

Indirect Tax Reform in Malawi

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Abstract

This paper examines the impact of marginal tax reform on poverty reduction and improvement of social welfare in Malawi. Using the 2002 Complementary Panel Survey, I found that marginal tax reform has a positive impact on alleviating poverty. Food commodities and health expenditures are the two kinds of items which should be subsidized through increasing the tax rate on other commodities, such as non-food commodities and education expenditures respectively. I also explore for the existence of social welfare improvement under the different economic efficiency ratios and ethical orders. Interestingly, Pen-improving is not proved by empirical work, but Dalton-improving and Kolm-improving appear in most cases.

1. Introduction

According to common wisdom, the presence of inequality in the distribution of personal income is expected to aggravate poverty and affect social relationships. Since poverty and social welfare are critical issues for human beings, people are eager to utilize the variant economic instruments to discover problems, in the form of unequal income and taxation by region and commodities respectively. As a result, poverty will be alleviated and social welfare will be improved. Is this hypothesis true, and is the result the same in all countries?

Economists have made great efforts with the measurement of inequality in order to tackle a wide range of questions, such as: do underdeveloped countries show less equality than developed countries, or does taxation lead to greater equality in the distribution of income and wealth? Atkinson (1970) explores the implication of adopting the form of the social welfare function to approach such questions, and its relationship to the conventional summary measures of inequality.

Some economists, on the other hand, are focusing on the measurement of poverty. Besley and Kanbur (1988) provide empirical evidence that poverty could be reduced effectively if one can find an optimal pattern of food subsidies. Thus, a rule has been established for reallocating food subsidies in terms of poverty alleviation.

Makdissi and Wodon (2002) explored the Consumption Dominance Curve (CD-curve) to observe the impact on poverty of indirect tax reform for pairs of commodities. The advantage of the CD-curve, compared with other methods, is that the impact of indirect tax reform on poverty could be characterized in unlimited order

of restricted stochastic dominance. Furthermore, Duclos, Makdissi and Wodon (2008) extend their previous theory into social welfare improvement. The critical poverty line and economic efficiency ratios are also used to characterize social improving tax reforms.

This paper explores the effect of indirect tax reform discussed above. In keeping with the most economists, who use data from developing countries, I use data from the Malawi Complementary Panel Survey. This paper examines the impact of indirect tax reform on poverty reduction and social welfare improvements in Malawi society. A main approach used in this paper is comparing the normalized CD-curves on aggregate food expenditure with those on aggregate non-food expenditure at different orders of stochastic dominance. An additional comparison is also illustrated by using two commodities' CD-curves.

The empirical analysis in this paper brings forth two interesting findings. First, increasing the tax rate on aggregate non-food expenditure and using the proceeds to subsidize aggregate food expenditure is an appropriate tax strategy for social improvement. Second, health care, as one of the non-food expenditures, should be overwhelmingly subsidized in comparison with other non-food expenditures, such as education. It should be noted that when we use education as a variable, pure expenditure is utilized instead of considering dynamic aspects for expositional simplicity.

The main body of this paper is organized in six sections. A review of the literature is given in section 2. Section 3 describes the normalized CD-curves

methodology proposed by Makdissi and Wodon (2002) and further developed by Duclos, Makdissi and Wodon (2008). In section 4, I introduce the data set from Malawi for analyzing the impact of indirect tax reform on social improvement. Empirical analysis is carried out in section 5; the graphs of CD-curves are also provided. The conclusion is drawn in section 6.

2. Literature Review

Many economists have analyzed the effect of economic instruments on poverty reduction and social welfare improvement, such as Atkinson (1970), Besley and Kanbur (1988), Yitzhaki and Slemrod (1991), Makdissi and Wodon (2002) and Duclos, Makdissi and Wodon (2008). Such instruments included Lorenz Curves and S-Gini Indices, commodity tax changes, and indirect tax reform. Most empirical work based on developing countries data suggests that there exists a positive relationship between tax reform and social improvement. In this section, I review literature on inequality, measurement of poverty and marginal tax reform in sub-sections 2.1, 2.2 and 2.3 respectively.

2.1 Inequality

Economic inequality comprises all disparities in the distribution of economic assets and income existing in a wide range of society: for instance, is the distribution of income more equal than it was before? Are developing countries identified by greater inequality than developed countries? Do taxes improve equality in distribution

of income or wealth? It is impossible to attain a completely equality in a unique way. Thus, we are required to use a variety of reasonable economics instruments to approach greater equality.

Measures of inequality have been used by economists to solve a wide range of problems for a long time. The conventional approach that is used in all empirical works before the year 1970 includes the variance, the coefficient of variation, the Gini coefficient or Lorenz Curves. Atkinson (1970) explored measures of inequality by considering directly the form of the social welfare function. He argues, however, that Gini indices and Lorenz Curves are not appropriate measures of a desirable distribution of income for two reasons. First, a complete ranking of distributions cannot be approached without fully specifying the form of social welfare function. Second, we have no grounds for believing that those conventional methods of approach would accord with social values. Thus, the form of the social welfare function, in this paper, is strongly to be recommended over those conventional measures.

2.2 Measurement of Poverty

The definition of poverty given by the World Bank is the lack of basic human needs, such as clean water, nutrition, health care, education, clothing and shelter, because of the inability to afford them. This is also referred to as absolute poverty. However, in many analyses, economists would like to use relative poverty, which is the condition of having fewer resources or less income than others within a society or

country, or compared to worldwide averages.

Some economists have shown interest in poverty in the last century. Hagenars and De Vos (1988) illustrated the poverty percentage for several definitions of poverty by applying one large data set which contains more than 12,000 households in The Netherlands in a survey from 1983. Through comparing the poverty percentages, they obtained discrepancies and similarities among the different definitions of poverty and identified the accuracy of results for the poverty probability of certain social sub-groups. Hagenars and De Vos (1988) concluded that some poverty indicators are better fit for defining the poor than others.

Besley and Kanbur (1988) concentrate on analyzing the optimal pattern of food subsidies to reduce poverty with respect to budget constraint. Through proposing one important assumption, that it is impossible to target perfectly households which are below the poverty line, the subsidized commodities are attractive for both poor and rich. Moreover, the subsidies on marginal units of consumption and infra-marginal units are analyzed separately in order to examine the impact of food subsidies. Within the framework of modern public finance literature, the rules have been established by them for reallocating food subsidies in terms of poverty alleviation.

2.3 Marginal Tax Reform

Yitzhaki and Slemrod (1991) state the difficulties of estimating the social welfare function and provide a new method to analyze the impact of commodity tax

changes for all individuals. The difficulties are due to a principal weakness of the theory of optimal taxation -- this problem mainly affects the developing countries that would like to levy high commodity taxes for increasing revenues, tackling poverty and shifting income distribution. By applying the new method, commodities with a large class of social welfare functions could be identified as to whether it is worthwhile to subsidize or should they be taxed. The government could also enjoy the cost efficiency if the social welfare functions indicated that subsidizing of one commodity should be proceeded with in order to increase the tax on other commodities. Furthermore, Yitzhaki and Slemrod (1991) were applying stochastic dominance, which was mentioned by Atkinson (1970) in the context of income distribution analysis, for indirect tax reform. The criterion of second degree stochastic dominance was used to assess the tax reform of commodities in their work.

Three changes have been made in the methodology. First, income distributions will be ranked instead of ranking portfolios. Second, they will focus on the dominance at the margin to identify if social welfare is improving. Third, the efficiency implications of reform have to be considered.

Yitzhaki and Slemrod (1991) then provide the result of commodities tax changes by comparing the shifted concentration curves. If governments subsidize one commodity by increasing the tax on another commodity without changing revenue and the shifted concentration curve of the first commodity is always above the shifted concentration curve of the second commodity, one could say that social welfare is increased. Yitzhaki and Slemrod (1991) conclude that "If and only if concentration

curves do not intersect will all additive social welfare functions show that the tax change increases welfare.”

Empirical work is also illustrated. The data set is the Survey of Family Expenditure conducted by the Israel Central Bureau of Statistics for the years 1979 and 1980. There are 2,271 urban households included in the survey. Through comparing the concentration curves of cooking oil, bread, public transportation and water separately, bread dominates all the other three commodities, which means that a small increase in the tax on any one of three commodities that subsidizes bread by decreasing its tax will be welfare improving for all social welfare functions.

