The Impact of Trade Openness on Poverty via Agricultural TFP in Ethiopia: A Sequential Dynamic Computable General Equilibrium Micro Simulation Analysis[1]

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Abstract

This study tries to address the impact of trade on poverty through of agricultural total factor productivity (TFP). Thus, we employed a Sequential Dynamic Computable General Equilibrium Model linked to a Micro Simulation Model. We also used an econometric model to estimate the agricultural TFP of Ethiopia to create scenarios.

The estimation results of this study shows that trade openness has a positive impact on agricultural TFP and our simulation result revealed that the proposed policy change mainly tariff cut and trade induced agricultural TFP have an incremental effect on all macroeconomic variables. However, poverty is exacerbated due to trade openness and tariff reduction during the simulation period.

Key words: Trade Openness, Agricultural Total Factor Productivity (TFP), Dynamic Computable General Equilibrium (DCGE), Micro-simulation (MS), Poverty, Ethiopia

JEL Classification: C33, C68, D24, F1, I32

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1. Introduction

The importance of trade openness in the reduction of poverty has been debated over the last three decades (for example, Brooks, (2003), Hameed and Nazir, (2006), and Kruger, (2009). One of the major challenges has been how exactly is trade openness channelled to influence the level of poverty in developing countries. Winters (2000) identifies seven possible mechanisms by which trade openness influences poverty: Farm household; distribution channel; wage and employment; taxes and spending; shocks, risks and vulnerability; economic growth and technology (total factor productivity); and short-term adjustment. Among these channels total factor productivity can be regarded as the most important conduit to carry the trade openness impact on poverty.

This is because the livelihoods of the vast majority people in developing countries depend on the agricultural productivity, such as Ethiopia. The agricultural sector provides employment opportunity to the rural population, supply production for the domestic as well as for international markets (Dethier and Effenberger, 2011). This implies the advancement of the sector enables the governments of these nations to meet the target they set to alleviate poverty. This argument has been supported by the empirical works of various studies (Christiaensen and Demery, 2007; Loayza and Raddatz, 2009; Godoy and Dewbre, 2010).

Opening up of trade would have a positive impact on the agricultural TFP3 because it has a potential to provide and to transfer a variety of new technologies from abroad. This is supported by the work of Madsen (2005) that in the OECD[4] countries, international technology has an upbeat spill-over effects on TFP through trade. But, the effect of trade is not only limited to improving TFP, it can go beyond that. Sherman et.al. (2006) found that trade induced productivity gain can have a significant contribution in the

[3] TFP refers to Total Factor Productivity
[4] OECD is Organization for Economic Cooperation and Development

diminution of poverty. However, this may not be realized unless the policy makers create a conducive economic environment and trade reform with poverty mapping analysis that benefit the majority of the population in general and the rural dwellers in particular (Abebe and Alemayehu, 2011) . Focusing on Ethiopia, some scholars have tried to assess what would happen to the country's economic growth, inequality and poverty situation if trade openness is allowed in the economy, particularly, following Ethiopia's anticipated accession to the WTO[5] (For example, Dejene et al., 2007; Seid, 2007; Bisrat, 2009; Ermias, 2009). However, most of these works used only the removal of tariffs in order to capture the openness and thereby change in the poverty status. But, the complete tariff cut may not necessarily reflect the degree of openness. More importantly, these studies have also been limited in explaining the mechanisms by which trade influences poverty.

Therefore, this paper addresses the question how the trade openness influences poverty through agricultural TFP in Ethiopia. To this end, we will employ the Dynamic Computable General Equilibrium-Micro Simulation (DCGE-MS) models. The DCGE model is crucial in this kind of study because it can capture various markets in the economy, present outcomes in sectoral level in line with macroeconomic framework and ability to link the macroeconomic outcomes with MS to analyze poverty. In order to create scenarios and thereby run the DCGE model, we will also perform econometric estimation on the agricultural TFP as the function of trade openness and other relevant variables.

The paper is organized as follows. Section 2 provides a literature review of trade, poverty and their links, specifically TFP. Section 3 describes trade, agricultural growth and poverty in the Ethiopian economy. Section 4 outlines the methodology that the paper will employ. Section 5 presents the empirical results and section 6 sets forth the conclusion and policy implications.

[5] WTO is World Trade Organization

2. Literature Review

2.1. Theoretical review

Openness of trade can play a paramount role in the process of economic development of a country. Trade can provide access to a variety of goods and services, market opportunities and thereby increase domestic production, getting better information and transfer of technology that improves productivity, improve resource allocation and reduce inefficiency (Brooks, 2003) and this may lead to the achievement of higher economic growth and reduce poverty (for example, White and Anderson, 2001; Kakwani and Pernia, 2000).

But, to understand the way how trade influence poverty depends of measuring trade openness is crucial. In this aspect, there are two ways of gauging openness, namely 'revealed openness' and 'policy openness' (Dowric-Golley, 2004). The former (is defined as the ratio of total trade to GDP) measures the degree of distortion indirectly using prices and quantities, that is, it is based on outcomes, whereas policy openness measures policy instruments directly, that is based on incidence.

Winters (2000) identifies seven possible mechanisms by which trade openness influences poverty: Farm household; distributive channel; wage and employment; taxes and spending; shocks, risks and vulnerability; economic growth and technology (total factor productivity); and short-term adjustment. But these channels can be classified as static effect and dynamic effect on poverty when they transmit trade openness impacts. A static effect of trade on poverty is manifested through the household, distributive channel, wage and employment; taxes and spending, whereas the dynamic effects are revealed through shocks, risks and vulnerability; economic growth and technology (total factor productivity); and short-term adjustment.

