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A Theoretical and Empirical Investigation of the Application of an Endogenous Poverty Line and Its Relationship with the Poverty Impact of Policy Reforms

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A Theoretical and Empirical Investigation of the Application of an Endogenous Poverty Line and Its Relationship with the Poverty Impact of Policy Reforms*

Teguh Dartanto†

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Abstract

This research aims to theoretically and empirically investigate the difference of poverty outcome between applying a fixed and an endogenous poverty line. Applying the microeconomic theory of consumer behavior and the CGE-Microsimulation, this study has theoretically and empirically proven that, if a fixed poverty line is applied, the poverty impact of policy reforms (economic shocks) which significantly increase (decrease) price will always be underestimated (overestimated). This study empirically found that there is 0.316 percentage point difference in the poverty outcome between applying the endogenous poverty line and the fixed poverty line when analyzing the impact on poverty in Indonesia of 100 percent increase in the world soybean price. Supposing the fixed poverty line, the poverty rate will increase by 0.180 per cent, while supposing the endogenous poverty line, the poverty rate will increase by 0.496 per cent. Therefore, applying either an endogenous or a fixed poverty line will have a different policy implication.

Keywords: Endogenous Poverty Line; Poverty; Economic Modeling; CGE; Micro-simulation; Economic Development
JEL : D11, I32, O12

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1 Introduction

Policy reforms (economic shocks) frequently have a large impact on the household welfare through changing both the price level and income (factors' income). How policy reforms (economic shocks) influence price and income could be explained clearly by the framework of the aggregate demand and the aggregate supply in the macroeconomic theory. The policy reforms (e.g. intervention policies) such as a decrease in value added tax or increase in public investment in infrastructures, will shift the aggregate demand curve to the right side. Supposing there is no change in the aggregate supply curve, the shifting of the aggregate demand curve to the right side will increase both the price and income.

In the case of poverty, a price increase would reduce the household's ability to afford an initial bundle of consumption; thus, the new consumption bundle might be below the poverty line (the threshold of minimum consumption). On the contrary, an increase in factors' income would increase the household's income, which implies an increase in the ability to consume. The increase in household consumption above the poverty line will change the household's status from poor to non-poor. Moreover, an increase in price will directly change the money metric of obtaining 2,100 calories as the minimum standard calories for measuring the poverty line (Ravallion, 1994 [21]; Decaluwe, Savard and Thorbecke, 2005[11]).

Therefore, it could be summarized that policy reforms (economic shocks) that increase the price level will have double effects on poverty: 1) reduce the purchasing power and 2) increase the poverty line. The first effect has been observed by many studies which are mainly focused on the relationship between changes in price (inflation) and poverty. Powers (1995)[19] using US data set found that inflation worsens a consumption-based poverty measure over 1959-92, but has no significant impact on the income-based poverty rate. Datt and Ravallion (1996)[10] found in a cross-time, cross-state study of India that observations with higher inflation rates also had higher poverty rates. Agenor (1998)[1] also found poverty rates to be positively related to inflation in cross-country data. Moreover, Son and Kakwani (2006)[14] showed changes in price influence to poverty in terms of two components, income effect and distributional effect. The income effect measures the change in poverty when all prices increase uniformly, whereas the distributional effect captures the changes in poverty because of the changes in relative prices.

However, most of the study on the poverty impact of policy reforms does not much pay attention to the second effect, as the poverty line is assumed as a fixed line; thus, the poverty outcome of policy reforms may underestimate and mislead in policy guidance. This research aims to theoretically and empirically investigate the difference of poverty outcome between applying a fixed and an endogenous poverty line. This study consists of three main sections. The first section briefly explains the theoretical framework of poverty measurement, the graphical analysis and the mathematical model. The mathematical model consists of the microeconomic theory of consumer behavior, the poverty function and the mathematical proof. All

frameworks are intuitively and mathematically intended to show the difference of poverty outcome between applying both poverty lines.

The second section explains the methodologies intended to prove empirically the difference of poverty outcome between applying both lines. This part describes a computable general equilibrium (CGE)-microsimulation model, the endogenous poverty line and the poverty calculation. The third section discusses the empirical evidence of the poverty impact of policy reforms between applying the endogenous poverty line and the fixed poverty line. The economic shock used in the empirical evidence is the dramatic increase in the world soybean price while the policy reform is the import tariff policy in soybean products. These issues are chosen because, since 2007, the world has experienced a dramatic surge in the world price of food commodities. The price of soybeans sharply rose from USD 255.87/metric ton (Jan. 2007) to USD 552.47/metric ton (June 2008) and then significantly decreased to USD 379/metric ton (Dec. 2009). Moreover, responding to a volatile world price of soybean and protecting the poor from high food prices, the government of Indonesia has a flexible policy to decrease or increase import tariffs of soybean products. Lastly, this study will end with some main findings and policy recommendations.

2 Theoretical Frameworks

2.1 Poverty Measurement

2.1.1 Poverty Definition

There are two main approaches for measuring poverty: 1) welfare approach and 2) non-welfarist approach. The welfare approach interprets "welfare" as an (interpersonally comparable) utility, i.e. attainment of personal satisfaction. Poverty means not having a sufficient income to attain some normative (reference) level of utility. Meanwhile, the non-welfarist approach is divided into two schools of thought: basic needs approach and capabilities approach. The basic needs approach attempts to define the absolute minimum resources necessary for long-term physical well-being, usually in terms of consumption goods. The poverty line is then defined as the amount of income required to satisfy those needs. On the other hand, the capabilities approach, well known as Sen's Capabilities Approach, argues that welfare should be thought of in terms of the functioning ("beings and doings") that a person is able to achieve. Poverty means not having a sufficient income to support specific normative functioning. Utility can be viewed as one such functioning relevant to well-being, but only one. Independently of utility, one might say that a person is better off if she or he is able to participate fully in social and economic activity (Ravallion, 1994[21]; 1998[20]).

The problem of defining and measuring poverty has been debated in the last decade, because there are many definitions and methods for calculating the poverty

incidence and the poverty has multi-characteristics. Researchers in the poverty field employ a wide definition of poverty. All definitions can basically fit into one of the following categories (Hagenaars and De Vos, 1988[13]): 1) poverty is having less than objectively defined, absolute minimum; Basic Needs Approach defines the absolute minimum in terms of "Basic Needs" such as food, clothing, and housing. 2) Poverty is having less than others in society. 3) Poverty is feeling people who do not have enough to survive; subjective minimum income definition stated that if their actual income level is less than the amount they consider being "just sufficient", they are categorized as poor.