Makdissi and Wodon (2002) introduced a graphical method, which is the Consumption Dominance curve (CD-curve), to analyze the impact on poverty of marginal tax reform for pairs of commodities. Compared with non-intersecting concentration curves, presented by Yitzhaki and Thirsk (1990) and Yitzhaki and Slemrod (1991), the advantage of the CD-curve is that it could be used to test poverty improvement for any order of restricted stochastic dominance. In the article, they used a larger class of additive poverty measures that are s -time differentiable of a continuous function, including an additive index of poverty with determined income and defined poverty line. This poverty line is considered to be a non-negative for all individuals. For those whose income is above the poverty line, the value of the poverty line will be defined as zero. Therefore, it is possible to test the indirect tax reform on poverty for an order higher than two even though the individual's income is above the poverty line.

Empirical work was done by Makdissi and Wodon in 2002. They used the data from the Bolivian Survey for the year 1999 and defined a reasonable poverty line to be between 325 and 353 Bolivars per-person per-month depending on the city. It was shown that half of the urban population was below the poverty line. Through testing a pair of commodities, namely interprovincial public transport versus medicine, by using their CD-curves, Makdissi and Wodon (2002) provide the result that a tax reform decreased poverty for the class of poverty measures of the second and third order since the two CD-curves associated with this class of measures did not intersect below the critical poverty line.

Duclos, Makdissi and Wodon (2008) extended the graphical method into the field of social improvement with regard to improving social welfare or alleviating poverty for large classes of social welfare and poverty indices. One should note that the critical efficiency ratio is used for concluding social welfare improvement and poverty improvement by means of tax reform if the critical efficiency value is greater than the differential efficiency cost or the critical poverty line is above the plausible poverty line. In the other words, under balanced budget constraints, if the government increases a tax rate on goods i to decrease a tax rate on goods j , poverty and social welfare will both be improved once the normalized consumption dominance curve of goods i is everywhere above the normalized consumption dominance curve of goods j . In the article, they state three measurement difficulties when analyzing the social impact of indirect tax reforms. First, when people estimate the impact of price changes on consumer welfare, it is complicated and the results could be unstable re

some important theoretical and econometric assumptions. Then marginal tax reform is instead used for estimating directly from the observed data alone, thus eliminating the estimation of individual demand and utility function. Second, the choice of a social evaluation function provides a basic problem “since any particular selection of functional form and parameters for a social evaluation function necessarily embodies arbitrary value judgements.” “The strategy we follow in this article is instead to define classes of social evaluation indices that incorporate increasingly stronger judgements on the importance of distributive issues in designing tax policy.” Third, it is hard to estimate the impact on tax revenues of changes in the structure of indirect taxation. This problem is addressed by using sensitivity analysis on the role of the unobserved economic efficiency parameter.

Duclos, Makdissi and Wodon (2008) illustrate the methodology based on a nationally representative survey of Mexico for the year 1996. By comparing the CD-curves for food and non-food, the authors reached the same result as Makdissi and Wodon (2002). Moreover, they also employed the estimator of critical poverty lines and economic efficiency ratios to help them prove the theory of socially improving tax reforms.

3. Methodological Framework

In this section, I will explain the methodological framework that has been used in Duclos, Makdissi and Wodon (2008). Notation and definitions will be presented first, and then poverty indices, social welfare indices and the normalized

CD-curve will be depicted as follows. At the end, the distributive benefit, critical efficiency ratio and critical poverty line will also be shown.

3.1 Notation and Definitions

To better understand how a marginal change in tax rates could affect household welfare and national poverty, Duclos, Makdissi and Wodon (2008) consider that there are K consumption goods with consumer price denoted by vector q and the tax rate, deployed on the consumption goods, denoted by vector t . In order to simplify the explanation of the method, they set the vector of manufacturer prices constant and equal to 1. Moreover, these prices are assumed to be invariant to changes in t . Then the equation $q = 1 + t$ and $dq_k = dt_k$ could be introduced, where q_k and t_k denote the price and the tax rate of good k respectively.

Suppose the indirect utility function is $v(y, \theta, q)$, where y and θ denote nominal income and consumers' preferences respectively. According to King (1983), to approach consumers' welfare in the presence of varying tax rates, q^R and y^R will be used respectively as a vector of reference prices and the post-reform real income. Duclos, Makdissi and Wodon (2008) define y^R both implicitly by function $v(y^R, \theta, q^R) = v(y, \theta, q)$ and explicitly by function $y^R = \rho(y, \theta, q, q^R)$. Therefore, the indirect utility function could be written as $v(\rho(y, \theta, q, q^R), \theta, q^R) = v(y, \theta, q)$.

In order to understand how a marginal change in tax rates could affect household welfare and national poverty, Besley and Kanbur (1988) employed Roy's identity to get the consumption of good k , $x_k(y, \theta, q)$, with respect to consumer's

income y , preferences θ and facing prices q ,

$$\frac{\partial \rho(y, \theta, q, q^R)}{\partial t_k} \Big|_{q=q^R} = -x_k(y, \theta, q^R) \quad (1)$$

where $x_k(y, \theta, q)$ is the Marshallian demand for goods k . Duclos, Makdissi and Wodon (2008) state that: “Observed pre-reform consumption of good k is a sufficient statistic to know the impact on consumer welfare of a marginal change in the price of good k .”

Now consider that preferences θ and nominal income y are jointly distributed in terms of the distribution function $F(y, \theta)$, the conditional distribution of θ given y is $F(\theta|y)$, and the marginal distribution of nominal income is $F(y)$, then the expected consumption of good k at income y could be expressed by,

$$x_k(y, q) = E_{\theta}[x_k(y, \theta, q)] = \int_{\Theta} x_k(y, \theta, q) dF(\theta|y) \quad (2)$$

where Θ is a set that contains all the preferences. Assume the income y is distributed over $[0, a]$, then the per capita consumption of the k th good could be defined as $X_k(q) = \int_0^a x_k(y, q) dF(y)$, where $X_k(q)$ is the average cost in well-being of an increase in the price of good k . According to the equation (1), the consumption of good k as a proportion of per capita consumption can be written as

$$\bar{x}_k(y, q) = \frac{x_k(y, q)}{X_k(q)}.$$

The next step is to consider the government budget constraint. The objective of government is to alleviate poverty or increase household welfare through the way that reduces the tax rate or increases the subsidy on the i th commodity. In order to keep the budget balanced, increasing the tax rate or decreasing the subsidy on the j th commodity should also be implemented simultaneously. Now, let per capita

commodity tax revenues $R(q)$ equals $R(q) = \sum_{k=1}^K t_k X_k(q)$, then according to the balanced budget constraint, one can get,

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

By manipulating the equation (3), one can get,

$$dq_j = -\gamma_{ij} \left(\frac{X_i}{X_j} \right) dq_i \quad (4)$$

where $\gamma_{ij} = \frac{X_i + \sum_{k=1}^K t_k \frac{\partial X_k}{\partial q_i}}{X_i} / \frac{X_j + \sum_{k=1}^K t_k \frac{\partial X_k}{\partial q_j}}{X_j}$. The numerator of γ_{ij} is the inverse of

the marginal economic efficiency cost of funds ($MECF_i$) from taxing goods i . The denominator is the inverse of the marginal economic efficiency cost of funds ($MECF_j$) from taxing goods j . Wildasin (1984) defines γ_{ij} as the differential efficiency cost of increasing one dollar of public funds by taxing the j th commodity and using the proceeds to subsidize the i th commodity. Duclos, Makdissi and Wodon (2008) state that the higher the value of γ_{ij} , the less economically efficient is taxing goods j .

3.2 Poverty Indices, Social Welfare Indices and Normalized CD-Curve

In order to analyze the effect of tax reform on poverty and household welfare, Makdissi and Wodon (2002) employ a method which is based on the comparison of Consumption Dominance Curves (CD-curves). The details of this method are presented as follows.

Suppose the poverty indices can be written as $P(z) = \int_0^a p(y, z) dF(y)$, where $P(z)$ is an additive poverty index, z is the poverty line with respect to income space, and $p(y, z)$ is the amount of poverty that a consumer contributes with income y .