In this regarded, trade induced technology or agricultural TFP on poverty is the most important conduit in the context of developing nations. This is also supported by a study of Bhagwati and Srinivasan (2002) that trade openness enhances TFP, which immediately promotes growth and thereby reduce poverty.

On the other hand, there are theories that explain how trade openness exacerbates poverty. The theory of absolute advantage implies that a country that loses in pure trade competition might face higher levels of poverty because when the country imports, it may get into debt. If this import is unable to create new, productive, and competitive activities, higher deficit would be inevitable and thereby poverty could ensue (Echevrria, 2005).
Trade openness may further the "poor" vulnerable to economic fluctuations because the "poor" lack physical, financial and/or human capital (Brooks, 2003). To protect such part of the society from vulnerability and to increase the beneficial effect of trade, trade openness reform should centre the "poor". Higher agricultural TFP due to trade can lead poverty. Specifically, when the growth of agricultural TFP due trade greater than the growth of output, production may need to use less input to produce the same level as previous amount and this leads decline in employment and thereby intensify poverty (Winters et al., 2004).

2.2. *Empirical Review*

To provide policy prescription and understand the connection between trade and poverty in the real world, the exiting theories have to be verified using pragmatic studies. There are many practical studies that assess the poverty impact of trade and the conduits that trade influences poverty. Much of these studies use Computable General Equilibrium-Micro-Simulation analysis.

Using the global CGE model and econometric estimate of trade induced TFP; Sherman et al. (2006) analyze the preferential trade agreements between Morocco and EU, and those of Egypt and EU. They found that trade induced TFP contributes a lot in the reduction of poverty in Morocco and Egypt.

Similarly, different studies discover that agricultural productivity gain is crucial to reduce poverty. For instance, Hassine *et al*. (2010) examines the impact of trade induced agricultural TFP on poverty. To capture agricultural technological change due to trade openness, first they estimated agricultural TFP using the latent Class Stochastic Frontier Model. Then by combining this estimated TFP with static Micro-Simulation CGE model they assessed the poverty impact of trade induced agricultural TFP. Their simulation result reveals when trade induced productivity is considered, the agricultural and full liberalization would reduce poverty in Tunisia by 19% and 38%, respectively.

Some studies have been undertaken to get the picture of the relationship between trade and poverty in Ethiopia. Using a Static CGE Micro-Simulation model, Dejene et al. (2006) identify that although a 100% tariff removal would improve the welfare of farm households, poverty at the national level might step up. On the other hand, Seid (2007) and Bisrat (2009) employed the Dynamic CGE to examine the impact of trade liberalization on poverty in Ethiopia. Their simulation result showed that in the long run trade liberalization could reduce poverty. However, in the short run Seid (2007) found that poverty remains unaffected by trade liberalization whilst Bisrat (2007) found that trade liberalization would exacerbate poverty in Ethiopia in the short run.

By utilizing econometric analysis of rural household panel data, Adugna (2009) uses the change in the price of input and output channel by which trade liberalization affects change in poverty status of rural farm household in Ethiopia. His result depicts that the probability of remaining being poor and falling into poverty would be higher if trade liberalization changes the price of cash crops. But, a combination of relative price change (due to trade liberalization) with access to credit and schools would create a higher probability for the household to be out of the poverty category.

However, these pragmatic studies in the case of Ethiopia around the issue of trade and poverty have missed through which channel trade impacted poverty. More importantly, they ignore the importance trade induced agricultural TFP on poverty. Assessing trade impact on poverty through agricultural TFP in the case of Ethiopia should be given priority because the agricultural sector has played an important role in Ethiopia. The importance of the sector has been stressed by finding of Mulat *et al.* (2003) that in order to overcome the severity of poverty in Ethiopia agricultural growth complement with its productivity growth is crucial.

3. Trade, Agricultural Growth and Poverty in Ethiopia

Under this topic we will review the trade, agricultural growth and poverty situation in Ethiopia between 2005 and 2010. The external sector of the Ethiopian economy includes export and imports of agricultural and industrial items; and trade in service. The export sector has grown by 38.4% between 2009 and 2010, and by 36.7% between 2008 and 2010. Most of the increase in export is attributed by the growth of Coffee and Oilseeds. For example, in 2008 coffee and oilseeds had grown by 35.8% share and 14.9% share of the total export. Similarly, coffee had grown by 26.4% share and the percent share of oilseeds was 17.9 in the year 2010 (NBE, 2010).The import side of the country has shown increment as the export sector.

Although the percentage changes of import are smaller than the percentage change in export, the volume of import much more than the export. In 2008, the volume of import was USD 6,810.5 mil. But, the volume of export was USD 1,465.7 mil. Similarly, this big gap is also true in the years 2009 and 2010. Such differences have been revealed in the mentioned years as well as the country's trade history (from the imperial regime) result the country to exercise negative trade balance.

The agriculture sector of Ethiopia is the main source of food consumption; it is also the livelihood of the majority of the country's farmers and the major source of foreign currencies. Thus, the growth of this sector has many implications for the country's economy as a whole and on the poverty situation in particular. According to the 2010 NBE report, the total value of the agricultural items had grown successively from 2005 to 2010. In 2005, the sectoral GDP of the sector was birr 39,728 mil., this growth continued to increase into 48,225 mil in 2007 and in 2010 reached 59,348 mil.