The choice of a certain definition is often made on the basis of the pragmatic argument of data availability. However, most researchers agreed that poverty can be conceptualized in the idea of absolute deprivation suffered by the population. A person suffers from absolute deprivation if he or she cannot enjoy the society's minimum standard of living. If one accepts a definition of minimum standard of living as consumption at a certain level which is mainly known as the poverty line (z), then the poverty measurement is straightforward: those with consumption expenditure (E) below the line are considered "poor" and the rest are "non-poor".

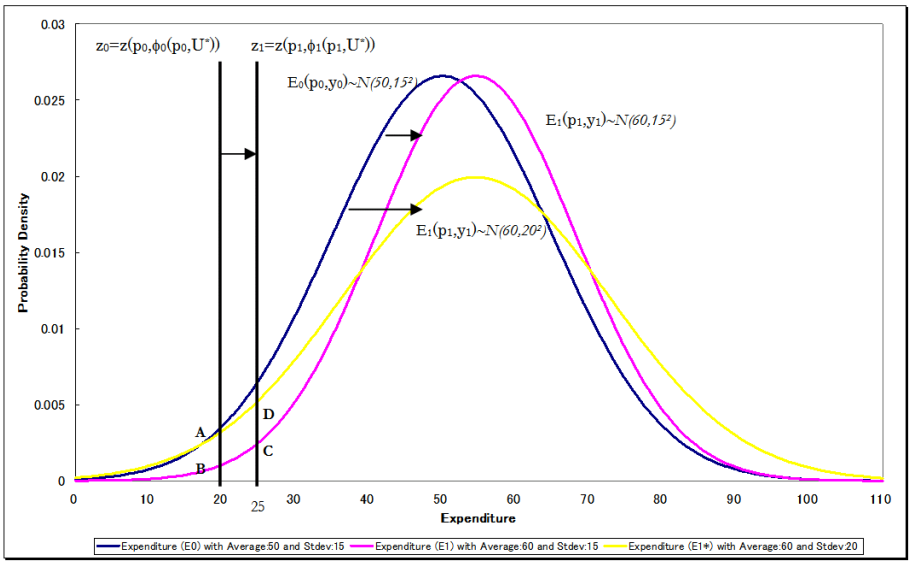
The consumption expenditure should theoretically be function of price and income, $E(p, y)$, while the ideal poverty line should be the minimum cost to a given individual of a reference level of welfare fixed across all individuals, (U^*) (Ravallion, 1994[21]). Thus, the poverty line can be defined as cost of achieving (U^*)when facing price vector p and the vector of consumption bundle (ϕ). Therefore, the poverty line can be defined as $z(p, \phi(p, U^*))$. The consumption expenditure function and the poverty line will specifically be explained in the mathematical model.

2.1.2 The Graphical Analysis: the Difference Outcome between Applying a Fixed and an Endogenous Poverty Line

Figure 1 shows the graphical analysis of the difference in poverty outcome of applying the endogenous or the fixed poverty line. The initial poverty incidence is the area of the expenditure distribution curve, $(E_0(p_0, y_0)\tilde{}N(50, 15^2))$, below the initial poverty line, $(z_0 = z(p_0, \tilde{}\phi_0(p_0, U^*))$, which is equal to the area of 020A. If the policy reforms (economic shocks) affect an increase in income and price level and assuming the constant income distribution and the fixed (constant) poverty line, the poverty incidence will decrease significantly from the area of 020A to the area of 020B. However, it is very difficult to guarantee that the effect of policy reforms could be equally distributed among households. Hence, the income distribution might be changed responding to policy reforms (economic shocks). Under the fixed poverty line and changing income distribution, the new poverty incidence is not very different from the initial poverty incidence. It is shown by the area of the expenditure distribution curve $(E_1(p_1, y_1)\tilde{}N(60, 20^2))$, below the poverty line $(z_0 = z(p_0, \tilde{}\phi_0(p_0, U^*))$, is almost equal to the area of the expenditure distribution curve $(E_1(p_1, y_1)\tilde{}N(50, 15^2))$ below the poverty line $(z_0 = z(p_0, \tilde{}\phi_0(p_0, U^*))$. Hence,

the policy reforms or economic shocks do not successfully decrease the poverty incidence.

Figure 1: **An Illustration of Poverty Impact of Shifting the Expenditure Distribution Curve and the Poverty Line responding to Change in Price and Income Level**



Source: Author
Note: p_0 is the initial price level while p_1 is the new price level as a result of po-licy reforms (economic shocks). y_0 is the initial income level whiley_1 is the new income level. ϕ_0 is the initial minimum consumption bundle both food and non-food while ϕ_1 is the new minimum consumption bundle both food and non-food after policy reforms (economic shocks). $z_0 = z(p_0, \phi_0(p_0, U^*))$ is the initial poverty line when price level p_0. $z_0 = z(p_1, \phi_1(p_1, U^*))$ is the endogenous poverty line. $E_0(p_0, y_0)\tilde{}N(50, 15^2)$ is the initial expenditure distribution function which is normally distributed with average=50 and variance $= 15^2$. $E_1(p_1, y_1)\tilde{}N(60, 15^2)$ is the new expenditure distribution function which is normally distributed with average=60 and variance $= 15^2$. $E_1(p_1, y_1)\tilde{}N(60, 20^2)$ is the new expenditure distribution function which is normally distributed withaverage $= 60$ and variance$= 20^2$.

However, assuming the fixed (constant) poverty line, when the price level is significantly changed, it does not seem appropriate. It should be remembered that the common starting point of many poverty calculations is a food intake requirement of 2,100 calories per person per day (Ravallion, 1994[21]); therefore, the increasing commodity price would also increase the money metric of obtaining 2,100 calories, therefore, the poverty line will change following a variation in relative prices. If the poverty line becomes endogenous following the price change, $(z_1 = z(p_1, \phi_1(p_1, U^*))$, and the income distribution is assumed as a constant, the new poverty incidence is the area of 025C which is larger than that of 020B. Moreover, if the poverty line becomes endogenous and the income distribution changes following the price

and income changes, the new poverty incidence is the area of 025D which is larger than either that of 020A or 020B. Therefore, the policy reform, which pushes high inflation and worsens the income distribution, is not beneficial to the poor.

