in that it is defined over the entire population, not only below a certain poverty line. Poverty measures depend on the average level of income or consumption in a country and the distribution of income or consumption. Based on these two elements, poverty measures therefore focus on the

situation of those individuals or households at the bottom of the distribution.

The concept of poverty in developing countries usually refers to the inability of households to meet their basic needs. Although there are differences in terminology in the various regions of the world, one often says that a household is in extreme poverty if it cannot meet its basic food needs, while a household is said to be moderately poor if it can meet its food needs but not its nonfood needs. Yet for practical purpose, in a developing context, poverty can be considered an absolute concept. By contrast, inequality deals with the differences in well-being between households (or individuals), not with the level of well-being achieved by these households. Inequality measures capture how far households are from each other in terms of well-being. Indeed, most inequality measures do not depend on the absolute level of well-being achieved in a society. That is, income inequality measures typically do not depend on the mean income observed in a country. It is thus possible for two countries, one very rich and one very poor, to have the same level of income inequality.

Taking inequality into account when measuring social welfare is important because individuals and households do not assess their well-being only with respect to their own absolute levels of consumption or income. They also compare themselves to others. This implies that for any given level of mean income in a country, a high level of inequality reduces the overall level of social welfare. In other words,

independent of its impact on poverty---even if there is no poverty at all in a society---inequality has a negative impact on social welfare.

2.3 Theories Relating to Marginal Tax Reform

According to Santoro (2007), there are three main 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 Lewis (1996) who propose the Dalton improving social indirect tax reform. Makdissi and Wodon (2002) developed a new tool which can be used to test for the impact of an indirect tax on poverty for any order of restricted stochastic dominance. This method can verify whether the marginal tax reform is poverty reducing or socially improving. The third approach is utilized in this paper.

According to Makdissi and Wodon (2002), the authors set up two assumptions. The first is that there is an additive index of poverty, determined by a defined poverty line and income, which is zero for those with income above the poverty line and non-negative for all individuals. The second is that the poverty measure is required to be an s-time piecewise continuous differentiable function. The second assumption indicates that the tax reform is socially improving if a transfer holds the Pen principle at the first order; the tax reform is socially improving if the transfer respects the Pigou-Dalton principle at the second order; and it is socially improving if the transfer holds the Kolm principle at the third order. With respect to these crucial

assumptions, the authors define the consumption dominance curve (CD-curve), which can be used to test for stochastic dominance of any order. Furthermore, according to Makdissi and Wodon (2002), if the two CD-curves associated with this class of measure are not intersecting before the maximum poverty line, a tax reform will increase welfare for the class of poverty measure.

In comparison to their earlier paper, Duclos, Makdissi and Wodon (2008) recommend a new methodology to analyze the social improvement. In this article, they improve on the derivation of normalized consumption dominance curve. Besides, instead of selecting a social evaluation function, the authors define classes of social evaluation indices which incorporate increasingly stronger judgments on the significance of distributive issues in designing tax policy. The authors propose two assumptions on the practical social welfare functions and additive poverty indices. If both of them satisfy the two assumptions, one can present whether the reform is Pen-improving at the first order, Dalton-improvement at the second order and Kolm-improving at the third order, and so on by increasing the ethical order. Furthermore, they conclude the notion of the welfare improvement by comparing the economic efficiency ration of taxing good j relative to good 1 and the distributive benefit of taxing good j relative to taxing good 1. Duclos, Makdissi and Wodon (2008) try to compare the relationship between the economic critical poverty line and the efficiency ratio. They prove that as order increases, the efficiency ratio becoming less constraining will imply that the critical efficiency ration will increase. Then, they use the data to

illustrate how to take advantage of this new method to analyze the indirect tax reform on poverty in specific country.

3. THE METHODOLOGICAL FRAMEWORK

3.1 Notation and Definitions

In order to assess the impact of the tax reform on poverty and social welfare over a wide range of potential poverty indices and poverty line, Makdissi and Wodon (2002) try to use stochastic dominance techniques instead of choosing a specific poverty index and specific poverty line. This method relies on the comparison of consumption dominance curves (CD-curve).

For the purpose of reducing an additive index of poverty, this additive assumption is such that poverty indices can be expressed as

$$P(F, z) = \int_0^a P(y, z) dF(y) \quad (1)$$

where

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

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

and p must be selected to aggregate the different individuals' contributions to poverty. y is the equivalent income, and F is the cumulative income distribution based on $[0, a]$, z is the poverty line, that is, individuals earning less than this amount are identified as poor. The function $p(y, z)$ represents the contribution to total poverty made by an individual with income y .

In this paper, attention focuses on a wide spectrum of poverty indices instead of one particular poverty index. I regroup these additive indices into classes π^s , $s=1, 2, \dots$, of absolute poverty indices. These classes are defined by

$$\pi^s := \{P \mid p(y, z) \in C^s \text{ et } (-1)^i \frac{\partial^i p(y, z)}{\partial y^i} \geq 0 \forall i = 1, 2, \dots, s\} \quad (2)$$

where C^s represents the set of continuous functions that are s times piecewise differentiable on $[0, a]$.

Assume the first order class as $\pi^1(z)$, poverty indices weakly decline ($p^{(1)}(y, z) \leq 0$) whereas welfare indices weakly increase ($u^{(1)}(y) \geq 0$) when an individual's income at some given percentile grows without any changes on others. This class of indices is Paretian: increasing anyone's income cannot be bad for poverty. They are also symmetric: interchanging any two individuals' incomes leaves unchanged the poverty and social welfare indices. For poverty comparisons, one must check the distribution of living standards with the poverty range $[0, z]$. For simplicity, we will refer to first-order welfare-improving tax reform as "Pen-improving tax reform". This class can be described as:

$$\pi^1(z) = \left\{ p(z) \left| \begin{array}{l} p_y^1(y, z) \leq 0 \text{ when } y \leq z \\ z \leq z^+ \end{array} \right. \right\} \quad (3)$$

where $P_y^1(y, z)$ is the first derivative respect to y .

The second order class of indices belongs to the first order of class. Poverty indices are convex and welfare indices are concave. They must obey the Pigou-Dalton

principle of transfers¹: a mean-preserving transfer of income from a higher-income person to a lower-income one constitutes a social improvement, in the form of increasing social welfare or decreasing poverty. The second order welfare improving is denoted as “Dalton-improving tax reforms” by Mayshar and Yitzhaki (1995).

$$\pi^2(z) = \left\{ p(z) \left| \begin{array}{l} p(y,z) \in \pi^1 \\ p_y^2(y,z) \geq 0 \text{ when } y < z \\ y(z,z) = 0, \end{array} \right. \right\} \quad (4)$$

Similarly, the third order class of indices belongs to the second order class. Besides, the poverty indices must also be sensitive to favorable composite transfers, namely, that a beneficial Pigou-Dalton transfer within the lower part of the distribution, coupled with a reverse Pigou-Dalton transfer within an upper part of the distribution, without a changing in the distribution variance. The third order welfare improving tax reform is also called Kolm-improving tax reforms.

$$\pi^3(z) = \left\{ p(z) \left| \begin{array}{l} p(y,z) \in \pi^1 \\ p_y^3(y,z) \leq 0 \text{ when } y \leq z \\ p(y,z) = 0 \text{ and } p_y^1(y,z) = 0, \end{array} \right. \right\} \quad (5)$$

In conclusion, poverty indices belong to $\pi^s(z)$ if

$$(-1)^s P_y^s(y,z) \leq 0 \quad \text{And if } P^s(z,z)=0 \text{ for } i=0,1,2,\dots,s-2$$

As order s increases, we can use the generalized transfer principles of Fishburn and

¹ It implies that a mean-preserving transfer of income from a higher order individual to a lower order individual ranked by income construct a social improvement that will increase welfare or reduce poverty.

Willig (1984) to interpret the higher orders of dominance. This principle states that the larger the orders, the more the transfers that occur in the lower part of the distribution contribute to a reduction in poverty.

3.2 Budgetary Impact

Assume that the government's tax reform increases the tax rate (or decreases subsidy) on good j and uses the proceeds to reduce the tax rate (or to increase the subsidy) on good i . This process can maintain the commodity tax revenues level during a marginal tax reform.