But, whether these increments of the agricultural GDP growth are emanated due to the increased in the total agricultural output or the increased general price level is the issue that should be addressed. When we assess the contribution of the agricultural sector to the GDP growth, its contribution continuously declined and replaced by the service sector. In 2005, the agricultural contribution was 6.4% and turn down to 3.2% in 2010, in the meantime the contribution of the service sector had increased from 5.1% in 2005 to 6% in 2010.

In the case of poverty situation in Ethiopia, we compare the head count index, the poverty gap index and poverty severity index (i.e., a class of decomposable poverty measures, FGT) of 2004/05 and 2010/11 using Household Income Consumption and Expenditure (HICE) surveys of CSA. This is depicted in Table.1 below. Accordingly, HCIE shows the ratio of the poor to the population at the national level, in rural and urban have declined in 2010/11 comparing from the year 2004/5. The PGI measure of poverty also shows that the mean consumption shortfall of the poor relative the poverty line across the whole population has depressed in terms national, rural and urban level.

However, the inequality among the poor has widened in 2010/11. At the national level, poverty severity has increased from 0.027 in 2004/5 to 0.031 in 2010/11. Similarly, in the rural area as well as in the urban area of the country the inequality among the poor has inflated. In rural area, it has increased to 0.032 from 0.027 and in urban, the severity has recorded to 0.027 from 0.026.

Table 1: National, Rural and Urban poverty indices

	2004/05	2010/11
National		
head count index	0.387	0.296
poverty gap index	0.083	0.078
poverty severity index	0.027	0.031
Rural		
head count index	0.393	0.304
poverty gap index	0.085	0.08
poverty severity index	0.027	0.032
Urban		
head count index	0.351	0.257
poverty gap index	0.077	0.069
poverty severity index	0.026	0.027

Source: the 2004/5 and 2010/11 HICE survey of CSA of Ethiopia and MoFED's (2012) computation

4. Data and Methodology

To capture the poverty impact of trade, the paper will employ a dynamic CGE (which is developed by IFPRI: International Food Policy Research Institute) and Micro-simulation (MS) models, that is, a Top-down approach. Besides this, to see how trade influence poverty via agricultural TFP in Ethiopia and to create scenarios, the study estimates agricultural TFP. For these purposes, secondary data are applied. The sources of these data are CSA (The agriculture sample surveys between 2006-2010 and the 2004/2005 Household Income Consumption and Expenditure (HICE) Metadata), International Trade Center (ITC UN) data of import and export between 2006 and 2010) and the 2005/06 SAM (Social Accounting Matrix) of Ethiopian Development Research Institution (EDRI).

4.1. Methodology

4.1.1 Econometric Model

The objective of estimating of the agricultural TFP in Ethiopia in this paper is to the get the value of the parameter of trade openness which helps to set the simulation value of the agricultural TFP in Ethiopia.

To estimate the agricultural TFP, the study assume the Cobb-Douglas production function that

$$Q_{it} = A_{it} L_{it}^{\alpha} La_{it}^{\beta} \qquad \textbf{(1)}$$

Where Q is total output

A is agricultural total factor productivity (TFP)
L is labor which is proxy by the number of holders
La is area of cultivated land,
α and β are share parameters of L and La, respectively
i represents agricultural commodity, i.e, i= 1,2,3…..n
t is production year

Taking the natural logarithm on both sides of equation (1)

$$lnQ_{it} = lnA_{it} + \alpha lnL_{it} + \beta lnLa_{it} \qquad \textbf{(2)}$$

We can generate the agricultural TFP (A) of each item for each year using either equation (1) or equation (2)

$$TFP_{it} = \frac{A_{it}}{L_{it}^{\sim} La_{it}} \qquad \textbf{(3)}$$

Alternatively,

$$\ln A_{it} = \ln Q_{it} - \sim \ln L_{it} + \quad \ln La_{it} \qquad \textbf{(4)}$$

Equation (3) and (4) the “Solow Residual” it means the part output that is not explained by the labor and capital/land (Solow, 1957; Comin, 2006). This “Solow Residual” simply represents the TFP.

Once we get the level of agricultural TFP of each item for each year, it is possible to estimate TFP. But it is necessary to get the possible determinants of agricultural TFP in the given economy. Based on some empirical works on developing countries (for example, Kumar et.al, 2008; Fantu, 2012) the factors the influence agricultural TFP in Ethiopia would be fertilizer (allfirti), seeds, pesticide, irrigation, extension package (which includes how to use best practice, transfer of technology to farmers and education among others), trade openness (trade) and agro-ecological zone (dummy).

$$TFP_{it}=f(allfirti, seeds, pesticide, irrigation, extension, trade, dummy) \quad \textbf{(5)}$$

$$lnTFP_{it}= \beta_0+\beta_1 ln\ allfirti_{it}+\beta_2 lnseeds_{it}+\beta_3 lnpesticide_{it}+ \beta_4 lnirrigation_{it} + \beta_5 ln\ extension_{it} + \beta_6 lntrade_{it} + \beta_7 dummy + e_{it} \quad \textbf{(6)}$$

4.1.2. DCGE Model

In examining of the poverty impact of trade, applying Computable General Equilibrium Model is more convenient. In fact, other methods are available to analyze the impact of trade and trade policies change on economy-wide in general and on poverty in particular, but some of these models concentrate on micro-level analysis by ignoring the broader market and macroeconomic effects and/or excluding the decision making individual agents and/or disregarding factor markets are among others (Thurlow et.al, 2011).