According to this figure, the impact of policy reforms or economic shocks on poverty depends on three main parts: 1) change in household expenditure distribution following change in price and income level; 2) change in income distribution since the impact of policy reforms commonly does not equally distributed among households; 3) change in the poverty line following change in the price level. It can also be concluded that supposing the fixed poverty line, the poverty impact of policy reforms (economic shocks) which significantly increase (decrease) price level in the economy will always underestimate (overestimate); consequently, it might provide biased policy guidance.

2.2 Mathematical Model

2.2.1 Microeconomic Theory of Consumer Behavior

The graphical illustration has clearly shown the underestimate of poverty incidence when the fixed poverty line is applied to analyze policy reforms (economic shocks). In order to strengthen the finding from the graphical analysis, this study would like to prove mathematically the underestimate of poverty impact of policy reforms when the fixed poverty line is applied. The microeconomic theories of consumer behavior - both the Utility Maximization Theory (UMP) and the Expenditure Minimization Theory (EMP) - will be utilized as a basic framework for examining how important an application of an endogenous poverty line is when analyzing the poverty impact of policy reforms.

We assume throughout that the consumer has a rational, continuous, and locally non-satiated preference relation, and we take $U(x)$ to be a continuous utility function representing this preference. The consumption set is $X = R^l_+$ in which l is a unit of commodity ($1 \leq i \leq l$). The initial income is y which comes from selling its endowment of labor and capital for production activities. The price vector is $p = (p_i, ..., p_l)$ in which p_i is the price of a unit of commodity ($1 \leq i \leq l$). Therefore, the set of all feasible commodity bundles for the consumer is $B(p, y) = \{x \in X | px \leq y\}$. The set $B(p, y)$ is called the budget set of the consumer if his income is y and the price system is p.

Then the optimization problem of a consumer with utility function $U(x)$, income y and price system p is max $U(x)$ subject to $px \leq y$, $x \geq 0$. This optimization results in the consumer's demand function $x = x(p, y)$. If $x = x(p, y)$ is the consumer's demand function, the indirect utility function of the consumer is $V = R^{l+1}_{++}$ which is given by $V(p, y) = U(x, (p, y))$. The properties of $V(p, y)$ are strictly increasing in y for all p and non-increasing in for all i=1,. . . ,l (decreasing in p); homogeneous of degree zero in (p,y), continuous in (p,y), and quasi-convex in (p,y) (Mas-Colell,

Whinston and Green, 1995, pp.56[18]).

On the other hand, the consumer can also look for a commodity bundle which guarantees him to achieve a utility level $U(x)$ with minimum expenditure y. This is well known as the expenditure minimization problem (EMP). The value of the EMP is denoted $e(p, U)$ which is called the consumer's expenditure function. Its value for any (p, U) is simply px^*, where x^* is any solution to the EMP. The properties of $e(p, U)$ are strictly increasing in U for every p and non-decreasing in for all i=1,. . . ,i; homogeneous of degree one in p; concave in p; continuous in p and U (Mas-Colell, Whinston and Green, 1995, pp.59)[18]. The set of optimal commodity in the EMP is denoted $h(p, U)$ and is known as the *Hicksian, or compensated, demand correspondence, or function* if single-valued. One of the properties of the Hicksian demand correspondence $h(p, U)$ is homogeneity of degree zero in p : $h(\alpha p, U) = h(p, U)$ for any p, U and (Mas-Colell, Whinston and Green, 1995, pp.61)[18].

If the x^* is the solution to the Utility Maximization Problem (UMP) when $y = px^*$, in which x^* is a solution to the problem of maximization $U(x)$ subject to $px \leq y$ and $x \geq 0$, then x^* is also the solution of the Expenditure Minimization Problem (EMP) when the required utility level is $U(x)^*$. Moreover, the minimized expenditure level in this EMP is exactly y. If the x^* is optimal in the EMP when required utility level is $U(x) > U(0)$, then x^* is optimal in the UMP when income is $y = px^*$. Moreover, the maximized utility level in this UMP is exactly U. The EMP is the "dual" problem to the UMP. From UMP and EMP, then we have:

$$y = px^* = e(p, U) = e(p, U(x^*)) = e(p, V(p, y)) \tag{1}$$

$$U = U(x^*) = V(p, y) = V(p, px^*) = V(p, e(p, U)) \tag{2}$$

$$h(p, U) = x^*(p, y) = x^*(p, e(p, U)) \tag{3}$$

$$x^*(p, y) = h(p, V(p, y)) \tag{4}$$

2.2.2 Poverty Function

Even though, there are many definitions, measurements and characteristics of poverty, this study simplify defines that poverty is those with consumption expenditure below the line are considered "poor" and the rest are "non-poor". According to Atkinson (1970)[2], Kakwani (1980[15]; 1993[16]), Foster, Greer and Thorbecke (1984)[12], and Sen (1973[22]; 1976[23]), it could be summarized that the poverty (HC) is a function of the welfare indicator (w), the poverty line (z) and the income distribution (σ). The poverty function is shown as follows:

$$HC = f(w, z, \sigma) \tag{5}$$

The properties of poverty function are continuous and decreasing in w, continuous and increasing in both z and σ. Decreasing in w implies poverty indicators will decrease following an increase in the welfare indicators. The measurable welfare

indicators commonly used in analyzing poverty are either income or expenditure. Meanwhile, increases in both z and implies that poverty indicators will increase in line with an increase in the poverty line and the income distribution. Supposing the expenditure as the welfare indicator and following Eq.1, then we have the welfare function shown below:

$$w = y = px^* = e(p, U) = e(p, V(p, y)) \tag{6}$$

On the other hand, the ideal poverty line should then be the minimum cost to a given individual of a reference level of welfare fixed across all individuals, (U^*) (Ravallion, 1994[21]). Thus, the poverty line can be defined as cost of achieving (U^*) when facing price vector p and the vector of consumption bundle (ϕ). The vector of consumption bundle (ϕ) is a function of p and U^*, $\phi(p, U^*)$ the Hicksian demand correspondence. $\phi(p, U^*)$ is the minimum consumption bundle to achieve (e.g. 2,100 calories) when price vector is p. According to Eq. 3 and Eq. 4, $\phi(p, U^*)$ must be equal to $\varphi(p, y)$, the demand function. Thus, the poverty line can be shown as below:

$$z = z(p, \phi(p, U^*)) \tag{7}$$

The poverty line, $z = z(p, \phi(p, U^*))$, is continuously increasing in p and ϕ . Suppose $U*$ is a fixed value[1], then $U_t^{*\prime} = \frac{\partial U^*}{\partial t} = 0$, and the one property of the Hicksian demand correspondence is the homogeneity of degree zero in p, then $\frac{\partial \phi}{\partial U^*}$ and $\frac{\partial \phi}{\partial p} = 0$.

