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Implications of high commodity prices on poverty reduction in Ethiopia and policy options under an agriculture-led development strategy

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Introduction

The Government of Ethiopia has been implementing an agriculture-led development strategy since 1993 through its Agricultural Development-led Industrialization (ADLI) policy. This strategy is maintained in the current development framework entitled the Growth and Transformation Plan (GTP) which will be implemented from 2010/11 fiscal year for a five year period. The GTP has the overall objective of eradicating poverty, improving citizens' livelihood and transforming Ethiopia into a middle income country. It intends to attain this through a sustained, rapid, and equitable economic growth and by maintaining agriculture as the major source of economic growth.

During the implementation of the previous medium term development strategy, the Plan for Accelerated and Sustained Development to end Poverty (PASDEP) between 2005/06 and 2009/10, economic growth averaged 11 %. In 2010/11, the country has registered 11.4 % real GDP growth rate surpassing the GTP target of 11 percent. The government aims at maintaining this pace over the coming five years in order to achieve its MDG targets.

The past years have witnessed important declines in poverty levels. Poverty measured by real consumption expenditure[1] declined by 14.8% between 1995/96 and 2004/05 reaching 38.7 % in 2004/05 and by 23.5% between 2004/05 and 2010/11 reaching 29.6 % in 2010/11. Food poverty has also declined from 42% in 1999/00 to 38% in 2004/05 reaching 33.6 % in 2010/11. Poverty is more concentrated in rural areas where more than 80% of the population resides. In 2010/11, while the proportion of the population below the poverty line stood at 30.4% in rural areas, it is estimated to be 25.7% in urban areas. While income inequality[2] declined from 0.44 in 2004/05 to 0.371 in 2010/11 in urban areas, it increased marginally in rural areas from 0.26 to 0.27 leaving the overall inequality unchanged over the same period.

Despite these performances, Ethiopia has been facing serious structural challenges that may undermine the progress made so far in economic growth and poverty reduction. Inflation levels over the last two decades, measured by consumers' price index (CPI) had remained below or around 10 % per annum, even reaching negative levels in the early 2000s (National Bank of Ethiopia, NBE, 2008). Since 2007, however, Ethiopia has recorded the highest inflation rates in Africa. Overall year-on-year inflation reached 28.4 % in July 2008 mainly caused by food price increases, which account for 60 % of the weight attached to the CPI basket of goods. On an annual basis, average headline inflation

[1] Source: MoFED 2013, Development and Poverty in Ethiopia 1995/96-2010/11. June 2013, Addis Ababa Ethiopia.
The cost of basic needs method was utilized for setting the poverty line. Poverty measurement is based on the cost of 2,200 kcal per day per adult food consumption with an allowance for essential nonfood items. The food and total poverty lines used since 1995/96 in the country are 648 and 1075 Birr at national average prices. The 1075 Birr poverty line is applied to real per adult household consumption expenditure in order to calculate head count, poverty gap and squared poverty gap indices. The 1999/00 and 2004/05 poverty indices were calculated by deflating all food and nonfood consumption items by spatial price indices and temporal price indices (relative to 1995/96 constant prices). As for the 2010/11 poverty indices, the 1995/96 poverty line was computed at 2010/11 prices. The food and total poverty lines for 2010/11 are 1985 and 3781 Birr respectively.
[2] Income (consumption) inequality measured by Gini Coefficient. Source: MoFED 2013, Development and Poverty in Ethiopia 1995/96-2010/11. June 2013, Addis Ababa Ethiopia.