The advantage of CGE over such models is that its ability to reflect a country’s economic structure and linkage because the model incorporates the interactions between different economic decision agents and its ability to be linked with micro-simulation modules to capture the effect of any change in the economy on households. In this DCGE model is separated into two:

"within-period" and "between-period". The within-period part, was developed by Lofgren et al. (2002), is static and solves the maximization problem of the consumers and the producers based on the prevailing prices. The between-period section, on the other hand, updating some of exogenous variables is either externally-determined or based on the previous period result (Thurlow et al., 2011).

4.1.3. Micro-Simulation Model

To analyze the poverty impact of trade through agricultural TFP, we will employee FGT[6] measure of poverty index, which was developed by Foster, Greer and Thorbecke in 1984.

This index is actually the extension of poverty indices of Sen (1979). The FGT - index is considered as a standard measurement of poverty because this measurement is additively decomposable (total poverty is the sum of a weighted average of sub-group of poverty levels). In addition, FGT incorporates inequality measures, the head count ratio and the income-gap ratio.

In FGT poverty (P_α)[7] is defined as:

$$P\alpha(y;z) = \frac{1}{n}\sum_{i-1}^{q}\left(\frac{z-yi}{z}\right)^{\alpha}$$

Or

$$P\,\alpha = \int_1^z \{ ((\frac{z-y}{z}))^{\alpha}\, f(y)\}dy$$

$\alpha \geq 0$, $i \geq 1$ and $z > 0$

[6] FGT stands for Foster, Greer and Thorbecke.

[7] *Where α is the measures poverty aversion, z is poverty line, y is income, i represents household or the sub-group of individuals which their income is below poverty line and n is number of population. Larger α emphasis to the poorest poor, P0 is the headcount ratio (it counts the number of the poor in the total population, was formulated to capture the problem of constructing poverty index using available information). P1 is a renormalization of the income-gap index (This measures the aggregate short-fall of income all the poor taken together from the poverty line) and P2 measures the severity of poverty (which measures the gap between poverty line and the average income of poor people, in short the index measures the square of the poverty gap).*

To get the impacts of our simulation on poverty, we demarcate the poverty line is based on the EDRI's SAM which defines the bottom 40% as poor in terms of descending household consumption expenditure level. Therefore, the poverty line is Birr 1782.98. The important thing that we note is that in the SAM rural, households are disaggregated into ten based on zonal level and urban households are divided into four on the basis of small and large settlement. We aggregated the rural households into two as rural poor and rural non-poor. However, the IFPRI's DCGE is modeled as urban households into urban poor and urban non-"poor". Then we introduced the adjusted expenditure per adult and poverty line in the MS model using DAD[8] (distribution analysis software) to calculate the poverty indices using FGT.

5. Econometric and Simulation Results

In this section we begin with the presentation of the estimation result of agricultural TFP and following this, the economy-wide and the poverty impact of simulation of tariff reduction and an increase in agricultural TFP will be described.

5.1. Econometric Result

We performed appropriate statistical tests to test the employed panel data, the parameters of estimates and the specification of the model. Breusch and Pagan LM test suggests that the model should be a Random Effect Model (REF). Accordingly, the result is given in Table 2.The result shows that fertilizer, seeds, irrigation, extension package and trade openness are statistically significant while pesticide and agro-ecological dummy (AgE) fail to explain agricultural TFP statistically.

[8] The DAD (distribution analysis) software was developed by Duclos *et.al* in 2010 "…to facilitate the analysis of and the comparison of social welfare, inequality, poverty and equity across distribution of living standards".

The negative sign of the coefficients of seeds and irrigation may signify that their application on the given cultivated land could be beyond the optimal level, but the negative coefficient of the extension package might be indicative of the fact that an extension package provides knowledge and information to farmers on how improving TFP would reduce the price of their produced items, as a result of which the farmers may not be willing to increase their productivity and they may allocate their resources sub-optimally which contributes to TFP decline.

The positive coefficient of fertilizer and trade openness could be explained by the fact that an increase in the application of fertilizer use by one percent would induce the agricultural TFP to increase by 1.063 percentage points, on average. In the same way, an increase in trade openness by one percent, on average, would trigger the agricultural TFP to respond by 0.144 percentage points.

The dependent variable pesticide is statistically insignificant, thus we cannot say anything about the association between pesticide and agricultural TFP. Regarding to the sign, the application of pesticide may not consider the agro-ecological difference of various regions in the country, thus it is likely to produce negative impact on agricultural TFP.

Table 2: Random-Effect GLS regression results for agricultural TFP

lntfp	Coef.	Std. Err.	z	P>|z|
_cons	14.0894	2.238	6.30	**0.000**
lnallfirtr	1.0633	0.2848	3.73	**0.000**
lnseed	-1.2522	0.1761	-7.11	**0.000**
lnpesticide	-.13788	0.1095	-1.26	**0.208**
lnirrigatn	-0.4574	0.1196	-3.82	**0.000**
lnextensie	-0.5134	0.1861	-2.76	**0.006**
Lntrade	0.1442	0.0631	2.29	**0.022**
AgE(dummy)	0.3063	0.2041	1.50	**0.133**

R-sq: within = 0.3532 overall = 0.9190 Wald chi2 (7) = 192.83 sigma_e = 0.14538502
Between = 0.9558 Prob> chi2 = 0.0000 rho = 0

5.2. Simulations

Baseline scenario

The model which we applied, DCGE, is calibrated to reflect what would happen to the economy when there is no policy change and external shocks; and to generate the growth path over time. Here the assumption is that the economy exhibits changes which arise from changes in the annual growth of factor supply and productivity (Thurlow *et al., 2011*). In our case, the base-run simulation covers the period between 2006 and 2015.