Lastly, let us simplify that the income distribution, which is mainly measured by either the Gini Index or Theil Index,σ is a function of the distribution of endowments (ω) among households in a society. Endowments could be defined as labor, capital, land ownership and education attainment etc. Let us assume that the properties of income distribution are continuous and increasing in ω. Increasing in means an unequal distribution of endowments in society related to more unequal in income distribution. The income distribution function is shown below:

$$\sigma = \sigma(\omega) \tag{8}$$

Substituting Eq.8, Eq.7, Eq.6 into Eq.5, then we obtain the poverty function as shown below:

$$HC = f(e(p, V(p, y)), z(p, \phi(p, U^*)), \sigma(\omega)) \tag{9}$$

2.2.3 The Mathematical Proof of Different Poverty Outcome

As mentioned in the graphical analysis, if the fixed poverty line is applied, the poverty impact of policy reforms (economic shocks) which increase (decrease) the

[1]The utility is fixed because the standard reference of welfare as a basis of calculation of poverty line is not easily changed overtime. For instance, the minimum standard of 2,100 calories for measuring the poverty line does not change for many years.

price level will always be underestimated (overestimated). This study will mathematically prove the evidence from the graphical analysis by utilizing Eq. 9 and the properties of expenditure function, indirect utility function, poverty function and income distribution function.

Proposition:
Supposing the application of a fixed poverty line, the poverty impact of policy reforms which largely increase (decrease) the price level, will always be underestimated (overestimated).

Proof:
Let us take the total derivate of Eq.9 and if,
$HC'_t = dHC/dt; f^t_e = \partial f/\partial e; e'_p = \partial e/\partial p; p'_t = \partial p/\partial t e'_V = \partial e/\partial V; V'_p = \partial V/\partial p; V'_y = \partial V/\partial y; y'_t = \partial y/\partial t; f'_z = \partial f/\partial z; z'_p = \partial z/\partial p; z'_\phi = \partial x/\partial \phi; \phi'_p = \partial \phi/\partial p; z'_u = \partial z/\partial U^*; \phi'_{U^*} = \partial \phi/\partial U^*; U^*_t * \prime = \partial U^*/\partial t; f'_\sigma = \partial f/\partial \sigma; \sigma'_\omega = \partial \sigma/\partial \omega; \omega'_t = \partial \omega/\partial t;$
then we have:

$$HC' = f'_e \cdot e'_p \cdot p'_t + f'_e \cdot e'_V \cdot V'_p \cdot p'_t + f'_e \cdot e'_V \cdot V'_y \cdot y'_t + f'_z \cdot z'_p \cdot p'_t + f'_z \cdot z'_\phi \cdot \phi'_p \cdot p'_t \cdot f'_z \cdot z'_{U^*} \cdot U^{*\prime}_t + f'_\sigma \cdot \sigma'_\omega \cdot \omega'_t \quad (10)$$

Suppose $U^{*\prime}_t = 0$ (there is no change in the reference of utility, U^*) and ϕ'_p (the homogeneity of degree zero in p), then Eq.10 will be:

$$HC' = f'_e \cdot e'_p \cdot p'_t + f'_e \cdot e'_V \cdot V'_p \cdot p'_t + f'_e \cdot e'_V \cdot V'_y \cdot y'_t + f'_z \cdot z'_p \cdot p'_t + f'_\sigma \cdot \sigma'_\omega \cdot \omega'_t \quad (11)$$

Since $F'_e < 0; e'_p > 0; p'_t > 0; e'_V >); V'_p < 0; V'_p > 0; y'_t > 0; f'_z > 0; z'_p > 0; f'_\sigma > 0; \sigma'_\omega > 0; \omega' > 0;$ and if $|(f'_e \cdot e'_p \cdot p'_t + f'_e \cdot e'_V \cdot V'_y \cdot y'_t)| > |(f'_e \cdot e'_V \cdot V'_y \cdot y'_t + f'_z \cdot z'_p \cdot p'_t + f'_\sigma \cdot \sigma'_\omega \cdot \omega'_t)|$, then the sign of change in poverty (HC) is negative. It means that the policy reforms or economic shocks benefit the poor. On the contrary, if $|(f'_e \cdot e'_p \cdot p'_t + f'_e \cdot e'_V \cdot V'_y \cdot y'_t)| < |(f'_e \cdot e'_V \cdot V'_y \cdot y'_t + f'_z \cdot z'_p \cdot p'_t + f'_\sigma \cdot \sigma'_\omega \cdot \omega'_t)|$, then the sign of change in poverty (HC) is positive meaning the policy reforms or economic shocks do not benefit the poor.

Eq.11 intuitively shows that the change in poverty responding to policy reforms or economic shocks depends on five components: 1) change in household expenditure as a result of a change in price, 2) change in household expenditure as a response to utility change due to a change in price, 3) change in household expenditure as a response to utility change due to a change in income, 4) change in poverty line as a response to a price change, 5) change in income distribution as a response to a change in endowment.

Eq.11 represents the poverty impact of policy reforms under the endogenous poverty line. The part of $f'_z \cdot z'_p \cdot p'_t$ in Eq.11 is the change of the poverty indicator contributed by the change in the poverty line. Deleting $f'_z \cdot z'_p \cdot p'_t$ in Eq.11, then we have:

$$HC'^{fix}_t = f'_e \cdot e'_p \cdot p'_t + f'_e \cdot e'_V \cdot V'_p \cdot p'_t + f'_e \cdot e'_V \cdot V'_y \cdot y'_t + f'_\sigma \cdot \sigma'_\omega \cdot \omega'_t \quad (12)$$

Eq.12 represents the poverty impact of policy reforms under the fixed poverty line. There is no change in the poverty indictor contributed by the change in the poverty

line. The different poverty outcome between applying the endogenous poverty line and the fixed poverty line can be calculated by deducting Eq.12 from Eq.11. The different outcome is shown below:

$$HC'_t - HC'^{fix}_t = f'_z \cdot z'_p \cdot p'_t > 0 \tag{13}$$

According to Eq.13, if $p'_t > 0$, the poverty outcome under the endogenous poverty line will always be large than that of the fixed poverty line. However, if the policy reforms or economic shocks did not affect the price level, then the poverty outcome either under the endogenous poverty line or the fixed poverty line will be equal. Therefore, the proposition, that supposing the application of a fixed poverty line, the poverty impact of policy reforms which largely increase (decrease) the price level will always be underestimated (overestimated) can be mathematically proven. **QED**