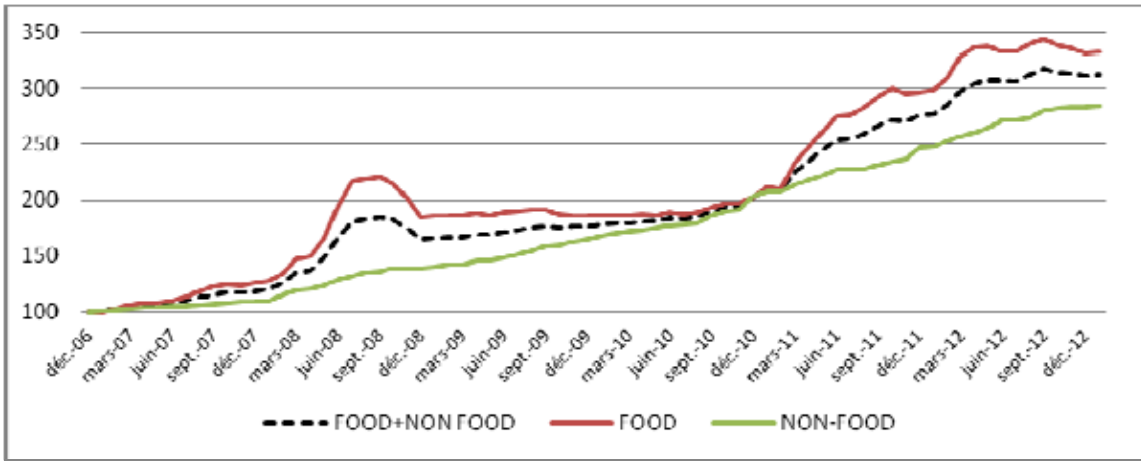
reached 36.4 % in 2008/09. As February 2012, overall year-on-year inflation rate stood at 35.9 percent, mainly driven by a rampant food inflation of 44.3 percent. In fact, after several straight months of food price deflation (from February to October 2010), food prices started to raise towards the end 2010, first with modest increases and then with a sharp acceleration since May 2011 with stable and increasing two-digit growth in following months (see Figure 1). Food inflation was most important for cereals like teff, wheat, maize, barely, followed by pulses, meat, butter, coffee and tealeaves, peppers, potatoes, tubers and stems.

This upsurge of high inflation rates has been a major threat to macroeconomic stability in Ethiopia, prompting the government to take several measures to contain inflation. The first measure taken by the government consisted in ceiling the retail price of selected commodities. Price caps on 18 essential commodities, including bread, rice, meat, cooking oil and sugar, were imposed in January 2011. However, most price ceilings were lifted in late May 2011. Other measures consisted in importing commodities such as grains (in particular wheat), sugar, or cement to stabilize local market prices. Imported wheat, sugar and palm oil were distributed at subsidized prices to poor urban households.

A key measure adopted by government has been to limit credit growth in the economy. In April 2011, in order to tighten money supply and reduce liquidity, the National Bank of Ethiopia (NBE) required private banks to hold 27 percent of their lending portfolio in the form of 5-years NBE bills. One of the sources of Ethiopia's rapid monetary expansion in recent years seems to have been fuelled by the public sector's domestic borrowing. Evidence shows that the bulk of banking system credit was absorbed by the public sector in recent years (NBE Annual reports). Therefore, in addition to the above measures, the NBE has ceased lending to the Government since the first quarter of 2011/12 fiscal year and financing of public sector borrowing requirements is manly addressed by sales of treasury bills to commercial banks and non-bank institutions.

Despite these measures inflation and in particular food inflation have been rising putting in distress the livelihoods of the populations. Figure 1 shows that food prices have increased significantly more than non-food prices. Higher food prices are more severe if a significant share of household expenditure is spent on food items. The latest Household Income and Consumption Expenditure Survey (HICES, 2010) has shown that food expenditure, as a share of total household expenditure, remains high as it stands at 52 percent.

Figure 1 - Trend in Consumer Price Index (Dec 2006 = 100)



Source: Ethiopian Development Research Institute

Also, higher commodities prices, and in particular food prices, are likely to affect real income and consumption if wages/income are not adjusted accordingly. Using monthly data on consumer prices and informal/unskilled wages to explore the impact of higher food prices Headey et al (2012) show that food prices outpaced nominal wage growth in 2007–2008 and 2011 food crisis. Testing whether daily laborer wages responded to price changes over the short run, they find that wages did not fully respond to the sharp food price spikes of 2008 and 2011 translating into a deterioration in the food and overall purchasing power of wages (20% and 10% in 2007/08). Their findings suggest that the 2010/11 food crisis had larger welfare effects owing to higher non-food inflation.

In line with its development strategy (the GTP) and as part of the Comprehensive Africa Agriculture Development Programme (CAADP), Ethiopia allocates more than 10 % of its expenditures to agriculture (the figures show a 22.1% share of total capital expenditure and 9.2 % of total current expenditure in EFY 2009/10) and has met the targeted 6 % growth rate in agriculture (6.4 % in 2008/09, 7.6 % in 2009/10 and 8.6 % in 2010/11). A recent IFPRI Discussion Paper by Dorosh, P. and Thurlow, J. (2009) uses a Computable General Equilibrium (CGE) Model for Ethiopia and finds that if Ethiopia can meet its targets for crop yields and livestock productivity, it should be possible to reach and sustain the 6% annual growth targeted in the CAADP. According to their simulations, this 6% growth would result in overall economic growth enabling a reduction of poverty to 18.4% by 2015. At the time of their research, inflation had stabilized. However, since the end of 2010, prices have been on the rise in Ethiopia. This implies that the positive impact of the simulated 6% agricultural growth on poverty ought to be revised in order to account for the negative effects of rising commodities prices. Income effects resulting from the simulated 6 % agricultural growth translate into an increase in consumption reducing the number of households below the poverty line. However, the level of poverty reduction is expected to be lessened if recent changes in prices are to be accounted for.