Now, consider the bundle of poverty indices $P(z) \in \Pi^s$, one could define that,

$$\Pi^s(z) = \left\{ P(z) \left| \begin{array}{ll} p(y, z) = 0 & \text{if } y > z, \quad p(y, z) \in \hat{C}^s(z), \\ (-1)^i p^{(i)}(y, z) \geq 0 & \text{for } i = 0, 1, \dots, s, \\ p^{(i)}(z, z) = 0 & \text{for } i = 0, 1, \dots, s-2 \quad \text{when } s \geq 2, \end{array} \right. \right\} \quad (5)$$

where $\hat{C}^s(z)$ is the set of function that is s -time piecewise differentiable over $[0, z]$ and the s could be interpreted as an s th-order derivative with respect to y .

For the social welfare function, Duclos, Makdissi and Wodon (2008) deploy the utilitarian social welfare function as $U = \int_0^a u(y) dF(y)$. Using the same method, as used in presenting the poverty indices, the social welfare indices that belong to the bundle Ω^s could be expressed as,

$$\Omega^s = \left\{ U \mid u(y) \in C^s(\infty), (-1)^{i+1} u^{(i)}(y) \geq 0 \quad \text{for } i = 1, 2, \dots, s, \right\} \quad (6)$$

Duclos, Makdissi and Wodon (2008) also state the interpretation of the poverty and social welfare indices when they are at a different order of classes. When $s \geq 1$, with individual income increases, the poverty indices will slightly decrease and social welfare indices will slightly rise. In this case, the poverty indices and social welfare will respectively belong to Π^1 and Ω^1 . According to the Pareto Efficiency, poverty will decline or social welfare will be improved if an individual's income increases, as long as the other conditions are unchanged. Moreover, the first-order class also conforms to symmetry or anonymity axiom since there is not any change in poverty and social indices through interchanging any two individuals'

income. To compare with poverty indices, one must check the distributions of living standards within the poverty range $[0, z]$. Due to the first excise suggested by Pen (1971), the name of the first-order welfare-improving tax reform is “Pen-improving tax reforms”.

When $s \geq 2$, the poverty and social welfare indices will respectively belong to Π^2 and Ω^2 . The poverty indices are convex and social welfare indices are concave, and they all respect the Pigou-Dalton principle of transfers¹. As mentioned in Mayshar and Yitzhaki (1995), second-order welfare improvement is called “Dalton-improving tax reforms”.

When $s = 3$, the poverty and social welfare indices belong to Π^3 and Ω^3 respectively. These indices are sensitive to favourable composite transfers, which means that an advantageous Pigou-Dalton transfer within the lower part of the distribution, coupled with a disadvantageous Pigou-Dalton transfer within the upper part of the distribution, will increase social welfare, if there is no change of distribution variance. Mkdissi and Wodon (2002) give the interpretation of transfer sensitivity: “Poverty is reduced with a progressive transfer at a low income level and a regressive transfer at a higher income level if those transfers do not increase the variance of the distribution.” Since Kolm (1976) was the first to introduce this scenario into the inequality literature, the name of the third-order welfare improving tax reforms is called “Kolm-improving tax reforms”.

Now it is time to derive the CD-curve for detecting the social improvement

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

of tax reforms. Duclos, Makdissi and Wodon (2008) employ the stochastic dominance curves under the condition $q = q^R$, which can be expressed as

$$D^s(z) = \frac{1}{(s-1)!} \int_0^z [z-y]^{s-1} dF(y). \text{ The stochastic dominance curves could also be}$$

shown by a process of sequential integration as

$$D^s(z) = \begin{cases} F(y) & \text{for } s = 1 \\ \int_0^z D^{s-1}(y) dy & \text{for } s = 2, 3, \dots \end{cases} . \text{ In the real income space, one could get,}$$

$$D^s(z) = \frac{1}{(s-1)!} \int_{\Theta} \int_0^{\eta(z, \theta, q, q^R)} [z - \rho(y, \theta, q, q^R)]^{s-1} dF(y, \theta) \quad (7)$$

since $z = \eta(z, \theta, q, q^R) = \rho(z, \theta, q, q^R)$ when $q = q^R$.

According to the equation (1), the Marshallian demand for goods k equals the differential in equivalent income with respect to the marginal change in taxing goods k . Through combining the equation (1) with the equation (7), one could get a better grasp on how the dominance curves are affected in variance taxing. The equation is as follows,

$$\frac{\partial D^s(z)}{\partial t_k} \Big|_{q=q^R} = \begin{cases} x_k(z, q^R) f(z) & \text{if } s = 1 \\ \frac{1}{(s-2)!} \int_0^z x_k(y, q^R) (z-y)^{s-2} dF(y) & \text{if } s = 2, 3, \dots \end{cases} \quad (8)$$

where $f(z)$ is the density of income at z . Thus, the equation (8) could be used as a Consumption Dominance Curve and expressed as,

$$CD_k^s(z) = \frac{\partial D^s(z)}{\partial t_k}, \quad s = 1, 2, \dots, \quad (9)$$

The normalized Consumption Dominance Curve could be shown as,

$$\overline{CD}_k^s(z) = \frac{CD_k^s(z)}{X_k(q)} \quad (10)$$

Makdissi and Wodon (2002) give the interpretation of the order of CD-curves.

For order $s = 1$, the CD-curve will be defined as $\overline{CD}_k^1(z) = \frac{x_k(z)}{x_k} * f(z)$, which is the ratio of consumption of goods k for an individual with income z over the aggregate consumption of the goods. For order $s = 2$, the meaning of $\overline{CD}_k^2(z)$ is the share of the total consumption of goods k for the individuals whose income is lower than z . For the higher order of CD-curve, it could be derived by integrating the CD-curves at order $s - 1$. Note that the benefit of CD-curves compared with concentration curves is that the CD-curves can eliminate the restriction of the order when testing for dominance, whereas the concentration curves can only be used for testing second-order dominance.

Duclos, Makdissi and Wodon (2008) provide two very important theorems regarding whether tax reforms are poverty or welfare improving through the instrument of CD-curves.

Theorem I (Duclos, Makdissi and Wodon (2008))

A necessary and sufficient condition for a marginal tax reform, $dq_j = -\gamma \left(\frac{x_i}{x_j} \right) dq_i > 0$, to be s -order poverty improving, that is, to decrease poverty weakly for all $P(z) \in [0, z^+]$ and for a given $s \in \{1, 2, 3, \dots\}$, is that

$$\overline{CD}_i^s(y) - \gamma \overline{CD}_j^s(y) \geq 0, \quad \forall y \in [0, z^+] \quad (11)$$

Theorem II (Duclos, Makdissi and Wodon (2008))

A sufficient condition for a marginal tax reform, $dq_j = -\gamma \left(\frac{x_i}{x_j} \right) dq_i > 0$, to be s -order welfare improving, that is to increase social welfare weakly for all $W \in \Omega^s$ and for a given $s \in \{1, 2, 3, \dots\}$, is that

$$\overline{CD}_i^s(y) - \gamma \overline{CD}_j^s(y) \geq 0, \quad \forall y \in [0, \infty) \quad (12)$$

It is apparent that Theorem I provides the condition of poverty improvement while Theorem II gives the criterion of identifying social welfare improvement. Duclos, Makdissi and Wodon (2008) point out the difference between the social improvement conditions of Theorem I and Theorem II in that the poverty improvement experiment only works out within the range of potential poverty lines $[0, z^+]$, yet the social welfare improvement test could extend over the entire space $[0, \infty)$.