3 Research Methodology

3.1 A CGE-Microsimulation

In order to show empirical evidence of the different outcome between applying the endogenous poverty line and the fixed poverty line, this research will utilize the CGE-Micro Simulation Approach (CGE-MS). The general idea of the CGE-MS approach is that a CGE model feeds market and factor price changes into a microsimulation household model. The main advantage of this approach is that it provides richness in household behavior, while remaining extremely flexible in terms of specific behaviors, which can be modeled. The main drawbacks to the approach are the coherence between the macro and micro models, which is not always guaranteed, and the fact that the feedback effects of household behavior are not taken into account in the CGE/Macro model. Chen and Ravallion (2003)[7], Boccafunso and Savard (2006)[3] and Dartanto (2009)[8] utilized this approach to address many issues related to poverty analysis. Chen and Ravallion (2003)[7] used this methodology and built microsimulations on economic assumptions that are consistent with the CGE model notably that households take prices as given and those prices clear all markets - they also did not attempt to assure full consistency between the micro-analysis and the CGE model's predictions.

There are five steps in calculating the impact of the volatility of world price and tariffs policy on poverty: First, calculate the initial condition of poverty utilizing the 2005 Susenas data (National Socio Economic Survey), covering 64,407 households, published by the Central Statistic Agency of Indonesia (Badan Pusat Statistik (BPS)). Second, using the CGE model, simulate the impacts of change in the world prices and import tariffs of soybeans on the domestic price (including factors' income). Third, data on the increases in prices (including factors' income) obtained from the CGE model is entered into the Susenas data set to calculate the impact of the fluctuating world price and import tariffs on household welfare. This

step is known as the microsimulation procedure. Fourth, adjust the poverty line using the price changes obtained from the CGE in which the poverty line becomes endogenous. Fifth, recalculate the poverty incidence using the data from step three and four and then compare it with the initial poverty incidence.

3.2 Indonesian Computable General Equilibrium

Computable General Equilibrium (CGE) models are a class of economic model that use actual economic data to estimate how an economy might react to changes in policy, technology or other external factors. The static CGE model is built based on the extension of the 2005 Indonesian Social Accounting Matrix (SAM) and follows the algorithm of the International Food Policy Research Institute (IFPRI) standard CGE model which was developed by Lofgren, Harris, and Robinson (2001)[17]. The data used for the extension of SAM refers to the 2005 Input-Output Table, the 2005 National Socio-Economic Survey, the labor force survey, and other sources. (BPS, 2005a, 2005b, 2005c)[4],[5], [6].

Activities/Commodities
The extended 2005 Indonesian SAM has 26 industry/commodity categories: food crops; soybeans; other crops; livestock; forestry; fishery; oil and metal mining; other mining and quarrying; rice; others food and beverage industry; textile-clothes-leather industry; wood processing industry; pulp-paper and metal industry; chemical industry; electricity-gas-water; construction; trade; restaurant; hotel; land transportation; air-water transportation and telecommunication; warehousing; financial services; real estate; government and private services; and individual/other services.

Factors Production
The factors production in this SAM is basically classified into five factors: agricultural labor, production-operator-unskilled labor, sales and administration (semi-skilled), skilled labor and non-labor factor included land and capital. However, each factor except non-labor factor is further divided into two categories: rural and urban labor. Hence, the total factors production is nine categories.

Institution and Household
There are three main institutions on the 2005 SAM: government, enterprise and household. The representative household is basically divided in to four categories: agricultural households, non-agricultural household, enterprise and government. The agricultural households are classified into agricultural labor, agricultural household with less than 0.5 hectare of land, agricultural household with land between 0.5 to 1 hectare, and agricultural household with more than 1 hectare of land. Non-agricultural household is separated in to rural and urban household. Each category of household in urban and rural is classified in to low-income group, non-labor force household and high-income group. Furthermore, other institutional accounts are the rest of the world (export-import), saving-investment and taxation. Taxation is divided into indirect tax, subsidy, income tax and import tariff.

Elasticity
The elasticity data used in this CGE refers to sources such as the elasticity in the Indonesian IFPRI CGE Model, Wayang Model and other estimations on elasticity. The Armington elasticities, the elasticity of substitution between imports and domestic output in domestic demand are 0.5 for all commodities except soybeans (2.0), rice (2.0), agricultural food commodity (1.5) and agricultural food industry (1.5). The constant elasticity of transformation (CET) for domestic marketed output between exports and domestic supplies is set equal to 0.5 for all commodities except rice (2.0), soybeans (1.5), agricultural food commodity (1.5), and agricultural food industry (1.5). The elasticity of substitution (CES) between factors production is 0.25 for all activities. The elasticity of substitution between aggregate factors and intermediate input is 0.5 and the elasticity of output aggregation for commodities is 6. Furthermore, household consumption is modeled under the Linear Expenditure System (LES), in which the elasticities vary between commodities, and the elasticity is less than 1 for food products and more than 1 for industrial products and services.

3.3 Microsimulation

The policy reforms (economic shocks) will influence household's welfare through the change in prices of domestic commodities and change in factors income. The microsimulation procedure basically translates how price (factors income) changes resulted from the CGE can influence the household's welfare. This research modified Ravallion and Chen's (2003)[7] work to calculate the monetary value of household's welfare changes responding to the changes in prices and factors income. The increasing price would reduce the household's ability to afford the initial bundle of consumption while the increasing of factors income would increase the household's income. The formula of household's welfare change is shown below:

$$\Delta W_i = -\sum_{j=1}^{m} p_j(q_{ij} - s_{ij})\frac{dp_j}{p_j} + \sum_{k=1}^{n}(w_k L_{ik}\frac{dw_k}{w_k}) + \sum_{j=1}^{l}(r_i K_{il}\frac{dr_l}{r_l}) \qquad (14)$$

ΔW_i is the welfare change of household-i, i: 1,2,3,...,64,407; q_{ij} is quantity of product-j consumed by household-i, j=1,2,3,...,26; s_{ij} is the quantity of product-j provided/supplied by household-i; $(q_{ij} - s_{ij})$ is the net consumption of product-j which must be bought by household-i; According to the SUSENAS dataset, the value of household consumption is always larger than or equal to the value of household production $q_{ij} \geq s_{ij}$; p_j is the price of product-j; $dp_j$is the price change of product-j; L_{jk} is the labor supply of household-i in sector-k, k=1,2,...,8; w_k is the wage in sector-k; dw_k is the wage change in sector-k; K_{il} is the non-labor endowment of household-i; r_i is the rate of return; and dr_i is the change in the rate of return.