Assume that the economy has K consumption goods. Let R represents the total income from the indirect tax reform. If the population consists of I individuals, then

$$R = I \sum_{k=1}^K t_k X_k \quad (6)$$

where X_k denotes the average consumption of the good K , and t_k states the tax rate on good k if $t_k > 0$ or the subsidy if $t_k < 0$. The impact of the indirect tax reform on total revenue is therefore:

$$dR = I \left\{ \left[X_i + \sum_{k=1}^K t_k \frac{\partial X_k}{\partial t_i} \right] dt_i + \left[X_j + \sum_{k=1}^K t_k \frac{\partial X_k}{\partial t_j} \right] dt_j \right\} \quad (7)$$

Revenue neutrality of the tax reform requires that $dR=0$. Integrating this into Equation (7) produces the following:

$$dt_j = -\gamma \left(\frac{X_i}{X_j} \right) dt_i \quad \text{Where} \quad \gamma = \frac{1 + \frac{1}{X_i} \sum_{k=1}^K t_k \frac{\partial X_k}{\partial t_i}}{1 + \frac{1}{X_j} \sum_{k=1}^K t_k \frac{\partial X_k}{\partial t_j}} \quad (8)$$

Wildasin (1984) interprets γ as the differential efficiency cost of raising one dollar of public funds by taxing the j th commodity and using the proceeds to subsidize the i th commodity. The numerator and denominator represent the inverse of the marginal economic efficiency cost of funds from taxing good i and j respectively. “The higher the value of γ_{ij} , the less economically efficient is taxing good j ” (Duclos Makdissi and Wodon, 2008). According to Yitzhaki and Thirsk (1900) and Yitzhaki and Slemrod (1991), it is impossible to have a second order dominant reform if γ is larger than 1 due to the increasing deadweight loss caused by fiscal reform. Nevertheless, in a poverty reduction framework, it is possible to have a second order dominant reform or even higher orders if the loss cost is supported by the non poor.

3.3 Impact on Poverty

With a marginal tax reform for two goods i and j , the change of share in poverty for an individual with an income of y is

$$dP(y, z) = \frac{\partial p(y, z)}{\partial y} \frac{\partial y}{\partial t_i} dt_i + \frac{\partial p(y, z)}{\partial y} \frac{\partial y}{\partial t_j} dt_j \quad (9)$$

By using Roy (1947)’s identity and assuming that the vector of reference prices, which is used for counting equivalent revenue, as the vector of prices before the reform. Besley and Kanbur (1988) show that the change in equivalent income

produced by a marginal change in the tax rate if good k is

$$\frac{\partial y}{\partial t_k} = -x_k(y) \quad (10)$$

where $x_k(y)$ is the Marshallian demand for good k with the current price vector

This equation shows that observed pre-reform consumption of good k, which is a sufficient statistic, shows the impact on consumer welfare of a marginal change in the price of good k.

Using Equations (8) and (10) into Equation (9), the following is obtained:

$$dP(y, z) = -\frac{\partial p(y, z)}{\partial y} \left[\frac{x_i(y)}{x_i} - \gamma \frac{x_j(y)}{x_j} \right] X_i dt_i \quad (11)$$

In order to get the reform's impact on poverty, Equation (11) is integrated:

$$dP(F, z) = -X_i dt_i \int_0^y \frac{\partial p(y, z)}{\partial y} \left[\frac{x_i(y)}{X_i} - \gamma \frac{x_j(y)}{X_j} \right] dF(y) \quad (12)$$

We know that dt_i is negative and $\frac{\partial p(y, z)}{\partial y} \leq 0$ for all income levels, than there will be

a poverty alleviation when $\left[\frac{x_i(y)}{X_i} - \gamma \frac{x_j(y)}{X_j} \right]$ is positive.

We now introduce the concept of the Consumption Dominance Curve or CD-Curve of order s. Makdissi and

$$CD_k^s(y) = \begin{cases} \frac{x_k(y)}{x_k} \cdot f(y) & s = 1 \\ \int_0^y CD_k^{s-1}(u) du & s > 1 \end{cases} \quad (13)$$

We start with $s=1$ and define $CD_k^1(y) = \frac{x_k(y)}{X_k} \cdot f(y)$, which is the ratio of

consumption of good k for an individual with income y divided by the aggregate consumption of the good k or the aggregate consumption of good k times the density of income at y .

Next, we define $CD_k^2(y) = \int_0^y CD_k^1(u)du$ for $s \geq 2$, which indicates the share of total consumption of good k for the individuals whose income is less than y .

Using equation (13) into (12), the following is obtained:

$$dP(F, z) = -X_i dt_i \int_0^y \frac{\partial p(y, z)}{\partial y} [CD_i^1(y) - \gamma CD_j^1(y)] dy \quad (14)$$

It is clear that X_i is positive, dt_i is negative and $\frac{\partial p(y, z)}{\partial y}$ is negative. $dP(F, z) \leq 0$,

based on $[CD_i^1(y) - \gamma CD_j^1(y)] \geq 0$. This is the first order of dominance curve.

Similarly, the s order of dominance curve can be obtained:

$$dP(F, z) = -X_i dt_i \int_0^y \frac{\partial p(y, z)}{\partial y} [CD_i^s(y) - \gamma CD_j^s(y)] dy \quad (15)$$

Obviously, the CD-curve method can be used to test dominance for any order.

Turning to the application of normalized CD-curves to evaluate the socially improving tax reforms, Duclos, Makdissi and Wodon (2008) present the following two theorems to show CD-curve is an instrument capable of testing whether marginal tax reforms are poverty reducing or welfare improving.

Theorem I (Duclos, Makdissi and Wodon 2008): A necessary and sufficient condition

for a marginal tax reform, $dt_j = -\gamma \left(\frac{x_i}{x_j}\right) dt_i > 0$, to be s order poverty reducing, that is

to say, to decrease poverty weakly for all $P(F, z) \in \pi^s, s \in \{1, 2, 3, \dots\}$ and for all $Z < z^+$, is that $CD_i^s(y) - \gamma CD_j^s(y) \geq 0, \forall y \leq z^+$.

Theorem II (Duclos, Makdissi and Wodon 2008): A necessary and sufficient condition for a marginal tax reform, $dt_j = -\gamma \left(\frac{x_i}{x_j}\right) dt_i > 0$, to be s order welfare improving, that is, to increase social welfare weakly for all $W \in \pi^s$ and for a given $s \in \{1, 2, 3, \dots\}$ is that $CD_i^s(y) - \gamma CD_j^s(y) \geq 0, \forall y \in [0, \infty]$, where γ is the economic efficiency ratio mentioned before.

Theorem I provides the welfare-increase criterion and Theorem II gives a condition to identify poverty-reducing. The social-welfare test extends over the entire space $[0, \infty)$ in Theorems I, whereas the poverty test is limited to the range of potential poverty lines $[0, z^+]$ in Theorems II. This is an only difference between the social improvement conditions of Theorems I and Theorems II.

For $\gamma=1$, if the normalized CD-curve of good i and the normalized CD-curve of good j do not intersect at order $s=1, s=2, s=3$, the tax reform is regarded as poverty-reducing at order $s=1, s=2, s=3$ respectively. That is to say, the indirect tax reform will improve social welfare at a given order of dominance if the CD-curve of good i is above the CD-curve of good j for every income level under poverty line; if the two CD-curves intersect but the first intersection lies above the critical poverty line, the marginal tax reform will still be welfare-increasing at order $s=1, s=2, s=3$ respectively.

If the CD-curve of good i and the CD-curve of good j do not intersect at order $s=1$, $s=2$, $s=3$ under any poverty line, the tax reform is regarded as welfare improving.

For $\gamma \neq 1$, in order to identify a welfare-increasing tax reform, one needs to multiply the CD-curve of good j by the economic efficiency ratio, then compare it with the normalized CD-curve of good i , then the left steps for measurement will be similar with the situation where $\gamma=1$.

For $\gamma > 1$, according to Duclos, Makdissi and Wodon (2008), they show that if the efficiency cost is paid by the household with income higher than the poverty line, the tax reform is still an efficient instrument for poverty-reducing.