This research aims at measuring the potential impact of high commodity prices on Ethiopia's prospects of maintaining agricultural growth objectives set in the CAADP agenda. Furthermore, we aim at measuring the likely impact on the country's effort and advancement towards attaining the poverty reduction targets. In view of this, we build a CGE model which uses the Dorosh et al (2009) approach as a benchmark and introduce international oil and fertilizer price shocks along with

nominal exchange rate devaluation. The rationale for choosing these shocks is outlined in the following sub sections.

Sources of inflation

Compared with previous periods, recent inflation has some unique characteristics. Historically, inflation peak in particular food inflation has been highly driven by supply side shocks resulting from droughts or bad weather. The recent pattern coincided with high economic growth and relatively good harvest. This is new to Ethiopia and it has become a concern for the government. This may seriously undermine the accomplishments made so far in terms of poverty reduction as well as future prospects. The targeted economic growth may also be unattainable. Therefore, understanding the determinants of inflation and its growth and poverty effects is essential in view of designing adequate policy interventions.

Inflation has several drivers in Ethiopia. These can be classified in two categories: external factors and internal ones. Internal factors are essentially related to expansionary monetary policy. Massive financing of public budget deficit, disbursement of large volumes of credit to the private sector with negative real interest rates including through micro-credit schemes, salary increment for government employees[3], inflow of remittances, monetization of food aid are major factors behind the increase in money supply. Other internal factors include the oligopolistic wholesale market structure, an overall increase in aggregate demand and inflation expectations.

In parallel to domestic factors, external shocks have contributed to the inflationary pressure. International food and commodities prices rises in particular fuel, food and raw material combined with a drastic devaluation of the local currency (20% devaluation against the USD in September 2010 by the National Bank of Ethiopia) and continuous depreciation of the Birr against major currencies (40.8 percent against USD in 2009/10 and by 25 percent during 2010/11) which increases the price of imported goods have been identified as main external sources of inflation in Ethiopia.

Looking at the literature on the subject matter, most of the above mentioned factors have been analyzed using different techniques. However, there appears to be no consensus on the primary sources of inflation in Ethiopia. The following summarizes findings from studies focusing on drivers of inflation in Ethiopia.

Klugman (2007) examines food inflation in Ethiopia based on micro-analysis. She suggests that recent food inflation can be largely explained by overall inflation, which is related to increase of money stock. Other explanations of the high food inflation include a shift from food aid to cash aid while activities of cooperatives would also affect the price level by improving the bargaining power of farmers.

Ahmed (2007) examines the determinants of inflation in Ethiopia and concludes “structural changes” such as increasing bargaining power of farmers and monetary expansion are the main reasons of

[3] At the beginning of 2011, wages of civil servants (about one million people) increased on average by about 33 percent, representing a re-alignment of salaries to the higher cost of life after three years of no increase.

inflation in Ethiopia. He argues that monetary expansion is largely dictated by credit expansion in both the public and private sector.

Ayalew (2007) constructs a macroeconomic model and simulates impact of various shocks on inflation. He uses annual data from 1970 to 2006. He suggests that inflation in Ethiopia is affected by real GDP, money stock, foreign prices, and the exchange rate.

The IMF in its 2008 country report argues that excess aggregate demand generated by expansionary monetary policy were key driving forces of inflation in Ethiopia. Inflation expectations are also identified as a source of continuous upward trend in inflation. The analysis shows that, until 2008, the role of external factors has been relatively limited, although it is noted that future upward adjustments of retail fuel prices would add some pressures on prices. Also, structural factors including the convergence of prices of some exported agricultural products to international prices are believed to have played a significant role in driving up domestic prices of some food items as they have been converging to higher world prices.