Simulation 1

Since currently Ethiopia is in the process of accession to the World Trade Organization (WTO) and most of the country's trading partners are the members of the WTO, it is reasonable to take the WTO's tariff cut requirement to create scenarios. Thus, we simulate a 24% tariff cut, assuming that Ethiopia will join in the category of developing countries within the simulation period. The maximum tariff cut for the agricultural items that developing countries are required is 24%. However, the tariff reduction for the non-agricultural items is not uniform. Thus, we apply a 24% tariff cut for all sectors. The result of this tariff cut on the economy may be affirmative or negative on the economy in general and on poverty in particular.

Simulation 2

In this scenario we simulate agricultural TFP using our estimation result given in Table 1. Accordingly, an increase in trade openness by 1% results in an increase in agricultural TFP by 0.144%, on average. This simulation is important to see how trade influences poverty in this economy through the agricultural TFP.

Simulation 3

This simulation is a combination of Sim-1 and Sim-2. It helps to understand how trade policy (tariff cut by 24%) associated with enhancing agricultural

TFP due to trade openness influences the economy and the poor in this economy, alternatively the combination of the two simulations more to capture the definition of trade openness.

Simulation 4

One of the factors that can influence the agricultural TFP is the level of the usage of fertilizer. Here again we use the above estimation result. Suppose that the price of fertilizes decreases, then there will be a tendency to increase the application of fertilizer. If this is the case, an increase in the use of fertilizer by 1%, on average, has an incremental impact on the agricultural TFP by 1.06%. The importance of the introduction of this simulation in our model is to compare which of the simulations, i.e., Sim-2 or Sim-4, is more important in explaining the process of poverty reduction.

5.3. Simulation Results

For the sake our study, we only present the simulation results pertaining to the macroeconomic and sectoral effects of the above scenarios.

5.3.1. The Macroeconomic Effects Simulation

The result of sim-1 in is depicted in Figure 1 and Table 3. When the country uses a 24% trim downs of tariff, it results in an increase in RGDP at factor cost by 15.08% percent from its initial value but this is a 0.006% increment when we compare with business as usual (BAU) situation. This increase in RGDP at factor cost would be explained by the fact that though there is a reduction of investment and government expenditure, by 0.08 and 0.03 percentage point changes, respectively, it is clearly offset by an increase in 0.04 percentage point change in private consumption and a 0.16 percentage point change in real export.

The increase in private consumption leads to an increase in absorption by 0.01percentage point change from BAU (or 13.54% increased from the initial value), although investment and government expenditure decreases. An increase in a 0.11percentage point change in real import is also recorded in this simulation. The decrease in government income by 0.33percentage point change shows that the government revenue may not be maintained when it reduces tariff.

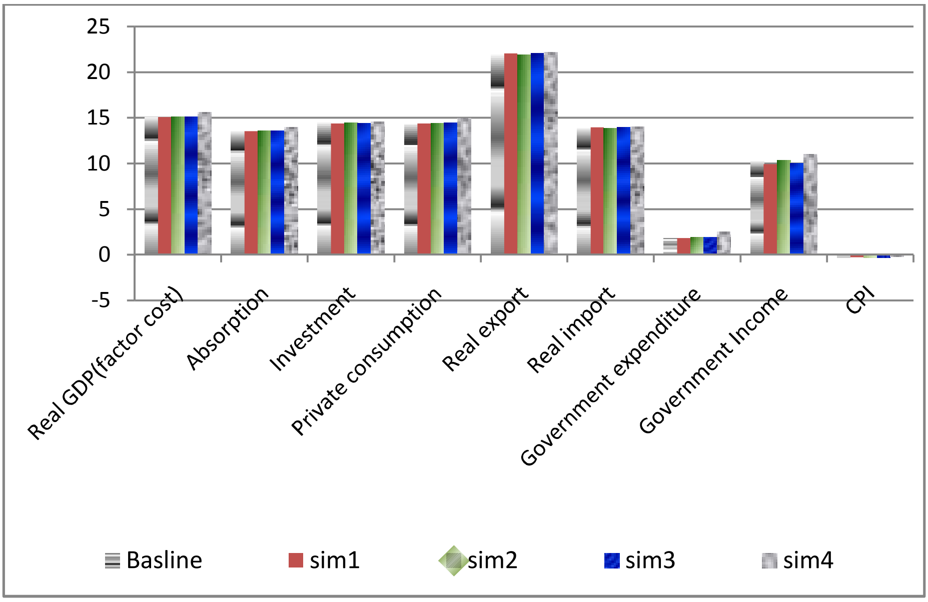
When we look at CPI, it has increased by 0.05percentage point change. This may be due to the fact that while real import has increased, the domestic producers are more interested to export instead of selling domestically. Since the increase in real export outweighs the increase in the real import, it implies that the domestic demand remains uncovered leading to an increase in CPI. In Sim-2, it can be understood that an increase in agricultural TFP due trade openness changes all the selected macroeconomic indicators positively within the simulation period in Ethiopia. Again in the Figure 1 and the Table 3 the increase in private consumption, investment, recurrent government expenditure and real export by 0.09% change, 0.01% point change, 0.08% point change, respectively, outweigh the increase in real import by 0.03% point.

Sim-3 contributes an increase RGDP at factor cost by 0.08% from BAU situation. Absorption has increased by 0.07% change as a result of an increase in private consumption, investment and the government expenditure. As agricultural TFP increase by 0.144%, the government income increase by 0.11% change. However, the CPI has increased by 0.02% change.