3.4 Critical Efficiency Ratio and Critical Poverty

According to Theorem I and Theorem II given by the Duclos, Makdissi and Wodon (2008), suppose a given value of $\gamma = \gamma^+$ such that $CD_i^s(y) - \gamma CD_j^s(y) \geq 0, \forall y \leq z^+$, there will be a critical value of γ for all $z \in [0, z^+]$, beyond which the equation will not hold, there are two ways followed. One may improve the order of dominance until a sturdy assessment is attained over the initially specified range $[0, z^+]$. This critical efficiency ratio is mathematically defined by

$$\gamma^s(z^+) = \sup\{\gamma \mid CD_i^s(y) - \gamma CD_j^s(y) \geq 0, \forall y \in [0, z^+]\}.$$

One may alternatively estimate an upper critical bound z^s for a range $[0, z^s]$ of poverty

lines that does not extend to z^s . Similarly, a critical value of poverty line $z^s(\gamma^+)$ can be formally defined by

$$z^s(\gamma^+) = \sup\{z \mid CD_i^s(y) - \gamma CD_j^s(y) \geq 0, \forall y \in [0, z^+]\}.$$

This specific stochastic dominance test is valid at the value of $z^s(\gamma)$, which is the maximum poverty line.

According to Duclos, Makdissi and Wodon (2008), For a given γ^+ and z^+ , $z^s(\gamma^+)$ and $\gamma^s(z^+)$ respectively give the critical upper poverty line and the critical economic efficiency ratio up to which the tax reform is necessarily s-order poverty improving.

4. EMPIRICAL ILLUSTRATION

4.1 An Overview of Poverty in Tajikistan

Tajikistan became a Soviet Republic in the early 20th century. As a part of the Soviet Union, Tajikistani infrastructure and living standards lagged behind those of other Soviet Republics. After independence in 1991, the economy collapsed due to a combination of civil war and localized natural disasters. After the end of the civil war in 1997, the government's pursuit of transition to a market economy through controlling inflation, privatization, financial sector restructuring and transfer of land to the private sector led to economic stabilization in the early 2000s. GDP per capita doubled from 2000 to 2005, and real GDP growth averaged 7 percent per year for the 2005 to 2009 period. The level of poverty decreased from 64 percent in 2003 to 39.6

percent in 2009. In 2009, economic growth slowed to 3.4 percent as falling global demand for aluminum and cotton Tajikistan's key export commodities, hit the export sector hard.

4.2 Data

I use the Tajikistan 2009 Living Standards Measurement Survey of The World Bank, which is a representative national survey that contains consumption modules for 1,500 households. The Living Standards Measurement Study is a research project which is designed to assist policy makers in their efforts to identify how policies could be designed and improved to positively affect outcomes in health, education, economic activities, housing and utilities, etc.

The first step of reorganizing the dataset is to have the variables of interest including component variables and living standard index. Component variables are used to be tested during the hypothetical tax reform. In this paper, the change of per capita consumption (which is better measured than per capita income) brought by a marginal tax reform is a primary subject for evaluation. More specifically, the variables include "Per capita food consumption"; "Per capita non-food consumption"; "Per capita expenditures on education"; "Per capita expenditures on health"; "Per capita expenditures on utility". These variables are already available in the original dataset. We denote these variables by "food", "non-food", "educ", "health", "util" respectively. Dividing per capita consumption by the official poverty line of 195 Tajikistan pounds

per month generates a new variable “ls”, which denotes the living standard. As a result, a level of normalized total expenditures equal to one represents the poverty line. Another new variable “sv”, which represent the statistical weight that will be used in our estimations, is generated by multiplying household size and household weight²

4.3 Empirical Analysis

With the adjusted dataset and the methodology provided in section III, we will test and evaluate the impact of a marginal tax reform for different cases in Tajikistan.

The first comparison is between food and non-food. Consider a marginal tax reform that increase the tax rate on non-food commodities and increase subsidy on food commodities. Figure 1³ represents the Normalized CD-curves for food and non-food with $s=1$ and $\gamma=1$. We can see that the two CD^1 curves intersect at $z^1(1) = 1.3744$, which is the estimated critical values of poverty line $z^1(\gamma)$ for $\gamma=1$ shown in Table 1. The standard error of $z^1(1)$ is estimated to be 0.0623. Thus, a 95% confidence interval for the estimated critical poverty line $z^1(1)$ with level of significance $\alpha=0.05$ and t-ratio=1.96 is [1.2523, 1.4965]. That is to say, under 95% confidence level, increasing the tax on non-food and using the proceeds to decrease the tax on food will reduce poverty for poverty line equal or less than 1.2523 times the official poverty line if $\gamma=1$.

² The household weight for a particular household is the inverse of its household selection probability multiplied by the inverse of the household response rate of its household response rate group.

³ All figures are shown in the Appendix

On the other hand, the two curves cross in Figure 1, this means that Normalized CD-curve for food is not everywhere above Normalized CD-curve for non-food. Therefore, Theorem II is not satisfied. Another word, the marginal tax reform is not first-order welfare improving or, Pen-improving tax reform.

For ethical order $s=2$, CD^2 curves for food and non-food do not intersect. There is no critical value for $z^2(\gamma^+)$ when $\gamma=1$ shown in Table 1. Therefore, assuming that poverty index and social welfare index are monotonic, symmetric and averse to inequality, increasing the tax on non-food commodities and providing subsidies for food expenditures will reduce poverty for any poverty index as well as increase social welfare for any social welfare index at the second order. At the third order with economic efficiency equal to 1, no poverty line is obtained, therefore, marginal tax reform would have similar effects as outlined above, without any limitation on a critical upper poverty threshold value. Moreover, this marginal tax reform is Dalton-improving and Kolm-improving at the second order and the third order respectively.

Now consider an economic efficiency ratio γ equal to 0.5. From Table 1, the two first-order CD-curves for food and non-food intersect at $z^1(0.5) = 3.2096$, with a standard error estimated to be 0.1400. The 95% confidence interval for $z^1(0.5)$ with level of significance $\alpha=0.05$ and t-ratio=1.96 is [2.9352, 3.4839]. It means that an indirect tax reform will reduce poverty up to a poverty line of 2.9352 at the first

order. Besides, the marginal tax reform is not first order welfare-improving or Pen-improving because the Normalized CD-curve for food is not everywhere above the Normalized CD-curve for non-food. For ethical order $s=2$, according to the Figure 4, there is no critical poverty line as CD^2 curves for food and non-food do not intersect. CD^2 Curve for food is everywhere above CD^2 Curve for non-food. Therefore, marginal tax reform is both poverty-reducing and welfare-improving for any poverty line. Similarly, for order $s=3$, the marginal tax reform is poverty-reducing and welfare-improving without any limitations on critical value of poverty line. Therefore, the indirect marginal tax reform is Dalton-improving at the second order and Kolm-improving at the third order with an efficiency ratio γ equal to 0.5.

With an economic efficiency ratio equal to 1.5, the two first-order CD-curves for food and non-food cross at 0.6633 with an estimate standard error 0.0352 (shown in Table 1). The 95% confidence interval for $z^1(1.5)$ with level of significance $\alpha=0.05$ and t-ratio=1.96 is [0.5944, 0.7323]. This result states that an increase of taxes on non-food and using the proceeds to increase subsidy on food commodities would reduce poverty for poverty line equal or less than 0.5944 times the official poverty line. Also, the marginal tax reform is not first-order welfare improving or Pen-improving tax reform since the two curves intersect. For order $s=2$, Figure 4 shows the Normalized CD-curve for food is not everywhere above the Normalized CD-curve for nonfood when $\gamma=1.5$. They have an intersection at 0.9221 with an

estimate standard error 0.0927 shown in Table 1, The 95% confidence interval for $z^2(1.5)$ with level of significance $\alpha=0.05$ and t-ratio=1.96 is [0.7406, 1.1038]. For any poverty line between 0 and 0.7406, increasing the tax on non-food and using the proceeds to reduce the tax on food will reduce poverty. However, the tax reform is not Dalton-improving as the two CD-curves intersect for $s=2$. For $s=3$, the two CD^3 curves for food and non-food cross at 1.2545 with an estimate standard error 0.1383, The 95% confidence interval for $z^3(1.5)$ with level of significance $\alpha=0.05$ and t-ratio=1.96 is [0.9833, 1.5257]. It means that poverty will be reduced by the tax reform for all poverty indices below the lower bound of the confidence interval. However, the tax reform is not Kolm-improving as the two CD-curves intersect for $s=3$.