Ethiopian Development Research Iinstitute, EDRI (2007) point out that domestic and external factors account for the recent inflation, among them (i) increase in international commodity prices including oil; (ii) structural change and continued good economic performance; (iii) increasing supply of money and injection of cash into the rural economy; (v) changes in farmers' behavior to supply products more uniformly over the year (improvements in access to micro-credit, storage facilities, marketing information, etc; and (vi) increased local purchases by governmental food security institutions, agricultural cooperatives, and relief agencies.

FAO in its 2012 country report attributes the recent surge in overall inflation rate to a series of factors, such as the rising international commodity prices (mainly fuel, food and raw materials), the expansion of national broad money supply with negative real interest rates, the large currency devaluation, the oligopolistic wholesale market structure and an overall increase in aggregate demand.

Loening et al (2009) use monthly data from 2000 to 2009 and find that, in the long run, domestic food and non-food prices are determined by the exchange rate and international food and goods prices. In the short to medium run, agricultural supply shocks and inflation inertia strongly affect domestic inflation, causing large deviations from long-run price trends. Money supply growth affects food price inflation in the short run, though excess money supply does not seem to drive inflation in the long run.

Durevall et al (2010) use the same data set to estimate models of inflation to identify the importance of the factors contributing to CPI inflation and three of its major components: cereal prices, food prices, and non-food prices. They find that movements in international food and goods prices, measured in domestic currency, determined the long-run evolution of domestic prices. In the short run, agricultural supply shocks affected food inflation, causing large deviations from long-run price trends. The evolution of money supply does not affect food prices directly, though money supply growth significantly affects non-food price inflation in the short run.

High commodity prices and poverty

Inflation has severe consequences on food access of the most vulnerable households, especially in urban areas and net buyers in rural areas (FAO, 2012). Populations and especially the poor and those just above the poverty line are suffering from an eroded purchasing power. The food-security assessments conducted by the World Food Program in Addis Ababa, for example, found the proportion of households consuming an adequate diet decreased from 64 to 40 per cent between January and July 2008 (World Food Program 2008). Few studies provide evidence on the adverse impact of the food-price shock on poverty in Ethiopia and findings are somewhat contradictory in regards urban versus rural poverty effects.

Ulimwengu et al (2009) estimate welfare change as a result of price increase measured by the compensating variation and nutrient elasticity with respect to price. They find there are significant short-term price effects between the world maize market and some Ethiopian regional markets but with no long-term connections. Due to the dominance of cereals in household food budgets, compensation or loss as a result of price increase is much higher for cereals than for other food items. Across regions, the amount of consumption loss is not evenly distributed. On average, they find that consumption loss is higher in rural areas than in urban areas for cereals, pulses, and legumes. In terms of loss in calorie intake, rural households are more affected than their urban counterparts.

Alem and Söderbom (2010) use panel survey data to investigate how urban households in Ethiopia coped with the food price shock in 2008. Qualitative data indicate that the high food price inflation was by far the most adverse economic shock between 2004 and 2008, and that a significant proportion of households had to adjust food consumption in response. Regression results indicate that households with low asset levels, and casual workers, were particularly adversely affected by high food prices.

Ticci (2011) assesses the poverty and distributive impact of the 2006–08 price acceleration in Ethiopia using price indexes and the 2004/2005 WMS-HICES. The estimated increase in the incidence of poverty is of 23 percentage points. She finds that the effect of overall inflation on poverty was differentiated both across rural and urban areas and across regions, but, overall, urban poverty and its severity increased. The worsening of poverty in urban areas is explained by the reliance on the market for most consumption needs. In rural areas, while the incidence of poverty might have actually decreased, the severity of poverty increased even under the most optimistic hypotheses suggesting that the main risk in rural areas is a further impoverishment of the poorest.

Headey et al (2012) look at the welfare impacts of rapid food price inflation in the cities and large rural towns of Ethiopia using monthly series of casual wages from 119 locations. They find that the disposable income of daily laborers declined sharply as food prices soared in 2007–2008, and there is neither descriptive nor econometric evidence that wages substantially adjust to higher food prices, except in the long run. Their analysis suggests that the 2010–2011 food crisis had larger welfare impacts than the 2008 crisis because of more rapid non-food inflation.

World Bank (2012) report on the Ethiopian economy and inflation estimates that the impact of rising consumer prices on expenditures in both rural and urban areas is non-negligible and leads to an estimated increase in the number of poor people of around 1.8 million. According to this report, it is to be expected that the consumer price inflation between July 2010 and October 2011 led to a greater increase in both the depth and the severity of poverty in urban than in rural areas.