Now to consider the scenarios if γ equals to one or not. When $\gamma = 1$, under the policy of indirect tax reform, which is reducing tax or increasing the subsidy on goods i marginally through increasing tax or decreasing subsidy on goods j , Theorem I indicates that poverty will be alleviated at order $s = 1, s = 2$ and $s = 3$ if the normalized CD-curve of goods i is all the way above the normalized CD-curve of goods j for every income level under the poverty line and all poverty indices belong to II^s . In other words, if the CD-curve of goods i and the CD-curve of goods j do not intersect at order $s = 1, s = 2$ and $s = 3$, then the indirect tax reform is considered to be a poverty improvement. However, if the two normalized CD-curves do have intersections and the first intersection lies above the critical poverty line, the indirect tax reform will still be poverty improving respectively at order $s = 1, s = 2$ and $s = 3$. Theorem II in this scenario implies that the indirect tax reform is considered to be social welfare improving if the normalized CD-curve of goods i and the normalized CD-curve of goods j have no intersection at order $s = 1, s = 2$ and $s = 3$. Precisely speaking, the indirect tax reform will be Pen-improving, Dalton-improving and

Kolm-improving if the normalized CD-curve of goods i is everywhere above the normalized CD-curve of goods j for all social welfare functions belonging to Ω^s . Any intersections will violate the welfare improvement in that specific order.

When $\gamma \neq 1$, with the same rule as described in the scenario $\gamma = 1$, one needs to multiply the normalized CD-curve of goods j by economic efficiency ratio γ_{ij} ², then compare it with the normalized CD-curve of goods i to analyze whether the indirect tax reform is poverty and social welfare improving.

3.3 Distributive Benefit, Critical Efficiency Ratio and Critical Poverty

According to Theorem I and Theorem II, one could rewrite $\overline{CD}_i^s(y) - \gamma \overline{CD}_j^s(y) \geq 0$ to $\frac{\overline{CD}_i^s(y)}{\overline{CD}_j^s(y)} \geq \gamma$ for all $y \in [0, z^+]$ and $y \in [0, \infty)$. Duclos, Makdissi and Wodon (2008) define a variable $\delta^s(z)$ for the ratio of $\overline{CD}_i^s(z)$ and $\overline{CD}_j^s(z)$ and give it the name of the distributive benefit ratio. It enables people to test whether poverty and social welfare are improving under the indirect tax reform by comparing $\delta^s(z)$ with γ for all $z \in [0, z^+]$ and $z \in [0, \infty)$. To do this, one should denote this distributive benefit ratio as $\delta^s(z) = \frac{\overline{CD}_i^s(z)}{\overline{CD}_j^s(z)}$. The meaning of $\delta^s(z)$ is the benefit that people obtain from taxing goods j instead of taxing goods i . Note that when $\overline{CD}_j^s(z) = 0$, $\delta^s(z)$ goes to infinite. Duclos, Makdissi and Wodon (2008) give a value γ^{++} to $\delta^s(z)$ when $\overline{CD}_j^s(z) = 0$ and extend the equation as follows,

² γ_{ij} is the economic efficiency cost of taxing j relative to that of taxing i : $\frac{MECF_j}{MECF_i}$.

$$\delta^s(z) = \begin{cases} \frac{\overline{CD}_i^s(z)}{\overline{CD}_j^s(z)} & \text{if } \overline{CD}_j^s(z) \neq 0 \\ \gamma^{++} & \text{if } \overline{CD}_j^s(z) = 0 \end{cases} \quad (13)$$

Therefore, when the value of the distributive benefit ratio $\delta^s(z)$ is greater than the economic efficiency ratio γ , one could easily say that the indirect tax reform means social improvement for all poverty indices belonging to Π^s and for any poverty line under the critical poverty line z^+ and vice versa.

More precisely, according to Theorem I, suppose a given value of $\gamma = \gamma^+$. The condition $\overline{CD}_i^s(y) - \gamma \overline{CD}_j^s(y) \geq 0$, for all $z \in [0, z^+]$ will hold for $\gamma < \gamma^+$ and there must exist a critical value of γ for all $z \in [0, z^+]$ beyond which the condition will not hold. This critical efficiency threshold is defined as,

$$\gamma_s(z^+) = \inf \{ \delta^s(z) \mid z \in [0, z^+] \} \quad (14)$$

This critical value of γ is the upper bound of the economic efficiency ratio so that $\overline{CD}_i^s(y)$ and $\gamma \overline{CD}_j^s(y)$ will intersect at maximum poverty line z^+ . When $\gamma > \gamma^+$, the marginal tax reform will still mean poverty improvement only if $\overline{CD}_j^s(z) = 0$ or $\delta^s(z) = \gamma^{++}$.

Similarly, a critical upper poverty threshold $z_s(\gamma^+)$ could also be defined as,

$$z_s(\gamma^+) = \sup \{ z \mid \delta^s(y) \geq \gamma^+, y \in [0, z], z \leq z^{++} \} \quad (15)$$

The condition $\overline{CD}_i^s(y) - \gamma \overline{CD}_j^s(y) \geq 0$, for all $z \in [0, z^+]$ will hold for any z below $z_s(\gamma^+)$. In other words, only if the two normalized CD-curves intersect at a level lower than the critical poverty line, will the tax reform be poverty improving.

Duclos, Makdissi and Wodon (2008) argue that: "For a given γ^+ and z^+ , $z_s(\gamma^+)$ and $\gamma_s(z^+)$ give respectively the critical upper poverty line and the critical

economic efficiency ratio up to which the tax reform is necessarily *s*-order poverty improving.”

4. Data Set

The developing countries are the best target for researchers for analyzing the impact of indirect tax reform. In this study, I use the data from Malawi, which is a developing country from south-centre Africa. The population of Malawi is around 15 million as of the 2009 census and per capita GDP in the year 2007 was about 800 dollars. According to the Living Standard Measurement Study (LSMS) from the World Bank, the poverty line is combined with the food poverty line and the non-food poverty line. The food poverty line is determined by estimating the cost of purchasing a sufficient amount of calories to satisfy a recommended daily calorie requirement. This value is estimated to be 10,029MK per person per year.³ For the non-food poverty line, it is more difficult to calculate as there is no concept like calorie that can be applied. However, the non-food poverty line could be obtained as the weighted average non-food expenditure for those close to food the poverty line. Thus, the non-food poverty line is 6,136MK per person per year.⁴ Therefore, the total poverty line is 16,165MK per person per year, which is simply the sum of food and non-food poverty lines described above. The percentage of the population whose household per capita consumption is below the poverty line was about 52.4% in the year 2004.⁵

To determine if indirect tax reform has an effect on reducing poverty and

³ See “Note on Construction of Expenditure Aggregate and Poverty Lines for IHS2” From the World Bank website.

⁴ See “Note on Construction of Expenditure Aggregate and Poverty Lines for IHS2” From the World Bank website.

⁵ The source of this number is from the World Bank website.

improving social welfare in Malawi, this study analyzes data from the Complementary Panel Survey (CPS). The CPS is a continuous work conducted by the Malawi Poverty Monitoring System (PMS) since 1997. Four rounds of the CPS in total were implemented between January 2000 and September 2002. It is worth noting that the CPS sample needs to be chosen from the Integrated Household Survey (IHS) before the IHS data is full clean. The sample size of CPS was considered to be lower than 800 households because of similar panel surveys elsewhere around the world. In my study, the data set consists of 667 households.

The data set was divided into three sub-categories, food expenditure, non-food expenditure and household income. In my analysis, I will mainly use the variables from food expenditure and non-food expenditure. In food expenditure, the data was collected with several variables, such as expenditure on meat, expenditure on cooking oil, expenditure on milk, expenditure on beverages. The variables included in non-food expenditure are such as expenditure on alcohol, expenditure on education, expenditure on health, expenditure on utilities.

It is worth mentioning that some variables, such as expenditure on utilities and expenditure on public transport, are popular with economists. For example, Yitzhaki and Thirsk (1990) used public transport versus electricity in Cote D'Ivoire to illustrate welfare improving by tax reform. Moreover, the aggregate food expenditure and the aggregate non-food expenditure are also commonly used as variables to analyze the impact of indirect tax reform in the empirical work of other economists. For instance, Duclos, Makdissi and Wodon (2008) demonstrated the comparison of

CD-curves by using the variables of food and non-food expenditure. In order to obtain the variables of aggregate expenditure on food and non-food items, I simply added up the spending on all food commodities and non-food commodities respectively for each household. In addition, total expenditure for each household could also be calculated easily by summing aggregate food expenditure and aggregate non-food expenditure. It should be noted that the missing values appear as a dot in the data set to show that I am unable to calculate the aggregate expenditure on food and non-food items. To adjust for this, the null is to be used instead of the dot.