The second case focuses on utility and education. Consider a marginal tax reform that increase the tax rate on education and increase subsidy on utility when $\gamma=1$. According to Table 2, the two first-order CD-curves for utility and education cross at 1.5596 with an estimate standard error 0.0472. Thus, the 95% confidence interval for $z^1(1)$ with level of significance $\alpha=0.05$ and t-ratio=1.96 is [1.4670, 1.6521]. Increasing the tax on education and using the proceeds to increase subsidy on utility will reduce poverty for any poverty index that is monotonic and symmetric. Figure 5 shows the Normalized CD-curves for utility and education when $s=1$. Since the two curves intersect, Theorem II is not satisfied. That is, the marginal tax reform for utility and education is not first-order welfare and improving tax reform.

For ethical order $s=2$ and $s=3$, from Figure 6 and Figure 7, the two second-order and the third-order CD-curves for utility and education do not intersect. And there are no critical values for $z^2(1)$ and $z^3(1)$ in Table 2. This result states that the marginal tax reform is both poverty-reducing and welfare-improving at the second and third order for any poverty line. Moreover, this indirect marginal tax reform is Dalton-improving and Kolm-improving.

Now consider an economic efficiency ratio γ equal to 0.5. The first-order CD-curves for utility and education have an intersection at 3.2096 with an estimate standard error 0.1400 (shown in Table 2). The 95% confidence interval for $z^1(0.5)$ with level of significance $\alpha=0.05$ and t-ratio=1.96 is [2.9352, 3.4839]. If the poverty line is assigned below 2.9352, increasing the tax on education while providing subsidies for utility will be first-order poverty reducing. For $s=2$ and $s=3$, there are no critical values for $z^2(0.5)$ and $z^3(0.5)$ in Table 2. From Figure 8, the second-order Normalized CD-curves for utility is everywhere above the Normalized CD-curves for education when $\gamma=0.5$. Therefore, for any poverty line, the indirect marginal tax reform of subsidizing utility by increasing tax on education is Dalton-improving and Kolm-improving.

Increasing the economic efficiency ratio γ to 1.5, there is a critical value $z^1(1.5)=5.3677$ with an estimate standard error 0.0174 in Table 2. The 95% confidence interval for $z^1(1.5)$ with level of significance $\alpha=0.05$ and t-ratio=1.96 is

[5.3335, 5.4019]. Likewise, if the poverty line is assigned below 5.3335, this indirect tax reform will be first-order poverty-reducing. Also, the marginal tax reform is not first-order welfare improving or Pen-improving tax reform since the two curves intersect. For order $s=2$ and $s=3$, there are no critical values for $z^2(1.5)$ and $z^3(1.5)$ in Table 2 and there is no intersection for the second order Normalized CD-curves for utility and education when $\gamma=1.5$ in Figure 8. Therefore, the marginal tax reform is both poverty-reducing and welfare-improving at the second and third order for any poverty line.

The third comparison is between utility and health, Consider a marginal tax reform that increase the tax rate on health and increase subsidy on utility when $\gamma=1$. there is a critical value $z^1(1)=1.1207$ with an estimate standard error 0.5613 in Table 3. Likewise, if the poverty line is assigned below 0.0204 (assuming a 95% interval), a marginal tax reform would be poverty-reducing at the first order. For order $s=2$ and $s=3$, the Normalized CD-curve for utility is everywhere above the Normalized CD-curve for health in Figure 10 and Figure 11. And there are no critical values for $z^2(1)$ and $z^3(1)$ in Table 3. Therefore, the indirect marginal tax reform is Dalton-improving and Kolm-improving for any poverty line.

For economic efficiency ratio $\gamma=0.5$, an intersection of CD-curves for utility and health occurs at $z^1(0.5)=2.6758$ with an estimate standard error 0.0556. The marginal tax reform will reduce poverty up to a poverty line of 2.5670 (assuming a

95% interval) at the first order. For $s=2$ and $s=3$, there are no critical values for $z^2(0.5)$ and $z^3(0.5)$ in Table 3. And CD-curve of utility is everywhere above the CD-curve of health in Figure 12. Therefore, the marginal tax reform is welfare-improving at the second and third order.

For economic efficiency ratio $\gamma=1.5$, from Table 3, $z^1(1.5) = 0.8133$ with an estimate standard error 0.0999. If the poverty line is assigned below 0.6174 (assuming a 95% interval), the marginal tax reform is poverty-reducing at the first order. Moreover, there are critical values $z^2(1.5) = 0.4460$ and $z^3(1.5) = 1.2732$ with estimate standard errors 0.0670 and 0.3715 respectively. It means that poverty will be reduced for all poverty indices below the lower bound of the confidence interval for $s=2$ and $s=3$. However, the tax reform is not Dalton-improving and Kolm-improving as the two CD-curves intersect.

The last comparison is between education and health, Consider a marginal tax reform that increase the tax rate on health and increase subsidy on education. There is a critical value $z^1(1) = 0.8850$ with an estimate standard error 0.0688 in Table 4. Similarly, the marginal tax reform will reduce poverty up to a poverty line of 0.7501 (assuming a 95% interval) at the first order. The marginal tax reform is not first-order welfare and improving tax reform because two curves intersect in Figure 13. For $s=2$, there is a critical value in Table 4 and CD-curve for education is not everywhere above the CD-curve for health. Thus, the tax reform is not

Dalton-improving. Moreover, the tax reform is Kolm-improving for $s=3$.

For economic efficiency ratio $\gamma=0.5$, from Table 4, $z^1(0.5) = 3.9491$ with an estimate standard error 0.0661. If the poverty line is assigned below 3.8195 (assuming a 95% interval), the marginal tax reform is poverty-reducing at the first order. For $s=2$ and $s=3$, the tax reform is Dalton-improving and Kolm-improving as the two CD-curves do not intersect.

For economic efficiency ratio $\gamma=1.5$, from Table 4, there are critical values $z^1(1.5) = 0.3231$, $z^2(1.5) = 0.4082$ and $z^3(1.5) = 0.5604$ with estimate standard errors 0.1445, 0.0826 and 0.2236 respectively. Welfare will be increased by the tax reform for all poverty indices below the lower bound of the confidence interval for $s=1, 2$ and 3 respectively. And the tax reform is not Pen-improving, Dalton-improving and Kolm-improving.

5. CONCLUSION

In this paper, four hypothetical marginal tax reforms are analyzed using normalized consumption dominance curve with different ethical orders and different critical values. Conditions for poverty reduction and welfare improvement were illustrated in the empirical work. It can be concluded that the appropriate taxation strategies in Tajikistan would be to increase tax on non-food to subsidize food, increase tax on education or health to subsidize utility, and increase tax on health to provide subsidy

on education.