The change of household welfare is the sum of the change in household expenditure and household income. The negative sign of the first part of the formula indicates that increasing the price will increase the household's expenditure, which means lowering the household's welfare. Conversely, the positive sign of the two last

parts of the formula indicates that increasing the wage and non-labor rate of return will increase the household income, thus increasing the household's welfare.

The formula assumes that the change of household welfare will directly influence the household's consumption/expenditure and there is no saving activity, i.e. households are not allowed to save the net welfare. The new expenditure function is shown below:

$$E_i((p_{0j} + \Delta p_j), (y_{0i} + \delta W_i)) = E_{0i}(p_{0j}, y_{0i}) + \Delta W_i \tag{15}$$

$E_i((p_{0j}+\Delta p_j), (y_{0i}$ is household-i's expenditure after the simulations in the world rice and import tariff of rice; $E_{0i}(p_{0j}, y_{0i})$ is the initial household-i's expenditure; p_{0j} is the initial vector price and y_{0i} is the initial endowment/income of household-i. $E_{0i}(p_{0j}, y_{0i}) + \Delta W_i$ is used to calculate the new poverty incidence.

3.4 Endogenous Poverty Line and Poverty Calculation

BPS (The Central Statistic Agency of Indonesia) used 2,100 calories/capita/day resulted from 52 commodities to calculate the food poverty line. The food poverty line is heterogeneous among regions due to the differences in food price and food consumption pattern among regions. To obtain the poverty line, it must be added with non-food expenditures such as health, education, transportation etc. By 2005, the monthly monetary value of the national poverty line was IDR 117,259 (USD 11.7) in rural and IDR 150,799 (USD 15) in urban. BPS is updating the poverty line for each province every year.

The increasing commodity price would also increase the money metric of obtaining 2,100 calories therefore the poverty line will change following a variation in relative prices (Decaluwé, Savard and Thorbecke, 2005)[**?**]. Hence, the initial food poverty line should be adjusted with the price change of food products as proportional to the share of those products in the poverty line and also be adjusted with the price change of non-food products. We assume that the composition of commodities in the poverty line does not change following the change in prices. This assumption follows the fact that the commodities in the poverty line are basic need products that are price inelastic. We also found that the composition and quantity of commodities in the poverty line does not much change in SUSENAS 2002, 2005 and 2008. The endogenous poverty line can theoretically be calculated as below:

$$z = \sum_{j=1}^{n} p_j \bar{\phi_j}(1 + \frac{dp_j}{p_j}) + \sum_{k=1}^{m} p_k \bar{\phi_k}(1 + \frac{dp_k}{p_k}) \tag{16}$$

Where, z is the poverty line; $\sum_{j=1}^{n} p_j \bar{\phi_j}$ is the food poverty line; $\sum_{k=1}^{m} p_k \bar{\phi_k}$ is the non-food poverty line; p_j is the food price-j, j=1,. . . ,n; $\bar{\phi_j}$ is the minimum consumption of food product-j; dp_j is the change in food price-j, j=1,. . . ,n; p_k is the non-food price-k, k=1,. . . ,m; $\bar{\phi_k}$ is the minimum consumption of non-food product-k, k=1,..,m; dp_k

is the change in non-food price-k, k=1,. . . ,m; However, the Central Statistic Agency (BPS) only annually published the aggregate value of the food poverty line (PFL) and the non-food poverty line (NFPL) for each province at rural and urban levels, therefore, Eq.15 is modified as below:

$$z_{pr} = PL_{pr} = FPL_{0pr}(1 + \frac{\Delta FP_{pr}}{FP_{0pr}}) + NFPL_{0pr}(1 + \frac{\Delta NFP_{pr}}{NFP_{0pr}}) \tag{17}$$

Where, $z_{pr} = PL_{pr}$ is the poverty line in province-p, p=1,. . . ,30, at region-r, r=urban and rural; FPL_{0pr} is the initial food poverty line in province-p at region-r; ΔFP_{pr} is the change in composite food price in province-p at region-r; FP_{0pr} is the initial composite food price in province-p at region-r; $NFPL_{0pr}$ is the initial non-food poverty line in province-p at region-r; ΔNFP_{pr} is the change in composite non-food price in province-p at region-r; NFP_{0pr} is the initial composite non-food price in province-p at region-r. The price changes for either food or non-food price are the same over all regions. This is because the CGE model can only produce price and factor income changes at a national level. The composite prices of either food or non-food are calculated based on the composition of consumption in the Social Accounting Matrix and in the SUSENAS dataset.

In order to calculate the poverty, this study applies the FGT (Foster, Greer and Thorbecke, 1984[12]) formula. The modified formula is shown below:

$$HC_{\alpha} = \frac{1}{n}\sum_{i=1}^{q}(\frac{PL_r - E_{ir}}{PL_r}) \tag{18}$$

Where,HC_{α} is head count index (poverty incidence); n is the number of population; i is the individual-i; PL_r is the poverty line in region-r; E_{ir} is the expenditure of individual-i in region-r; q is the number of individuals below or at the poverty line; α is the parameter for the FGT. When α is zero, the poverty measure is the headcount index which represents the percentage of the population below the poverty line. The poverty-gap index, PG, which measures the depth of poverty, is calculated by setting to 1 and the squared poverty gap is obtained with equal to 2.

4 Empirical Evidence

The purpose of simulations is to empirically show the different outcomes between applying the endogenous poverty line and the fixed poverty line. The simulations are done under four scenarios: Simulation 1 (SIM_1) simulates 100 per cent increase in the imported soybean prices; Simulation 2 (SIM_2) simulates 60 per cent decrease in the imported soybean prices; Simulation 3 (SIM_3) simulates 100 per cent increase in the import tariff of soybeans; lastly, Simulation 4 (SIM_4) simulates 20 per cent decrease in the import tariff of soybeans. SIM_1 and SIM_2 can be viewed as simulations related with the external economic shocks, while SIM_3 and SIM_4

can be viewed as simulations related with the policy reforms. The simulations are done under the following closure rules: investment driven saving, flexible government saving and fixed direct tax rate, flexible exchange rate and fixed foreign saving, fixed capital formation, labor fully employed and mobile between activities, capital fully employed and activity-specific and price numereire-domestic producer price.