Finally, for the purpose of expositional simplicity, adjusted total expenditure is derived by using total expenditure divided by the official poverty line, which is 16,165MK per person per year. Since the value of total expenditure for each household in the data set is on monthly basis, adjusted total expenditure should also be multiplied by 12 to convert to a yearly basis. Thus, for those whose adjusted total expenditure is lower than 1, they are considered to be poor since their consumption per household is under the official poverty line and vice versa. In this sample, 76.8% of the population is poor.

5. Empirical Illustration

According to Table 1, the data set has been sorted by household income from the poorest to the richest and equally divided into 5 groups. The average values were calculated for each group by different categories. For the poorest group, it is worth to note that the average value of expenditure on food commodities is very similar to the

one on non-food commodities. However, these expenditures are both lower than the other groups because of the lower household income. The middle class, which are presented 20% to 80% of sample size behaved the same performance as the poorest group. The average value of expenditures on food and non-food increased as the income of household raised. The richest group spent much more money on food and non-food expenditure than the other groups, and moreover, non-food expenditure is 2.5 times than food expenditure. For the other categories, which are education and health expenditures, one could notice that the health expenditure is larger than education expenditure in all groups expect the richest group. The richest people would like to spend more money on education compared to expenditure on health care. As the same as food and non-food expenditures, education and health expenditures are getting larger when household income increased.

	Household Income	Food Expenditure	Non-food Expenditure	Education Expenditure	Health Expenditure
0 - 20% (poorest)	54.88	51.37	41.44	0.11	1.4
20%-40%	268.54	138.85	133.06	1.66	5.59
40%-60%	644.86	310.79	278.41	7.35	17.45
60%-80%	1603.63	533.42	664.92	11.04	50.67
80%-100% (richest)	9354.21	1729.30	4300.33	290.02	103.32

Table 1: Average value of different expenditures for different household groups

To better analyze the impact of indirect tax reform on poverty and social welfare improvement, I will test and evaluate the impact through two different cases

in Malawi. One thing needs to be mentioned: instead of using per capita incomes⁶, I use adjusted total expenditure for the horizontal axis, which has been normalized by the official poverty line. Therefore, the value of a unit on the horizontal axis is the same as the official poverty line. The value of 2 and 3 on the horizontal axis means that they have twice and triple the amount of the official poverty line respectively.

In the first case, I suppose that a marginal tax reform will increase the tax rate on non-food commodities with the proceeds used to decrease the tax rate on food commodities. Table 2 presents the estimated critical values of poverty lines $\hat{z}_s(\gamma)$ for different economic efficiency ratios γ under different ethical orders s on food and non-food commodities.

Critical poverty lines $z_s(\gamma)$ for different ratios of economic efficiency costs γ and for different orders of dominance $s(*)$			
	$\gamma = 0.5$	$\gamma = 1.0$	$\gamma = 1.5$
$z_1(\gamma)$	6.033 (0.047)	4.330 (0.492)	1.623 (0.148)
$z_2(\gamma)$	N/A	N/A	6.478 (1.355)
$z_3(\gamma)$	N/A	N/A	12.392 (9.186)

Table 2: Indirect Taxation for Food Commodities versus Non-food Commodities, Malawi 2004

From Table 2, one could see that the two CD-curves cross at $\hat{z}_1(\gamma) = 4.330$, which is the first-order critical poverty line for $\gamma = 1$. The standard error of the sampling distribution of $\hat{z}_1(1)$ is estimated to be 0.492, which implies that a 95% confidence interval for the true value $z_1(1)$ would be [3.366, 5.294]. In other words, when $\gamma = 1$, one can be 95% certain that poverty will be improved under a

⁶ Duclos, Makdissi and Wodon (2008) used per capita income as the value on the horizontal axis for Mexico's 1996 ENGLISH, a nationally representative survey with detailed income and consumption modules.

balanced-budget indirect tax reform by raising taxes on non-food items and reducing taxes on (or providing a subsidy for) food items if the poverty line is below 3.366 times the official poverty line. Figure 1 depicts the normalized CD-curves for food and non-food in the first ethical order when $\gamma = 1$. It is apparently that the normalized CD-curve for food is not everywhere above the normalized CD-curve for non-food, so that Theorem II is not satisfied. Therefore, this marginal tax reform is not a Pen-improving tax reform and it could not increase social welfare in its first order.

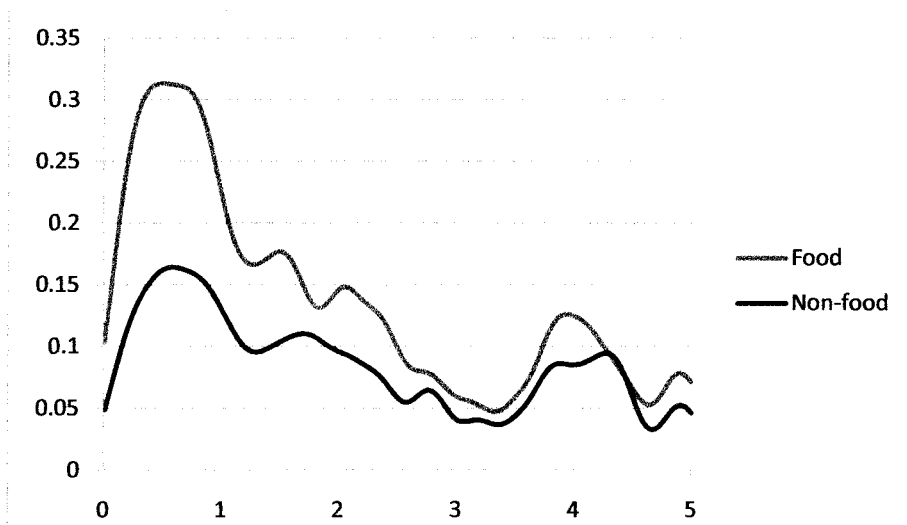


Figure 1: Normalized CD-curves for Food and Non-food Commodities, $s = 1$, $\gamma = 1$

For the second ethical order $s = 2$, there is no value for the critical poverty line in Table 2. Figure 2 also provides evidence that the CD-curves for food and non-food do not intersect in the wide range of adjusted total expenditure. As a result, the marginal tax reform is qualified for both poverty reduction and social welfare improvement for any poverty line at the second ethical order. More precisely, if the government implements an indirect tax reform, which increases the tax on non-food

commodities and subsidizes food commodities, it will reduce poverty for any poverty line and for any poverty index that is monotonic, symmetric and averse to inequality and will increase social welfare as well for any poverty index that is monotonic, symmetric and averse to inequality. Similarly, there is no critical poverty line at the third ethical order with economic efficiency ratio equal to 1. Thus, the marginal tax reform that is mentioned above will also decrease poverty and improve social welfare without any limitation on a critical upper poverty threshold value.

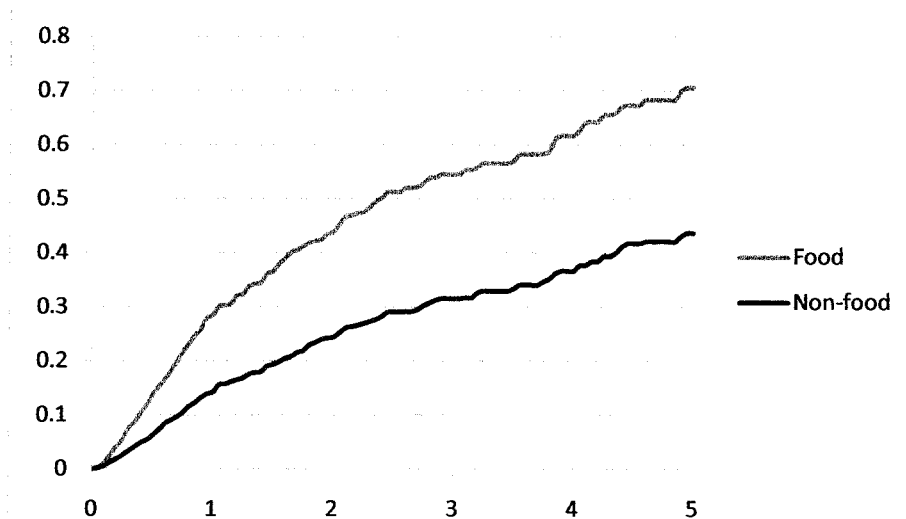


Figure 2: Normalized CD-curves for Food and Non-food Commodities, $s = 2$, $\gamma = 1$

Therefore, when the efficiency costs of taxing food and non-food items are equal, increasing the tax on non-food commodities and reducing the tax on food commodities will alleviate poverty at the first, second and third ethical orders. Moreover, Dalton-improving and Kolm-improving are also recognized by this indirect marginal tax reform.