Our survey of the literature on inflation in Ethiopia showed important negative poverty or welfare impact. None of the research we came across used economy wide models to analyze the impact of rising prices. We use a CGE model to analyze the impact of world petroleum and fertilizer price shocks and the devaluation of the national currency which have been identified as some of the drivers of inflation in Ethiopia. CGE models are an excellent tool to estimate important general equilibrium effects of the price shocks while at the same time allowing to capture poverty impact through micro-simulation methods. It is essential to measure the potential impacts of rising prices on economic performance, government accounts, investment, employment, trade, income and consumption. This type of modeling enables to account for the different dimensions of such shocks.

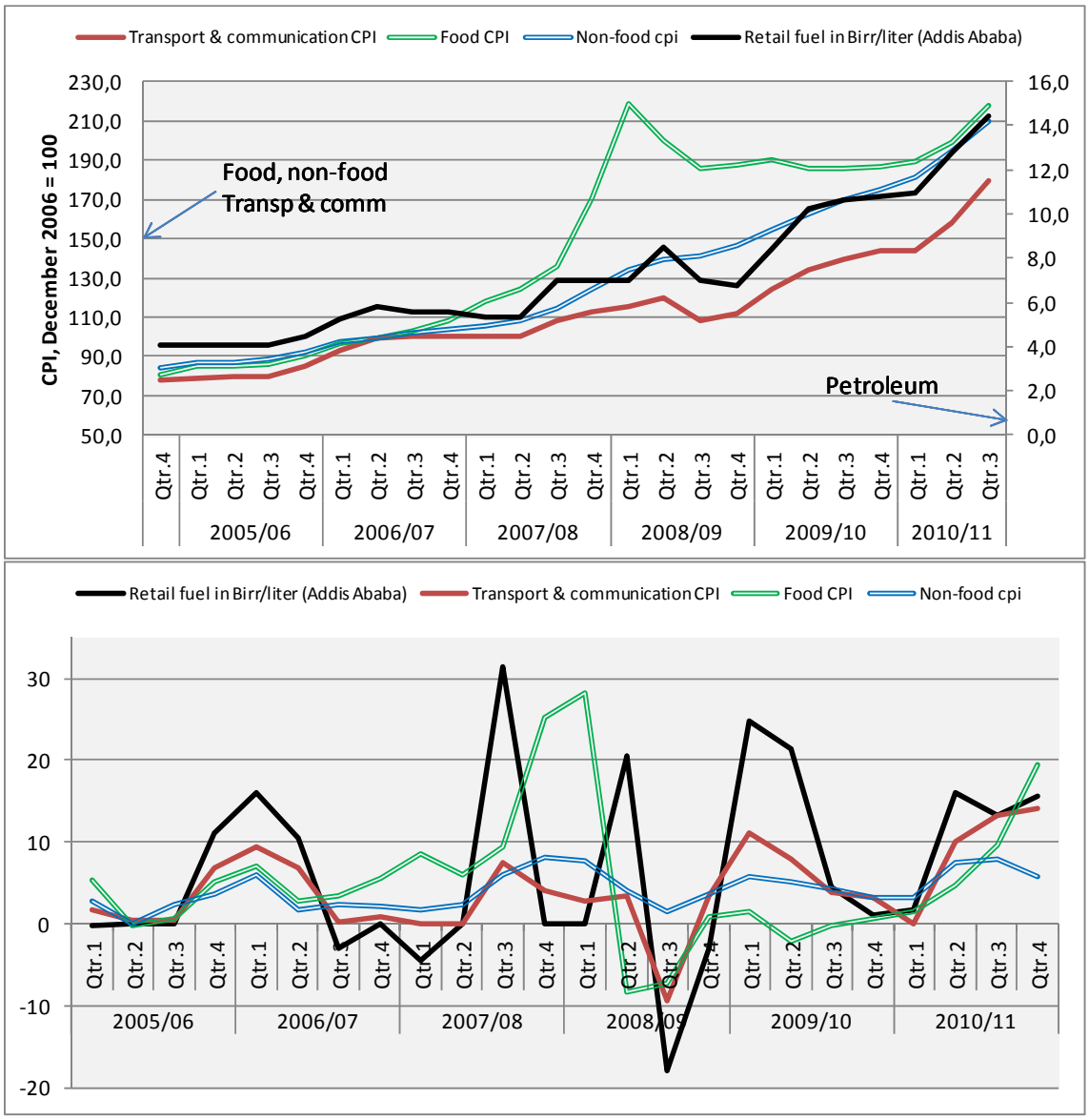
Analytical framework

In a CGE framework, it is not possible to talk about inflation per-se. To introduced changes in prices two options were available: either to build a financial CGE or to explore ways of introducing price hikes in the standard CGE model. We opted for the second option.