Comparing sim-3 with BAU situation, Table 5 and Figure.1 provide the combination of sim-1 and sim-2 results an increase in RGDP at factor cost by 0.081%, absorption by 0.08%, private consumption by 0.13%, real export by 0.20%, real import by 0.13%, recurrent government expenditure by 0.06% and CPI by 0.06%. However, investment and recurrent government income have decreased by 0.068% and 0.23%, respectively. The increase in RGDP is aroused due to the increased in private consumption, recurrent government expenditure and real export greater than the decrease in investment and real import. The increase in private consumption also contributes absorption to change positively. In this scenario, the domestic demand still unable to be satisfied while real import has increased and this results CPI to increase.

Finally, the result of simulation 4 indicates that RGDP at factor cost has grown by 0.56% change because private consumption, investment, recurrent government expenditure and real export have increased as shown in Table 3 and Figure.1. The increase in absorption by 0.49% change would be explained by the increment of private consumption, investment and government expenditure by 0.65%, 0.09% and 0.78% changes, respectively.

Figure.1: Simulation results of Macroeconomic Indicators (% change from initial)



Source: Simulation result from the DCGE model.

Table 3: Simulation results of Macroeconomic Indicators (percentage point changes)

	Sim1	Sim2	Sim3	Sim4
Real GDP (factor cost)	0.00596	0.07509	0.08136	0.56043
Absorption	0.01412	0.06567	0.08012	0.48856
Investment	-0.08186	0.01329	-0.06822	0.09325
Private consumption	0.04319	0.0865	0.12987	0.64225
Real export	0.16215	0.03959	0.20234	0.30281
Real import	0.10617	0.02592	0.13257	0.19879
Government expenditure	-0.02647	0.08627	0.0615147	0.642856
Government Income	-0.33439	0.1052594	-0.229315	0.773974
CPI	0.04485	0.0172	0.06165	0.12712

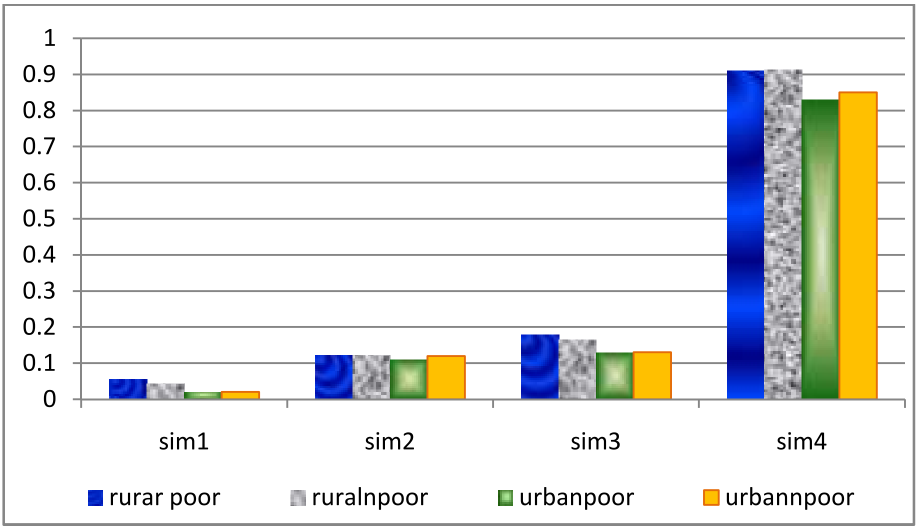
Source: Simulation result from the DCGE model.

5.3.2. Consumption Expenditure Growth Effect of Simulation (% change from baseline)

In the simulation period, the consumption expenditure of all household groups have registered a very small growth as we relate to the baseline run simulation interlude. As Figure.2 portrays, in sim1, expenditure of rural poor household and rural non poor household have raised by 0.056% and 0.044%. These changes are greater than that of urban households. This is also true in sim2 and sim3.

In sim4 we found that greater percentage increments than the others simulations, that is, expenditure of rural poor, rural non poor, urban poor and urban non poor have increased on average by 0.91%, 0.914%, 0.83% and 0.85%, respectively, between 2006 and 2015. However, the registered augmentations on consumption expenditure are too small and less than 1%. Therefore, one should not expect these changes to reduce poverty. The household consumption expenditure per adult (Exp/adult), which is not reported here but we employed in the micro-simulation model, confirms the above facts that in each simulation it has increased with insignificant amount.

Figure 2: Private Consumption Expenditure (% change from baseline)



Source: Simulation result from the DCGE model.

5.3.3. Sectoral Effects of Simulations

Under this topic we present the effects of the simulations on the agriculture, the industry and the service sector growth. We divide the agricultural sector into cereals, cash crops and other agricultural outputs. We also carve up the industrial sectors into manufacturing and other industry growth.

Figure 3 depicts the business as usual scenario case the growth of cereal production, cash-crops, other types of agricultural products, manufacturing, other types of industrial outputs and services increases by 15.74%, 16.68%, 13.49%,19.18%, 18.27% and 15.14%, respectively. In sim-1, a reduction in tariff results in an increase in cereal production by 15.7%. Comparing this percentage change with the baseline scenario, it is less. This could be explained by when tariff decreases, imported cereal become cheaper than domestically produced, thus domestic producers may be enforced to reduce their production. Cash-crops and other agricultural products also increase by 16.67% and 13.48%.