Now to consider the economic efficiency ratio γ equals 0.5. As shown in Table 2, the estimated critical poverty line $\hat{z}_1(0.5)$, which is determined by the

intersection of two CD-curves, is 6.033. The standard error of $\hat{z}_1(0.5)$ is estimated to be 0.047. The confidence interval for the estimated critical poverty line $\hat{z}_1(0.5)$ with 95% significance level is [5.941, 6.125]. As a result, when $\gamma = 0.5$, increasing the tax on non-food commodities and decreasing the tax on food commodities will reduce poverty at the first ethical order if the poverty line is below 5.941 times the official poverty line. Figure 4 (next page) provides the same evidence that the normalized CD-curve for food intersects with the normalized CD-curve for non-food. Thus, this marginal tax reform could not improve social welfare at the first ethical order since the CD-curve for food is not everywhere above the CD-curve for non-food. In other words, Pen-improving is not satisfied. Furthermore, as ethical order is increased, there is no critical poverty line found under the same economic efficiency ratio $\gamma = 0.5$. From Figure 5 and Figure 6 (shown in Appendix), it is obvious that the CD-curve for food is all the way above the CD-curve for non-food at the second and third ethical orders. Therefore, for any poverty line, the indirect marginal tax reform of subsidizing food by levying tax on non-food will reduce poverty and be Dalton-improving and Kolm-improving.

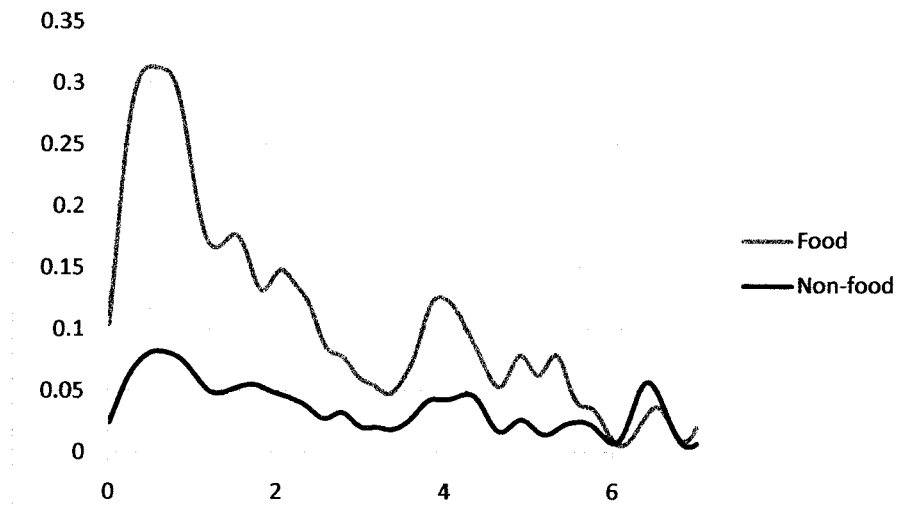


Figure 4: Normalized CD-curves for Food and Non-food Commodities, $s = 1$, $\gamma = 0.5$

With the economic efficiency ratio γ equals 1.5, the two CD-curves for food and non-food have intersections in the first and second ethical orders. This result is shown in Table 2. However, although there exists a value at the third ethical order, this value is not statistically significant because the standard error of $z_3(1.5)$ is too large to reject the null hypothesis, which is $z_3(1.5) = 0$. Thus, one conclusion could be drawn right away that the marginal tax reform, which increases the tax on non-food to subsidize food will not be Pen-improving or Dalton-improving due to the fact that the two CD-curves for food and non-food intersect at first and second ethical orders. Kolm-improving could be identified because of the missing value found in the third ethical order. According to Figure 7, the two CD-curves cross at 1.623 in its first ethical order, with an estimated standard error to be 0.148. The confidence interval for the estimated critical poverty line $\hat{z}_1(1.5)$ with 95% significant level (t-ratio equals to 1.96) is [1.333, 1.913]. Similarly, I could also obtain the confidence interval for the estimated critical poverty line $\hat{z}_2(1.5)$ at the second order with 95% significant level

which is [3.822, 9.134]. This result leads to a conclusion under the condition that the economic efficiency ratio equals 1.5. Once the government increases the tax on non-food and uses the proceeds to subsidize food, social poverty will be reduced at the first and second ethical order for all poverty indices below their lower bound of confidence interval. At the third ethical order, poverty will be reduced for any poverty index because of the absence of the critical poverty line.

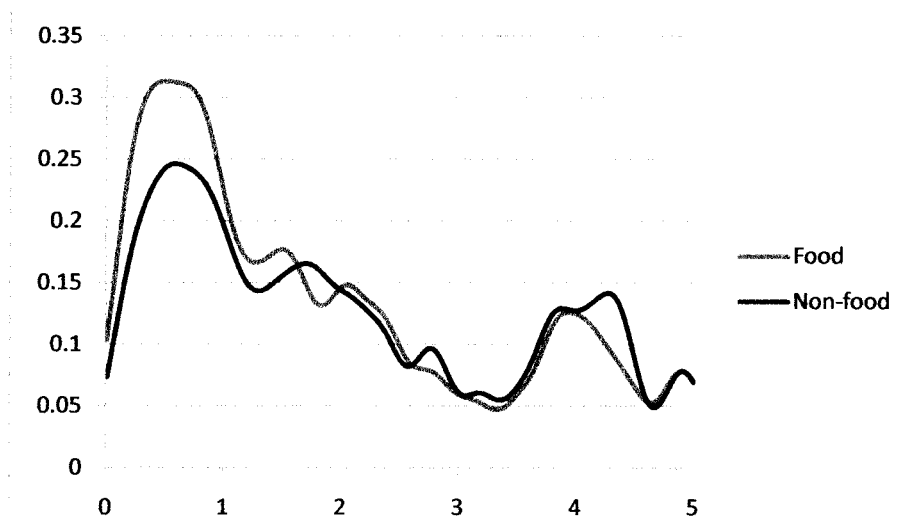


Figure 7: Normalized CD-curves for Food and Non-food Commodities, $s = 1$, $\gamma = 1.5$

The second example that is used to illustrate the impact of indirect tax reform on poverty reduction and social welfare improvement is in regard to education expenditures versus health expenditures. Now consider a marginal tax reform that increases the tax rate on education and raises the subsidy on health. Table 3 shows the estimated critical values of poverty line $z_s(\gamma)$ for the different economic efficiency ratios γ at the different ethical orders s . By using the same methodology as the one used in the first case, I analyse the impact of marginal tax reform on alleviating the poverty only at the first-order condition for different economic efficiency ratios, and

then briefly discuss how social welfare will be affected under the different ethical orders and economic efficiency ratios.

	Critical poverty lines $z_s(\gamma)$ for different ratios of economic efficiency costs γ and for different orders of dominance $s(\ast)$		
	$\gamma = 0.5$	$\gamma = 1.0$	$\gamma = 1.5$
$z_1(\gamma)$	3.429 (0.097)	2.829 (0.466)	2.728 (0.194)
$z_2(\gamma)$	N/A	N/A	17.441 (0.401)
$z_3(\gamma)$	N/A	N/A	30.201 (10.883)

Table 3: Indirect Taxation for Education Expenditure versus Health Expenditure, Malawi 2004

When $\gamma = 1$, Figure 10 (next page) depicts that the CD-curve of health expenditures is not everywhere above the CD-curve of education expenditures. The two CD-curves cross at 2.829, which is also the critical value of $z_1(1)$. The confidence interval is [1.916, 3.742] at 95% significant level. In other words, when the economic efficiency costs of taxing education and health expenditures are equal, all poverty lines inferior to 1.916 times the official poverty line could be considered to reduce poverty under the policy of increasing the tax rate on education expenditures, while providing subsidizes on health expenditures.