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Appendix

Table 1

Indirect Marginal Tax Reform for Food and Non-food

Critical poverty line $z^s(\gamma^+)$ for different economic efficiency cost γ and			
for different order s			
	$\gamma=0.5$	$\gamma=1$	$\gamma=1.5$
$z^1(\gamma)$	3.20957017 (0.13998207)	1.37440264 (0.06231027)	0.66333997 (0.03516586)
$z^2(\gamma)$	---	---	0.92217666 (0.09265142)
$z^3(\gamma)$	---	---	1.25450635 (0.13837014)

Figure 1

Normalized CD Curves for Food and Non-food ($s=1, \gamma=1$)

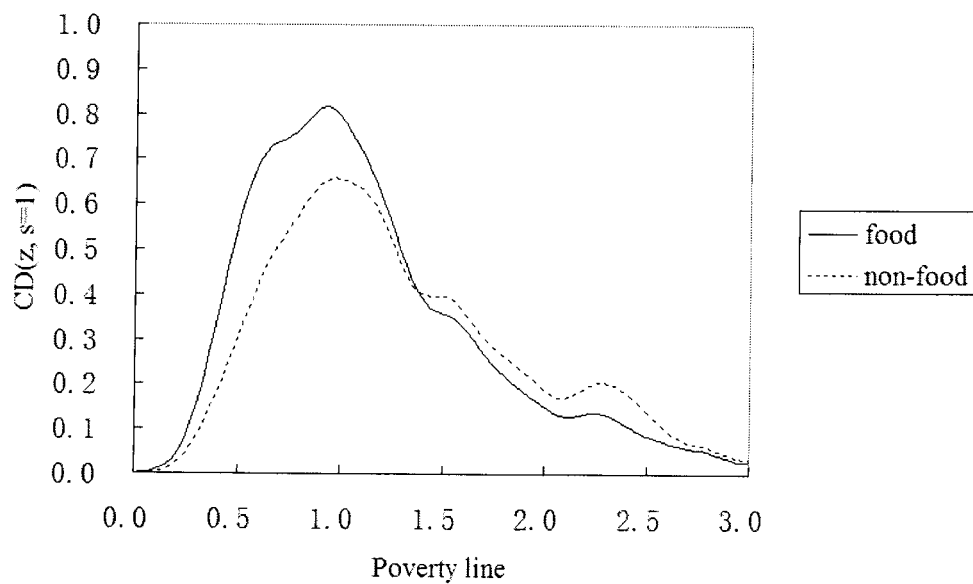


Figure 2

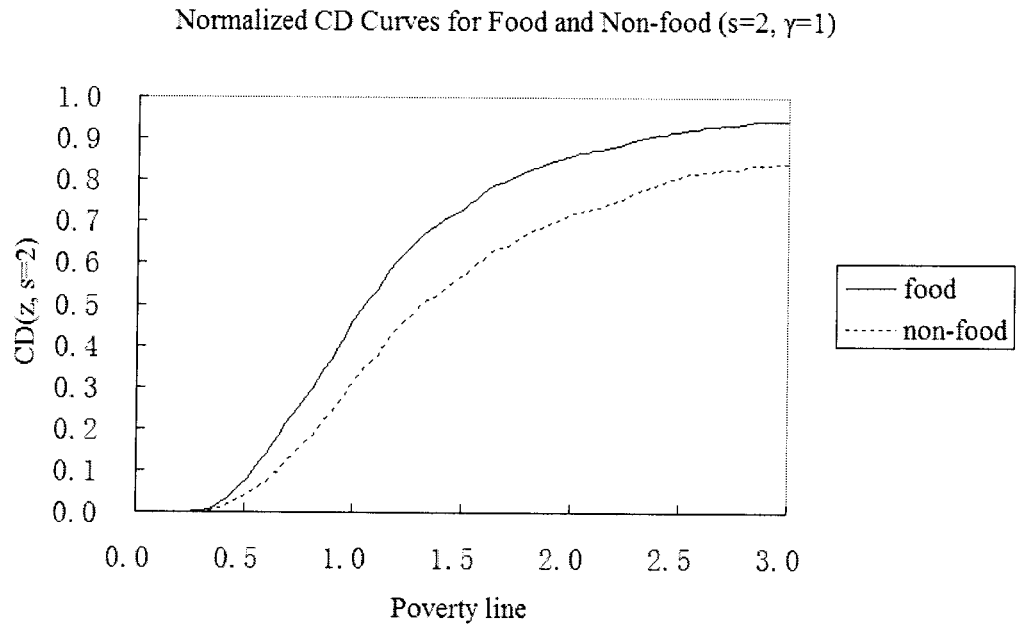


Figure 3

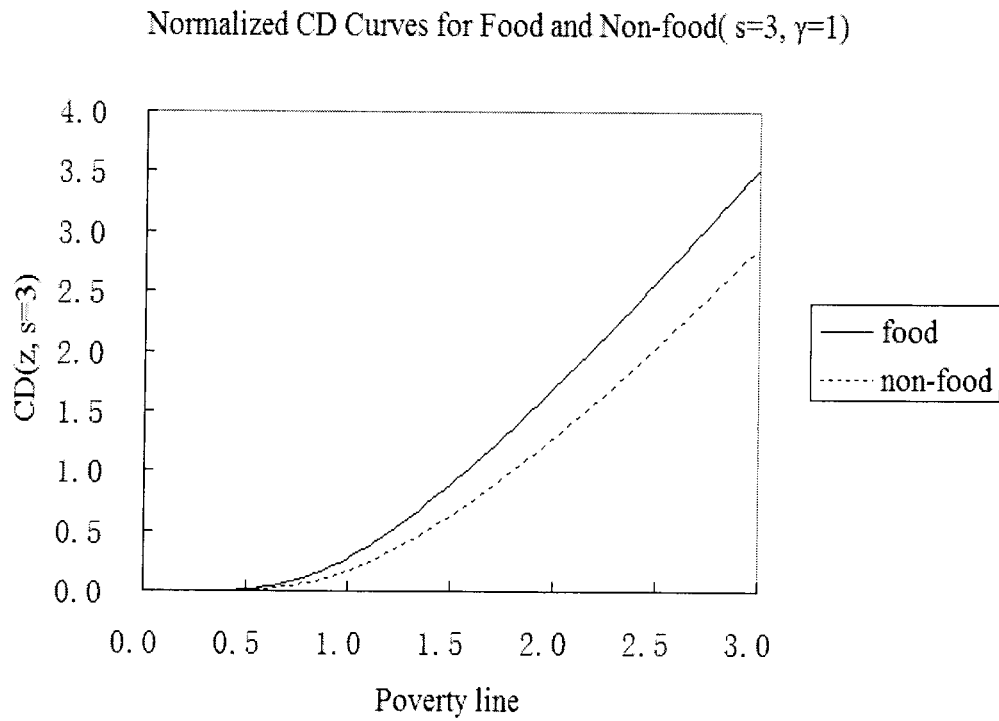


Figure 4

Normalized CD Curves for Food and Non-food ($s=2, \gamma=0.5, 1, 1.5$)

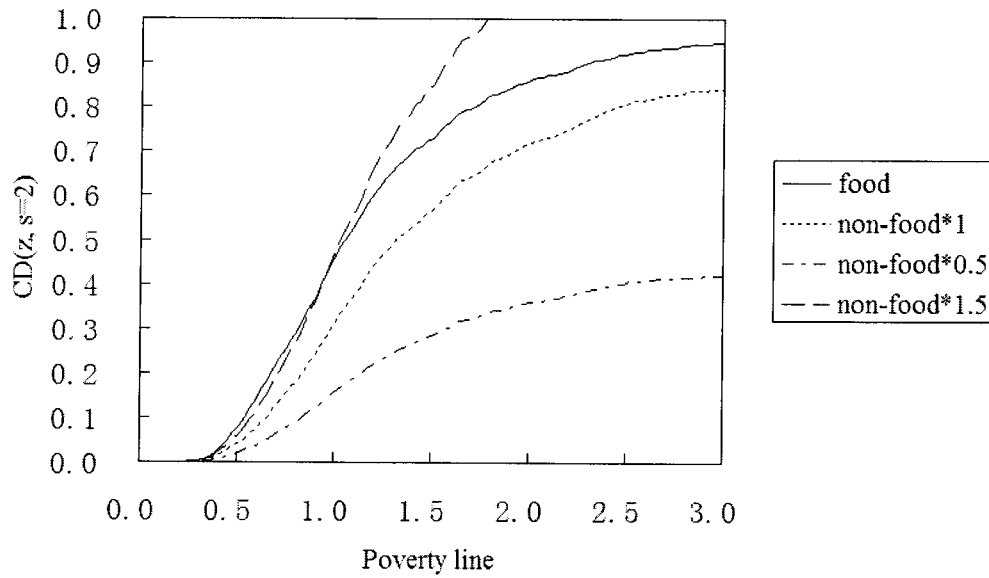


Table 2

Indirect Marginal Tax Reform for Utility and Education

Critical poverty line $z^s(\gamma^+)$ for different economic efficiency cost γ and			
for different order s			
	$\gamma=0.5$	$\gamma=1$	$\gamma=1.5$
$z^1(\gamma)$	2.67277884 (0.04712197)	1.55956173 (0.04722745)	5.36771631 (0.01744872)
$z^2(\gamma)$	---	---	---
$z^3(\gamma)$	---	---	---