4.1 Changes in the Poverty Line

Table 1 shows that Simulation 1, 100 per cent increase in the imported soybean prices, significantly raises the composite price of soybeans in the domestic market by almost 50 per cent. This increasing is also followed by an increase in the prices of other agricultural products varying from 0.6 per cent to 1.8 per cent and a decrease in the prices of non-agricultural products varying from 0.03 per cent to 2.9 per cent. Consequently, responding to the external shock of 100 per cent increase in the imported soybean prices, the food poverty line should be raised by 0.83 per cent while the non-food poverty line should be decreased by 0.40 per cent. The poverty line averagely should be corrected by 0.38 per cent in the urban area and by 0.45 per cent in the rural area. Under Simulation 1, the poverty line in both areas increases varying from IDR 553.9 to IDR 1037.6 (Table 2).

On the other hand, Simulation 2, 60 per cent decrease in the imported soybean prices, drastically decreases the domestic composite price of soybeans by 46 per cent. In contrast to Simulation 1, the decreasing of the domestic composite price of soybeans is followed by an increase in the prices of non-agricultural products ranging from 0.13 per cent to 0.86 per cent and a decrease in the prices of other agricultural products ranging from 0.37 per cent to 1.6 per cent. Under Simulation 2, the food poverty line should be adjusted by -0.62 per cent and the non-food poverty line should be increased by 0.48 per cent. Therefore, the poverty line should be corrected by -0.31 per cent in the urban area and -0.39 per cent in the rural area. Under Simulation 2, the money metric of the poverty line in both areas decreases varying from IDR 377.7 to IDR 669.3 (Table 2). Simulation 3, 100 per cent increase in import tariff, raises the domestic composite price of soybeans by 7.6 per cent. Due to the price and income effect, the prices of agricultural products increase ranging from 0.1 per cent to 0.3 per cent and the prices of non-agricultural products decrease ranging from 0.02 per cent to 0.6 per cent. As a result, the food poverty line and the non-food poverty line should be adjusted by 0.13 per cent and -0.05 per cent respectively. Moreover, the poverty line will increase by 0.08 per cent in the urban area and 0.09 in the rural area. 100 per cent increase in the import tariffs of soybeans led to the increase in the provincial poverty line ranging from IDR 87.5 to IDR 165.8. Lastly, Simulation 4, 20 per cent decrease in the import tariff of soybeans, decreases the domestic composite price of soybeans by 1.6 per cent and decreases the composite price of agricultural products ranging from 0.034 per cent to 0.065 per cent. According to this simulation, the food poverty line and the non-food poverty line should be corrected by -0.035 per cent and 0.002 correspondingly. Thus, the

Table 1: **Change in Commodity Prices Resulted from CGE Simulations (in per cent)**

Commodity	SIM_1	SIM_2	SIM_3	SIM_4
Agricultural Food	1.800	-1.483	0.300	-0.065
Soybeans	50.000	-46.000	7.600	-1.600
Agricultural Non Food	1.600	-1.281	0.200	-0.059
Livestock	1.300	-1.076	0.200	-0.053
Forestry	1.800	-1.582	0.300	-0.064
Fishery	0.570	-0.369	0.100	-0.034
Oil, Gas, Metal Mining	-0.182	0.160	-0.099	0.013
Non Oil, Gas, and Metal Mining	-0.783	0.760	-0.100	0.017
Rice	-0.032	0.243	0.022	-0.014
Processed Food	-0.028	0.130	-0.024	-0.004
Textile Industries	-0.354	0.454	-0.060	0.004
Wood Industries	-0.246	0.353	-0.051	0.002
Machine and Metal Ind.	-0.378	0.359	-0.093	0.011
Chemical Industries	-0.274	0.358	-0.085	0.010
Electricity, Water and Gas	-0.758	0.855	-0.071	0.005
Constructions	-0.470	0.557	-0.091	0.010
Trade	-2.900	-2.000	-0.600	0.400
Restaurant	0.040	0.144	0.036	-0.017
Hotel	-0.477	0.559	-0.088	0.010
Land Transportation	-0.670	0.657	-0.094	0.011
Non-land Transp. and Telecommunication	-0.558	0.555	-0.067	0.005
Warehousehing and Transp. Services	-0.464	0.556	-0.079	0.008
Banking and Insurances	-0.740	0.852	-0.042	-0.001
Real Estate	-0.564	0.656	-0.074	0.006
Government Services	-0.532	0.650	-0.035	-0.003
Individual Services	-0.650	0.754	-0.061	0.003

Source: CGE Simulations

poverty line should be corrected by -0.025 per cent and -0.027 per cent respectively. Due to little effect on changing prices, Simulation 4 does not significantly change the provincial poverty line.

4.2 The Poverty Outcome under the Different Poverty Lines

Table 3 calculated based on the microsimulation procedure clearly shows the difference of outcome between applying the endogenous poverty line and the fixed poverty line. The initial poverty incidence in 2005 was 16.4 per cent which is equivalent to 34.3 million. If we utilized the endogenous poverty line, under Simulation 1, 100 per cent increase in the imported soybean prices significantly increases the head count index (poverty incidence) from 16.397 per cent to 16.893 per cent or equal to 0.496. However, if the fixed poverty line is applied, the poverty rate increases by only 0.180 per cent. It is found that there is 0.316 percentage point difference of outcome. This figure equals 661,010 people, a large number which cannot be easily neglected.