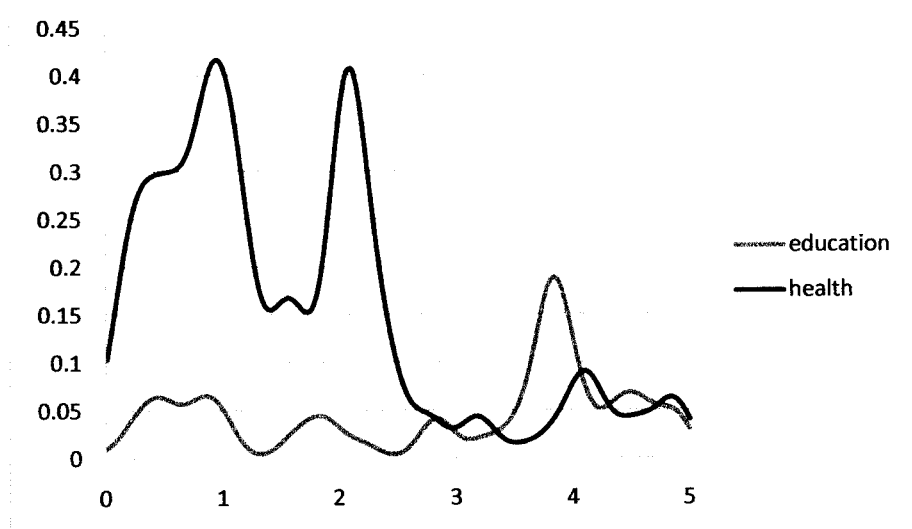


Figure 10: Normalized CD-curves for Education and Health Expenditure, $s = 1, \gamma = 1$

For the economic efficiency ratio equal to 0.5, the two CD-curves for education and health expenditures intersect at the estimated critical poverty line $\hat{z}_1(0.5) = 3.429$, which is shown in Table 3. With the standard error of the sampling distribution of $\hat{z}_1(0.5)$ estimated to be 0.097, I arrive at the confidence interval at the 95% significant level which is [3.239, 3.619]. Under the same policy that I used when $\gamma = 1$, poverty could be alleviated if the poverty line is assigned below 3.239 times the official poverty line. Figure 11 (shown in Appendix) shows the normalized CD-curves for education and health when $\gamma = 0.5$ at the first ethical order.

As I increase the economic efficiency ratio to 1.5, the intersection of the two CD-curves moves to 2.728 with the standard error of $\hat{z}_1(1.5)$ estimated to be 0.194 under the first-order condition. Thus, the confidence interval at 95% significant level is [2.348, 3.108]. Therefore, with the economic efficiency ratio equal to 1.5, if the poverty line is below 2.348 times the official poverty line, increasing the tax on education expenditures and subsidizing health expenditures under the

balanced-budget condition will be first-order poverty reduction. Figure 12 (shown in Appendix) gives the shape of the two normalized CD-curves when $\gamma = 1.5$ at the first ethical order.

From Table 3, it is obvious that the two CD-curves for education and health expenditures intersect in all the values of γ at the first ethical order. Thus, none of the policy of marginal tax reforms for different γ will be satisfied by Theorem II. Therefore, increasing the tax rates on education expenditures while using the proceeds to subsidize health expenditures will not improve social welfare at the first ethical order. In the second and third ethical order, the marginal tax reform is Dalton-improving and Kolm-improving respectively when $\gamma = 0.5$ and $\gamma = 1$ since there is no value for the critical poverty line in the corresponding conditions. However, Dalton-improving and Kolm-improving do not exist when $\gamma = 1.5$ due to the intersection of the two CD-curves for education and health expenditures at the second and third ethical order.

6. Conclusion

In this paper, I examined the impact of marginal tax reform on poverty reduction and social welfare improvement using normalized Consumption Dominance Curves, which first were derived by Makdissi and Wodon (2002). Two comparisons of commodities, food commodities versus non-food commodities and education expenditures versus health expenditures are employed in the illustration of the empirical work.

This examination of the impact of indirect tax reform on social improvement using CPS data has enabled me to draw the following conclusions. There is aggregate evidence of a positive indirect tax reform impact on poverty reduction under certain conditions, namely that the policy, which increases the tax rate on non-food commodities and education expenditures to subsidize food commodities and health expenditures respectively, could only be effective if the poverty line is below the lower bound of the critical poverty line for any value of the economic efficiency ratio at the first ethical order. Moreover, this policy also works when the two CD-curves are at second and third ethical orders.

Social welfare improvement is also found under the condition that the two CD-curves are located at the second and third ethical orders when the economic efficiency ratios equal 0.5 and 1. Therefore, subsidizing food and increasing tax on non-food is a reform that should be considered in Malawi. Additionally, the subsidy of health expenditures with respect to taxing education expenditures is also recommended in Malawi as being a social welfare improvement.

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Appendix

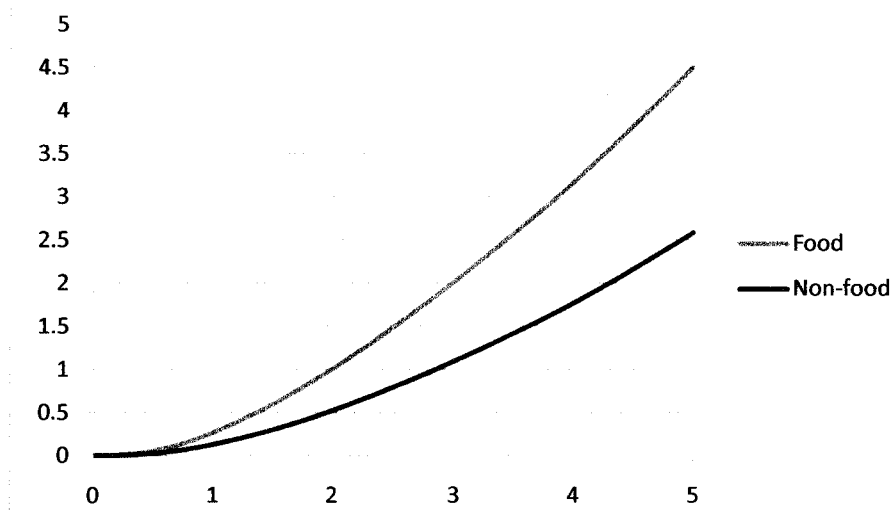


Figure 3: Normalized CD-curves for Food and Non-food Commodities, $s = 3$, $\gamma = 1$

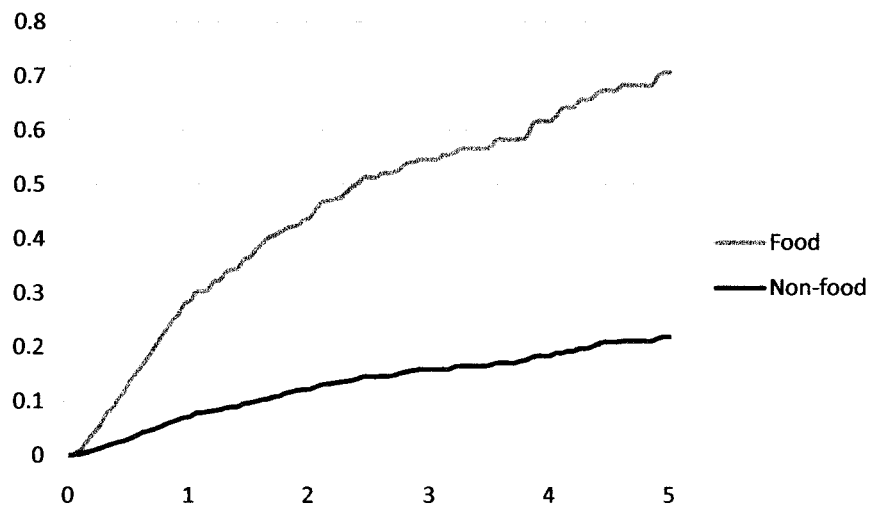


Figure 5: Normalized CD-curves for Food and Non-food Commodities, $s = 2$, $\gamma = 0.5$