Figure 5

Normalized CD Curves for Utility and Education ($s=1, \gamma=1$)

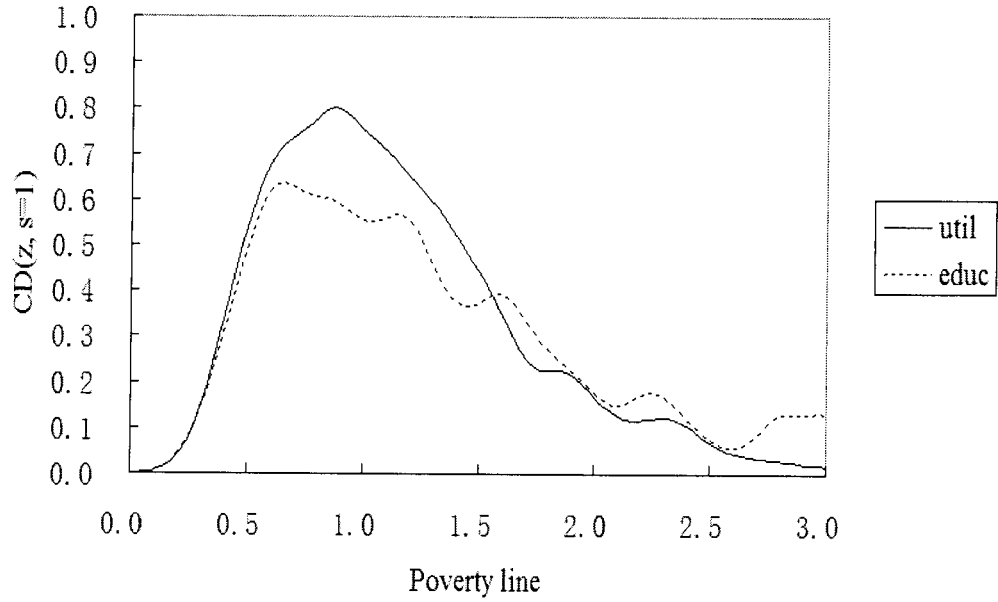


Figure 6

Normalized CD Curves for Utility and Education ($s=2, \gamma=1$)

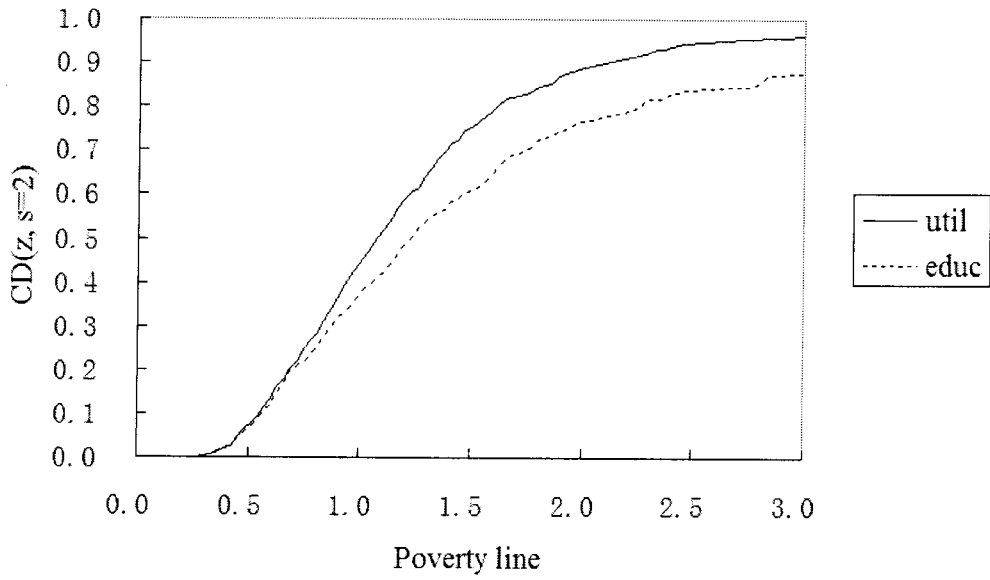


Figure 7

Normalized CD Curves for Utility and Education ($s=3, \gamma=1$)

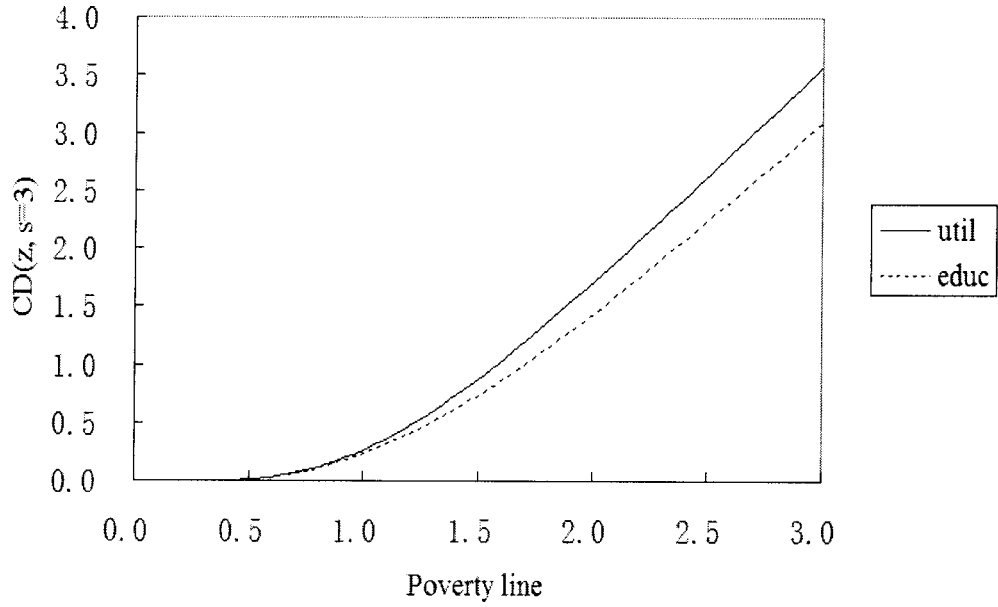


Figure 8

Normalized CD Curves for Utility and Education ($s=2, \gamma=0.5, 1, 1.5$)

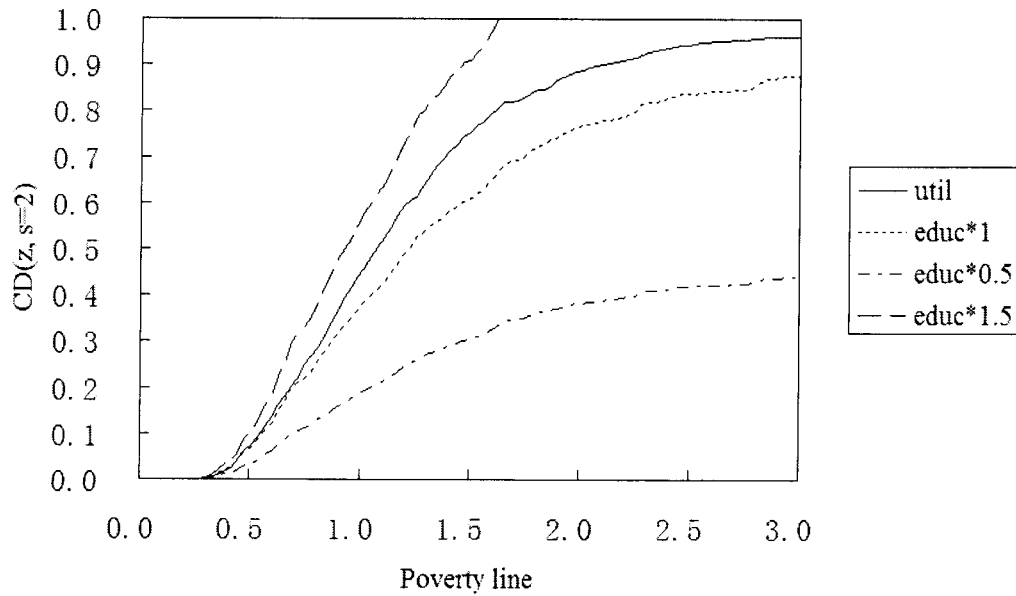


Table 3

Indirect Marginal Tax Reform for Utility and Health

Critical poverty line $z^s(\gamma^+)$ for different economic efficiency cost γ and for different order s