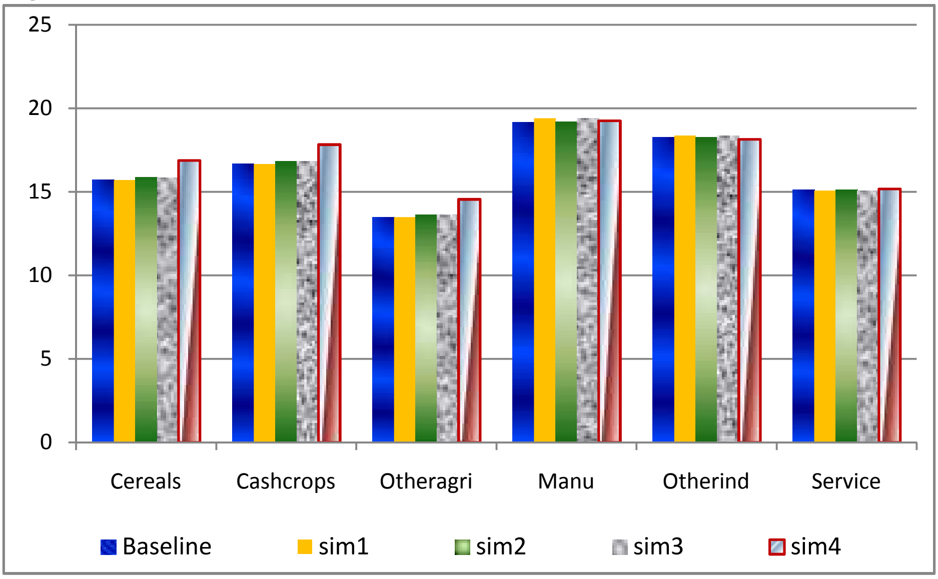
This situation is similar to the case of cereal production. In the industrial sector's production, both manufacturing and other industrial sector productions have grown by 19.4% and 18.37%, respectively. These growths are greater than that of the BAU situation. This is because a reduction of tariff enables the efficient domestic industries to import raw materials with cheap cost. Therefore, the industrial output has increased. However, in this simulation the service sector has grown by less than the growth in the base-run simulation.

In simulation 2, all sectors' production has grown except the service sector in comparison with the baseline growth. This implies trade induced agricultural TFP enhance the production of the agricultural and the industrial sectors. This again helps to understand there is some kind of relatively strong link between these two sectors. But, there is less significant growth of the service sector due to this simulation.

The combination of tariff reduction and trade induced agricultural TFP in sim-3 also shows similar results as sim-2 except they have different values. Nevertheless, the growth in the service sector has declined. This may be tariff reduction and trade induced agricultural TFP more favor to the agricultural and the industrial sectors than service sector.
In the case of Ethiopia the link between the service sector with the agricultural sector is very much less and tariff reduction is mostly applied to non-service sectors. As a result any progress in the agricultural sector is not reflected in the service sectors.

In the last simulation, productions of all sectors have grown. For example, cereal production has swelled by 16.88%, manufacturing products has grown by 19.25% and the service sectors also have shown an increment by 15.17%. Comparing with the baseline scenario, the results of sim-4 are higher.

Figure 3: Sectoral Growth Effect of simulations



Source: Simulation result from the DCGE model.

5.3.4. Poverty Effects of Simulations Results

5.3.4.1. Poverty Head Count Index (P_0)

From Table 4, we understand that poverty head count index has recorded a small rise in national, rural and urban areas in all simulations, except sim-4 compared with the baseline scenario case. When we look at the poverty head count index of rural and urban, “poor” people in rural is higher than urban areas. This result can be explained as in sim-1, the reduction of tariff has a strong impact on the agricultural sector than the industrial sector in the case of Ethiopia. This tariff reduction enables the country to import more agricultural items with lower price from either the country with efficient agricultural sector or the country that subsidized the agricultural sector. As a result, the domestic farm output price declines or remains unsold.

In urban area tariff reduction reduces prices, which may drive some domestic firms to exit the market notwithstanding the depressed price that leads to an increase in the number of "poor" people. As the majority of the rural peoples' livelihood is based the agricultural sector the impact of such policy has a dramatic effect on this subdivision of the country's sector than the others. Therefore, higher level of "poor" per population is revealed in rural area. In sim-2, trade induced agricultural TFP also has a declining price effect because it has a direct effect on the agricultural items that is farmers could produce a greater amount of output than before.

At the given level of the national and the rest of the world (RoW) demand, there may exist a surplus which its substantial amount leftovers unsold or sold by small prices that leads farmers to allocate resources sub-optimally. But, the outcome of this simulation on the industry is indirect. Thus, it is expected that there will be less increments in the number of "poor" in urban than rural. The result of sim-3 can be enlightened using the combined justification of sim-1 and sim-2.

Simulation 4, however, results a greater change in the national, rural and urban "poor". The national, the rural and the urban poverty head count index have grown by 8.97%, 10.2% and 8%, respectively. This again could be elucidated as in the above three simulations.

Table 4: Poverty Head Count Index (P_0)

Simulation	baseline	sim1	sim2	sim3	sim4
National	0.1001	0.1291	0.1109	0.1398	0.1898
Rural	0.1107	0.1452	0.1239	0.1579	0.2127
Urban	0.0918	0.1164	0.1006	0.1256	0.1718

Source: Micro-simulation result

5.3.4.2. Poverty Gap Index (P_1)

The micro-simulation result shown in Table 5 indicates that the aggregate consumption shortfall relative to the poverty line has widened in all scenarios between 2006 and 2015.