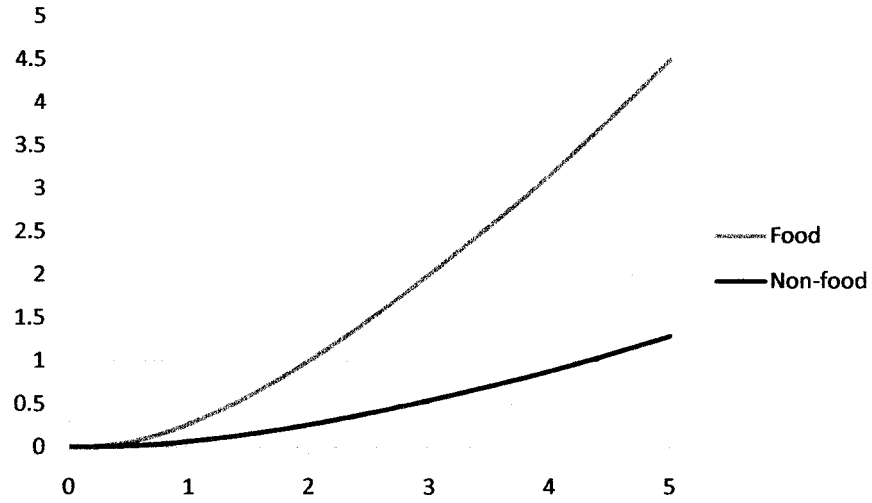


Figure 6: Normalized CD-curves for Food and Non-food Commodities, $s = 3$, $\gamma = 0.5$

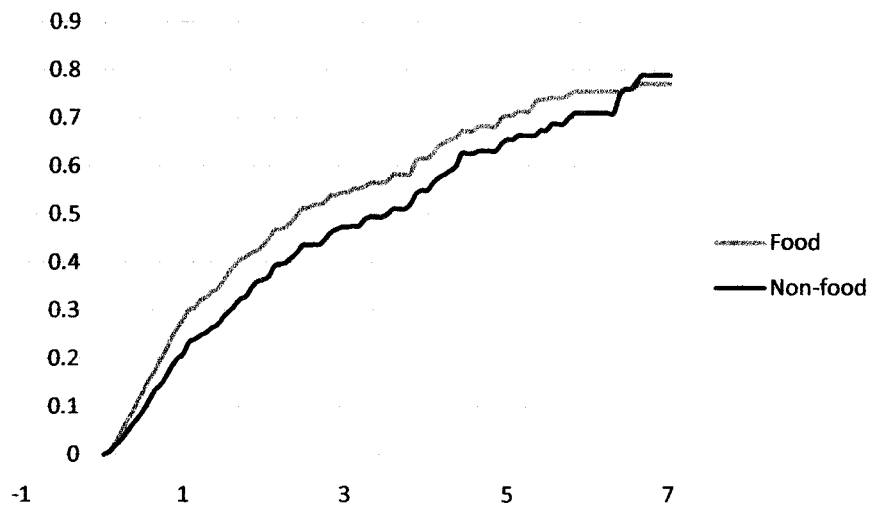


Figure 8: Normalized CD-curves for Food and Non-food Commodities, $s = 2$, $\gamma = 1.5$

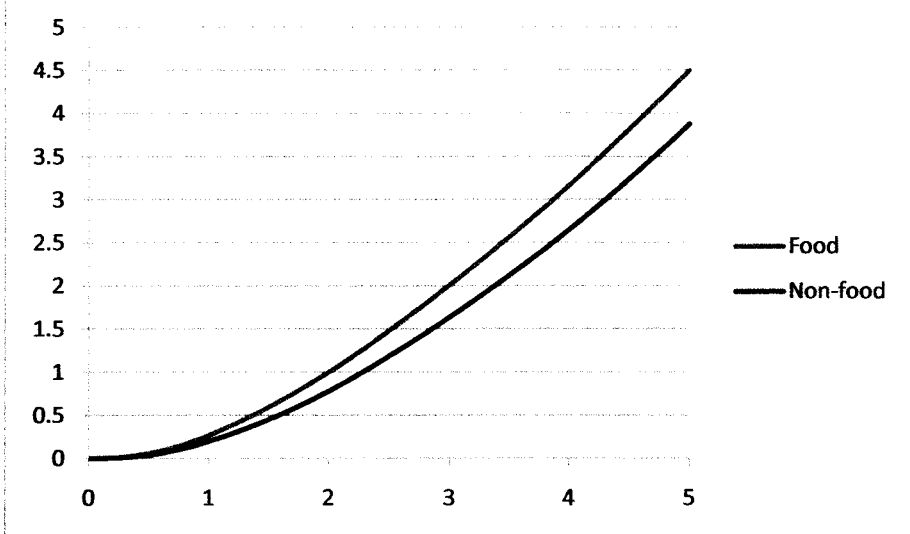


Figure 9: Normalized CD-curves for Food and Non-food Commodities, $s = 3, \gamma = 1.5$

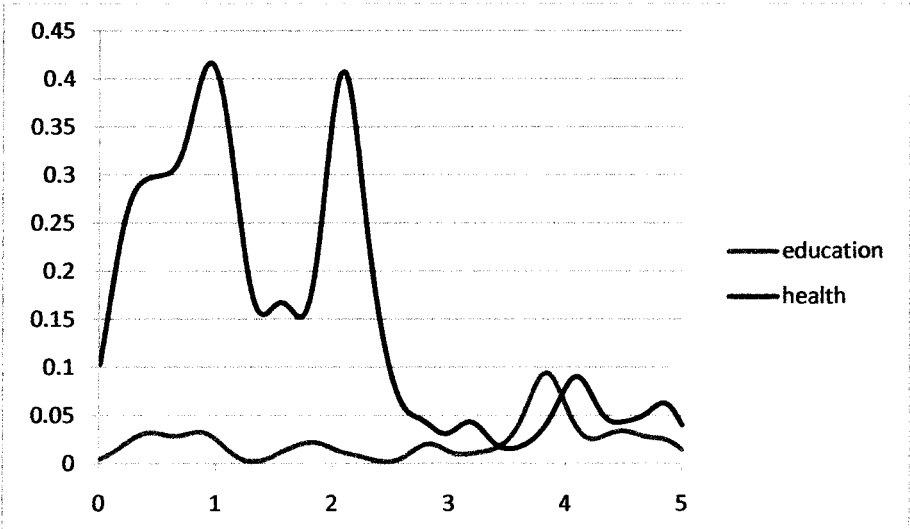


Figure 11: Normalized CD-curves for Education and Health Expenditure, $s = 1, \gamma = 0.5$

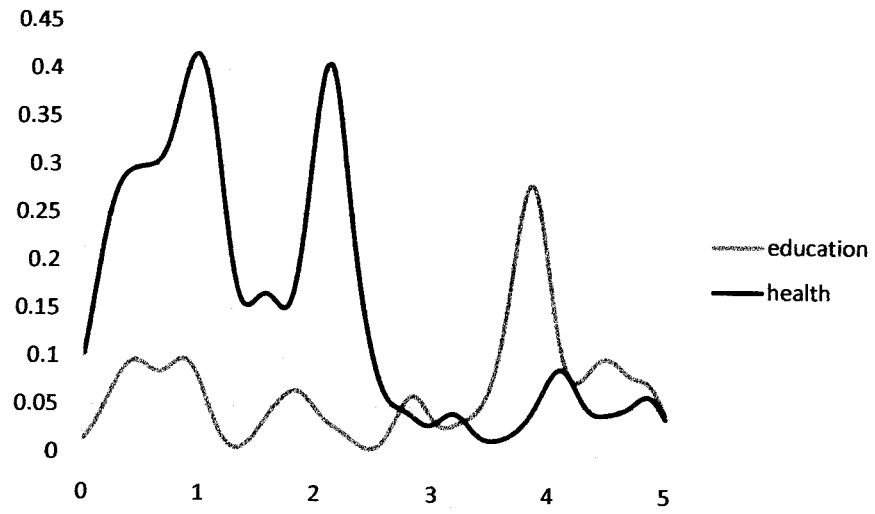


Figure 12: Normalized CD-curves for Education and Health Expenditure, $s = 1, \gamma = 1.5$