	$\gamma=0.5$	$\gamma=1$	$\gamma=1.5$
$z^1(\gamma)$	2.67584944 (0.05556881)	1.12066519 (0.56134146)	0.81334829 (0.09996547)
$z^2(\gamma)$	---	---	0.44601819 (0.06709081)
$z^3(\gamma)$	---	---	1.27327740 (0.37151168)

Figure 9

Normalized CD Curves for Utility and Health ($s=1, \gamma=1$)

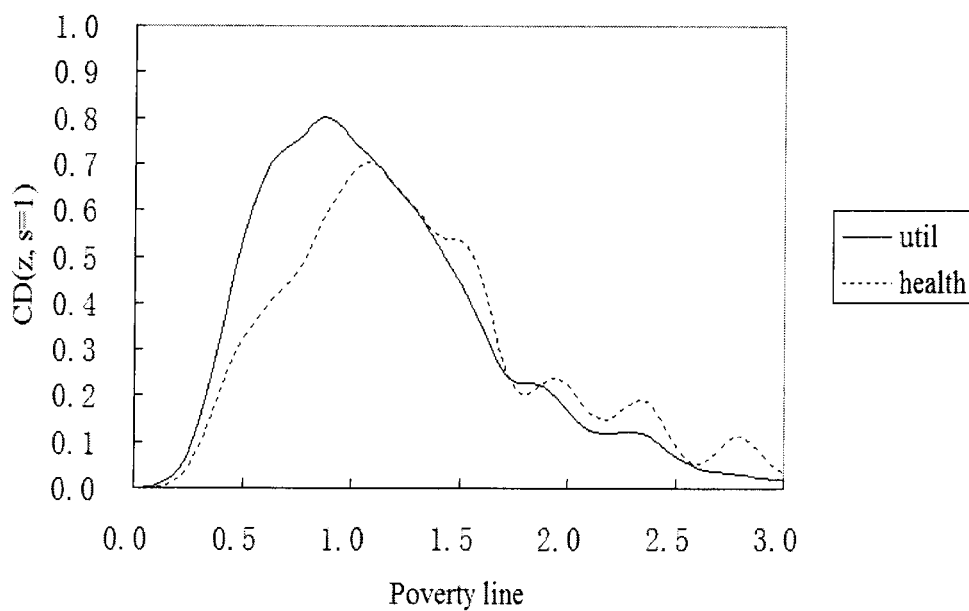


Figure 10

Normalized CD Curves for Utility and Health ($s=2, \gamma=1$)

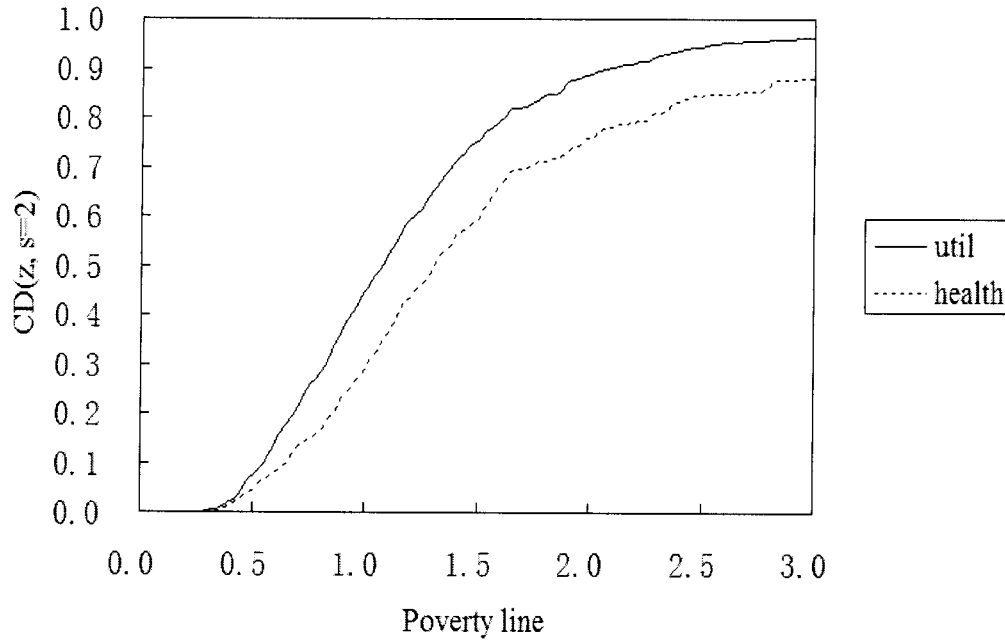


Figure 11

Normalized CD Curves for Utility and Health ($s=3, \gamma=1$)

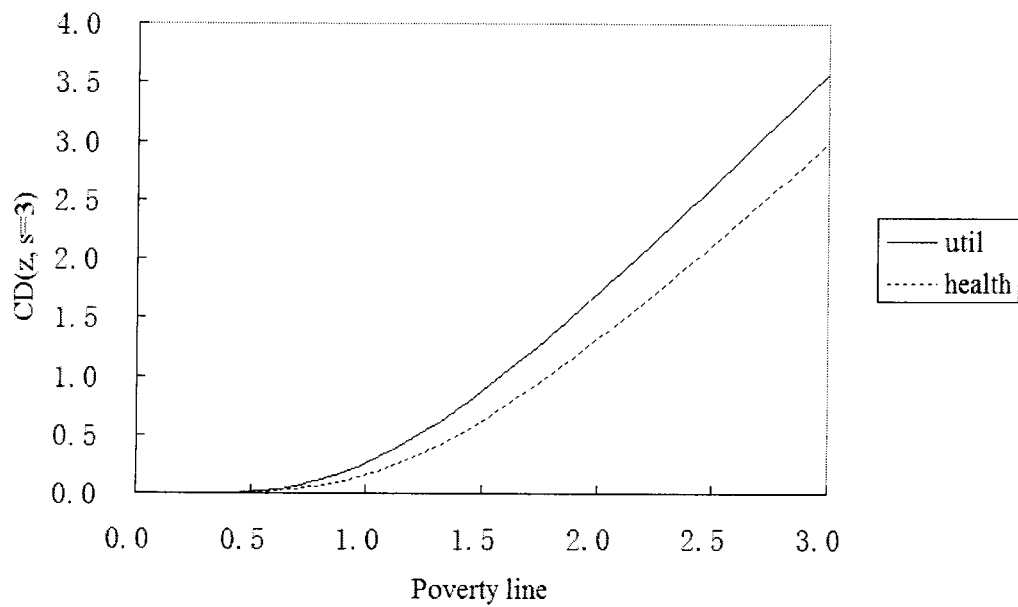


Figure 12

Normalized CD Curves for Utility and Health ($s=2, \gamma=0.5, 1, 1.5$)