In sim-1, the reduction of tariff leads to the poverty gap of the national poor, rural poor and urban poor have grown by 2.26%, 2.43% and 2.14%, respectively. The substitution and income effects of the tariff cut for imported foreign goods are negative, implying that domestically produced goods are substituted. Although tariff cut would provide a variety of items with cheap price, the domestic producers selling prices are decreased strongly and end up with domestic production cut as well as unemployment. Therefore, the separation distance between the aggregate consumption shortfall and poverty line has further increased.

In sim-2, sim-3 and sim-4, we also found similar consequence as sim-1 but the interpretation is different. In sim-2, the poverty gaps have increased by 1.88%, 1.99% and 1.79%, for the national "poor", the rural "poor" and the urban "poor", respectively. The fourth simulation also has similar direction. In general, the result of sim-2 and sim-4 show that as agricultural TFP increases, cheap agricultural output would prevail in the market.

Although the registered rise of poverty gap index is relatively small, the potential impact should not be underestimated. Unless the industrial sector increases its productivity, which enables to absorb the surplus of labor in the agricultural sector as a result of the increased agricultural TFP, the "poor" will further become "poorer". The third simulation revealed that the combined effect of sim-2 and sim-3 guides an increase in poverty gap in the three categories of the "poor". From these simulation results we understand that more resources are needed to eliminate the disparity between the aggregate consumption short-fall and the poverty line.

Table 5: Poverty Gap Index (P_1)

Simulation	baseline	sim1	sim2	sim3	sim4
National	0.0168	0.0226	0.0188	0.025	0.0354
Rural	0.0177	0.0243	0.0199	0.0269	0.0386
Urban	0.0161	0.0214	0.0179	0.0235	0.0329

Source: Micro-simulation result

5.3.4.3. Poverty Severity Index (P_2)

This measurement of income poverty is vital in a sense that it captures both the distance separating the "poor" from poverty line and gives more value to those poor who are way far from the poverty line. Thus, it helps to see the magnitude of the poverty level on the poor. Our simulation result is presented in Table 6.

When we relate sim-1 with BAU scenario, the severity of poverty in the national "poor" has increased by 0.17%. The respective increment in poverty severity in the rural and the urban "poor" are 0.18% and 0.16%. We found similar results in sim-2 and sim-3 as sim-1 designating little growth of the poverty severity. However, huge percentage increases in sim4 are revealed that 55.78%, 62.19% and 50.76% growth in the national, rural and urban, respectively, poverty severity. Overall, the rural poor are greatly affected by these policy simulations and what we have understood is these policies should be incorporated with other "poor" policies.

Table 6: Poverty Severity Index P_2

Simulation	baseline	sim1	sim2	sim3	sim4
National	0.0046	0.0063	0.0052	0.0071	0.5624
Rural	0.0047	0.0065	0.0053	0.0073	0.6266
Urban	0.0045	0.0061	0.0051	0.0068	0.5121

Source: Micro-simulation result

6. Conclusion and Policy Implications

Understanding of the impact of trade on poverty is a crucial issue for developing country to create appropriate policy measures. Whether trade has impeding effects or not on poverty remains debatable. Trade is believed to reduce poverty by introducing new technology which enables efficient resource allocation, enhancing productivity and making available diversity of products with fewer prices. Whereas others argue that trade associated with tariff reform and openness may have an exacerbating effect on poverty because it displaces domestically produced goods and wind up with the higher idle domestic resource. In this viewpoint, we set forth our attempt to analyze the impact of trade on poverty through agricultural TFP in the case of Ethiopia.

Since such issue covers both the macro and micro aspect of the economy, we employed the dynamic computable general equilibrium model linked with the micro-simulation model. Their link is based on the “top-down” approach. To create scenarios we used the WTO’s maximum tariff requirement for agricultural items of developing nations and we also estimated the agricultural TFP with respect to trade openness. For DCGE-micro-simulation purpose, we utilized the2005/06 EDRI’s SAM and the HICE survey data of 2004/5. Whereas for the econometric estimation we used the agricultural sample surveys data of CSA and import and export of ITC UN between 2006 and 2010. The simulation result indicates an increase in most macroeconomic variables. As expected, all simulations stimulate growth in GDP, absorption, export, import and private consumption. However, the increase in household consumption expenditure is insignificant that in all scenarios, it exhibited below one percent. On the other hand, tariff cut leads to a reduction of investment, government expenditure and government income in the simulation period.

This shows the tariff reduction may discourage domestic producers to invest in the domestic economy and government may not be able to compensate the reduction of its revenue using imposition of domestic tax. When we look at the impact of trade on poverty, we consider both the tariff policy and trade induce agricultural TFP (we used the two variables to capture trade openness). The micro-simulation result suggests that the proposed level of tariff cut and trade induced agricultural TFP will slightly worsen the level of poverty in both rural and urban areas in the simulation period. This result may consistent with the argument that the growth of productivity due to trade have to be less than the growth of output, otherwise agricultural productivity would exacerbate poverty (Winters, 2000).

Finally, we recommend that to get the full picture of the impact of trade openness on poverty in Ethiopia, other channels, by which trade influence poverty should be assessed. In addition that achieving a positive impact of trade on poverty through agricultural TFP needs pro-poor complementary policies that boost the industrial sector productivity and human capital development, and policies that create efficient market and thereby reduce poverty in the country. It should also be helpful to maintain the growth of in the agricultural TFP less than the growth in agricultural output.

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