Table 2: **Change in the Poverty Line after Adjustment in Prices: Selected Provinces**

Province	Region	PL*	Change in Poverty Line (IDR)			
			SIM_1	SIM_2	SIM_3	SIM_4
North Sumatera	Urban	195,882	952.54	-614.42	152.22	-48.22
	Rural	166,608	951.09	-648.52	150.34	-45.26
Central Java	Urban	143,776	699.16	-450.98	111.73	-35.40
	Rural	120,115	685.69	-467.54	108.39	-32.63
Bali	Urban	166,962	811.91	-523.70	129.74	-41.10
	Rural	136,897	781.49	-532.87	123.53	-37.19
East Kalimantan	Urban	213,378	1037.62	-669.30	165.81	-52.53
	Rural	161,910	924.28	-630.23	146.10	-43.99
South Sulawesi	Urban	138,576	673.87	-434.67	107.69	-34.12
	Rural	97,027	553.89	-377.67	87.55	-26.36
Papua	Urban	193,307	940.02	-606.34	150.22	-47.59
	Rural	145,610	831.23	-566.78	131.39	-39.56

*Poverty Line in 2005 (IDR/Month)

In the disaggregate level, under the fixed poverty line, 100 per cent increase in the imported soybean prices is beneficial to the landless agricultural households. The head count index of landless agricultural household decreases by 0.089. As many cases of agricultural exporting countries, an increase in the world soybean prices gives an incentive to domestic producers to increase production of soybeans that raises the demand for agricultural labor, bidding up its wage. An increase in wage of agricultural sectors benefits landless agricultural households since they are mostly depended on selling labor as a main source of income. Therefore, an increase in the world soybean prices reduces the poor of landless agricultural households. However, a decrease in the poverty rate of landless agricultural households as response to 100 per cent increase in the world soybean prices might be true if Indonesia is a soybean exporting country. According to Food and Agriculture Statistic (FAO), since 2000, the imported soybeans have played a crucial role in supplying the domestic demand of soybean products. On average, the imported soybeans contribute more than 60 per cent of the domestic consumption of soybeans. Moreover, in 2007 Indonesia imported 1.44 million metric tons of soybeans for consumption, which was 71 per cent of domestic demand (Dartanto and Usman, 2011 forthcoming)[9]. Therefore, it is doubtful that 100 per cent increase in the imported soybean prices benefits agricultural households.

Simulation 2 (SIM_2), 60 percent decrease in the imported soybean prices, decreases poverty by 0.296 per cent under the endogenous line and 0.055 under the fixed poverty line. There are 0.242 per cent differences in outcome which equal 505,749 people. Under the endogenous poverty line, the poverty index of all household categories significantly shrinks particularly for households working in the electricity, water, gas and construction sectors, while under the fixed poverty index; the poverty index of all household categories except landholder and landless agricultural households also decreases. The decrease in the imported soybean prices reduce the

Table 3: **Change in the Head Count Index: Endogenous Poverty Line versus Fixed Poverty Line**

Sector	Pop*	IP**	Change in Head Count Index (Percentage Point Change)							
			Endogenuous Poverty Line				Fix Poverty Line			
			SIM1	SIM2	SIM3	SIM4	SIM1	SIM2	SIM3	SIM4
	57.3	23.81	0.53	-0.32	0.07	0.00	0.03	0.06	-0.01	0.00
1	20.4	25.73	0.39	-0.18	0.02	-0.04	-0.09	0.13	-0.04	-0.04
2	19.9	11.25	0.57	-0.44	0.10	-0.02	0.31	-0.25	0.05	0.00
3	14.3	17.66	0.73	-0.66	0.08	-0.12	0.55	-0.37	0.03	-0.02
4	47.2	10.81	0.39	-0.22	0.10	-0.02	0.16	-0.06	0.04	-0.01
5	26.8	6.94	0.58	-0.24	0.08	-0.02	0.41	-0.16	0.03	-0.02
6	23.2	15.81	0.39	-0.23	0.07	0.00	0.22	-0.02	0.05	0.00
Total	209.3	16.40	0.50	-0.30	0.08	-0.02	0.18	-0.05	0.02	-0.01

*Population in million; ** Initial Poverty 2005; 1=Agriculture (without Land); 2=Industry; 3=Electricity, Water, Gas and Constructions; 4="Trade, Hotel, Restaurant, Transportation and Telecommunication";5="Banking, Financial Int., Government and Private Services";6=Others.

factors income (wage rate) of agricultural labors which are mostly supplied by landless agricultural households and also decrease the income of agricultural producer due to drop in the price. Thus, both these groups suffer from the decreasing in the imported soybean prices. However, it again might be true if Indonesia is an exporting country.

Simulation 3, 100 per cent increase in the import tariffs of soybeans, will increase the number of poor by 161,131 people (0. 077 per cent) under the endogenous poverty line and 41,314 (0.020 per cent) under the fixed poverty line. Supposing a fixed poverty line, 100 per cent increase in the import tariffs seems beneficial to both landless agricultural households and agricultural households with land which is shown by decreasing the poverty index of both groups. These results might provide biased policy guidance. This is because under the assumption of the fixed poverty line, 100 per cent increase in the import tariffs of soybeans does not significantly affect an increase in poverty. This seems beneficial to either land owner or landless agricultural households. Therefore, the government might choose to increase import tariffs as one of its poverty alleviation policies. However, if the endogenous poverty line is applied, the poverty outcome is totally different; then government might not choose to increase the import tariffs of soybeans due to suffering to the poor in all household categories. Lastly, simulation 4 shows the poverty impact of 20 per cent decrease in the import tariffs of soybeans on poverty. Under the fixed poverty line, this policy will reduce the poverty index by 0.010 per cent (20,544 people) while, under the endogenous poverty line this policy will reduce the poverty index by 0.022 per cent (46,218 people). The author believes that since the imported soybeans contribute more than half of the domestic consumption, decreasing the import tariffs of soybeans will significantly advantage the poor.

5 Concluding Remarks

Many studies on the poverty impact of policy reforms or economic shocks have assumed the fixed poverty line; therefore, the poverty outcome might provide biased policy guidance due to the inappropriateness in outcomes. This study has theoretically and empirically proven that, under the fixed poverty line, the poverty impact of policy reforms (economic shocks) which significantly increase (decrease) price will always be underestimated (overestimated). However, if the policy reforms (economics shocks) do not change the price level in the economy, applying either the fixed poverty line or the endogenous poverty line will result in a similar outcome.

Applying the CGE-Micro Simulation Approach (CGE-MS), this study empirically shows that there is 0.316 percentage point difference of outcome between applying the endogenous poverty line and the fixed poverty line. This figure equals 661,010 people, a large number which cannot be easily neglected. Under the fixed poverty line, 100 per cent increase in the world price of soybean changes the poverty incidence by 0.180 per cent. Hence, due to a small impact on poverty, the government might not take an action responding to an increase in the world price of soybeans. However, if the endogenous poverty line is applied, the poverty incidence will change by 0.496 per cent. Then, the government might actively intervene to stabilize the domestic price of soybean in order to reduce the negative effect of increasing the world price. These results might provide biased policy guidance and have a different policy implication; therefore, policy makers should collect additional information to decide which of the results reflects the real condition.

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