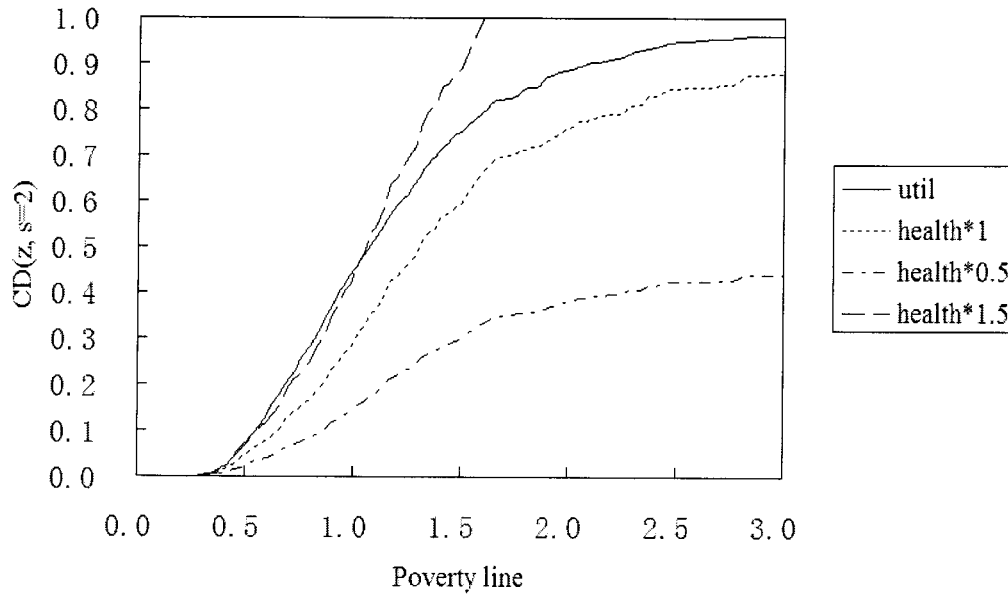


Table 4

Indirect Marginal Tax Reform for Education and Health

Critical poverty line $z^s(\gamma^+)$ for different economic efficiency cost γ and for different order s

	$\gamma=0.5$	$\gamma=1$	$\gamma=1.5$
$z^1(\gamma)$	3.94916368 (0.06615508)	0.88498366 (0.06883989)	0.32310253 (0.14445073)
$z^2(\gamma)$	---	1.52327299 (0.40747793)	0.40821186 (0.08256981)
$z^3(\gamma)$	---	---	0.56041723 (0.22360218)

Figure 13

Normalized CD Curves for Education and Health ($s=1, \gamma=1$)

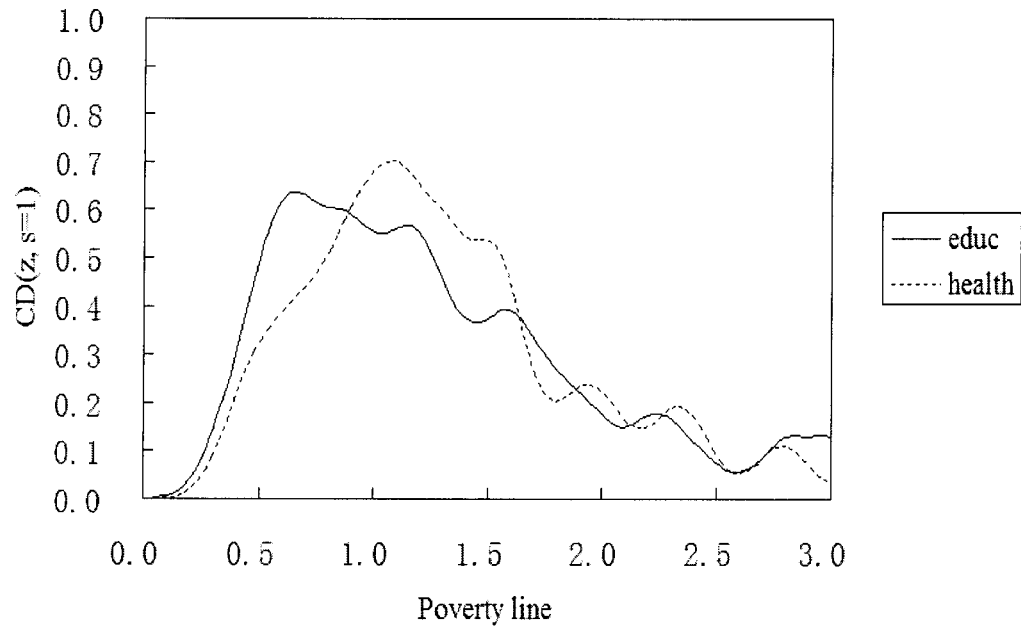


Figure 14

Normalized CD Curves for Education and Health ($s=2, \gamma=1$)

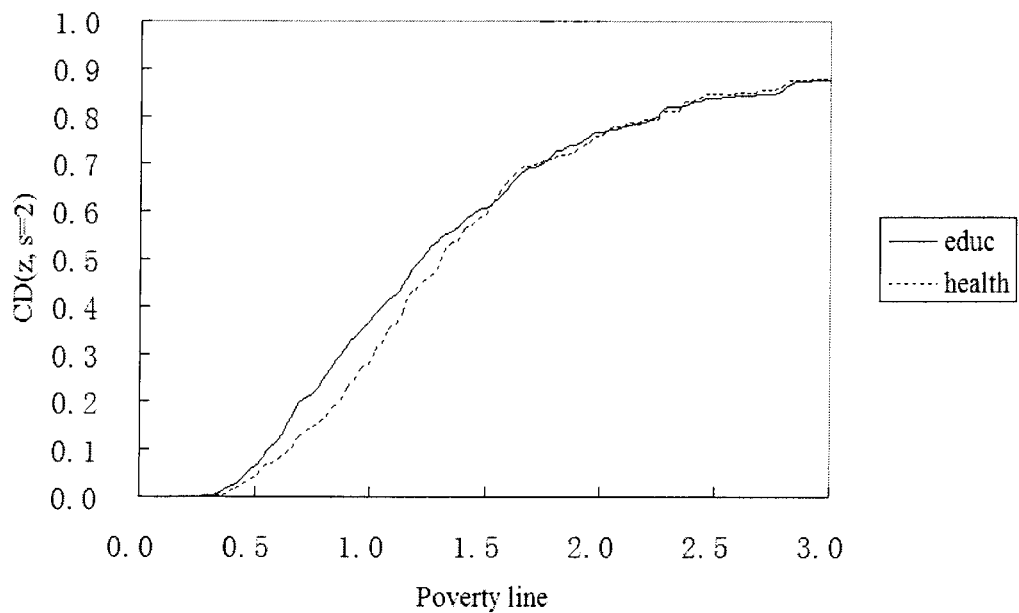


Figure 15

Normalized CD Curves for Education and Health ($s=3, \gamma=1$)

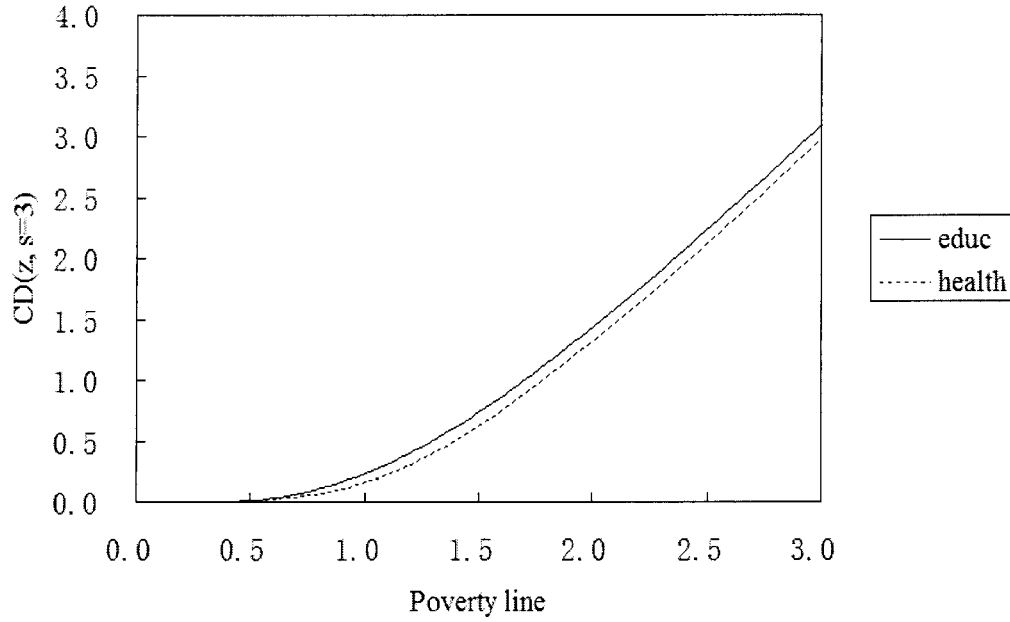


Figure 16

Normalized CD Curves for Education and Health ($s=2, \gamma=0.5, 1, 1.5$)