To introduce price changes within a CGE framework, we looked into the root causes of inflation in Ethiopia. As presented in the introduction, we found there both internal and external sources. Internal factors are essentially related to expansionary monetary policy while external drivers are fueled by international food and commodities prices in particular oil and fertilizer combined with a drastic depreciation of the local currency. Having this information at hand, we opted for the introduction of price hikes which have an external source. We therefore introduce a shock on world fuel and fertilizer prices followed by a depreciation of the nominal exchange rate.

Retail prices of petroleum products have long been regulated in Ethiopia. Although they were adjusted in mid-2006, early 2007, and early 2008, they were isolated from world prices through government subsidy (IMF 2008). Price controls may have helped mitigate the impact of the hike in world petroleum prices on domestic prices, but subsidies on oil have been lifted since 2008. Since then, domestic retail prices of petroleum products are adjusted monthly in line with the movements of oil prices in the world market. Recent increases in international commodity prices and in particular petroleum prices are contributing to food and nonfood inflation where large fluctuations are to be noted. While changes in retail fuel price appear to affect both food and non-food CPI, Figure 2 shows that food CPI is strongly correlated with fuel prices. Our assumption here is that fluctuations in world oil prices will transmit to local prices thereby affecting intermediate input and transport costs.

Figure 2 - Food and Non-Food CPI, Transport & communication CPI and Retail fuel prices (level and percent changes from previous quarter)



Source: Computed from NBE data in quarterly reports

This enables us to look at the impact of 'imported' inflation on agricultural growth and poverty reduction. Here, the focus will be on the cost of high commodity prices on attaining the objectives set in the CAADP framework in terms of growth and poverty reduction.

The SAM

The CGE model used in this analysis is calibrated on a social accounting matrix (SAM) of Ethiopia which was built by the Ethiopian Development Research Institute (EDRI) based on 2005/2006 data. The EDRI 2005/2006 SAM distinguishes 47 activities (14 agricultural, 20 manufacturing and 13 services) producing 69 commodities (25 agricultural, 30 manufacturing and 14 services). There are 5 primary factors of production (agriculture labor, non agriculture labor, land, livestock, non agricultural capital). Non agricultural labor is also disaggregated by occupational category (administrative and professional, unskilled and skilled). There are 4 aggregate household groups: rural and urban, and by income level: poor and non poor. The SAM has 17 tax accounts as well as aggregate accounts for trade margins, transport margins, government, investment, and the rest of the world.

The SAM required aggregation and disaggregation work to fit the needs of the present study and the modeling requirements. In addition, the SAM has been updated until 2009/10 to reflect to the extent possible the macroeconomic situation during that period. The value of the GDP for 2009/10 at constant market price was taken as a reference. Information was taken from the National Bank of Ethiopia (NBE) and the Ministry of Finance and Economic Development (MOFED) data. After proceeding to the update of real GDP, the following rates were taken as benchmarks to update the SAM using their shares in the 2009/10 GDP.

- Agricultural GDP: 42%
- Manufacturing GDP: 13%
- Imports: 33%
- Exports: 13.6%
- Gross fixed capital formation: 22.3%
- Private final consumption: 86.1%
- Tax revenue: 11.3%
- Current net income and transfers: 8.3%
- Current account Balance: 30%

The CGE model

The proposed CGE model uses an adapted version of the PEP standard computable general equilibrium model presented in Decaluwé et al (2009). Our model runs on a dynamic basis enabling the evaluation of long-term impacts. 2015 will be the medium-term time frame as it corresponds to the MDGs time line as well as to that of the CAADP. It also marks the end of the current government medium terms development agenda. The eleventh year time line corresponds to the end of Ethiopia's Agricultural Sector Policy and Investment Framework (PIF) 2010-2020. The model has a poverty module using a "top-down" approach where changes in the CGE model are imported in the household data. It uses micro data from the most recent Household Income and Expenditure Survey. The CGE model used in this analysis is calibrated on a social accounting matrix of Ethiopia presented in the previous section.

Production – The production function in the model is a two-level constant elasticity of substitution (CES) function. At the lowest level, agricultural labor, administrative and professional, unskilled and skilled non agricultural labor are aggregated into composite labor. In parallel, non agricultural capital, land and livestock are combined into composite capital. At the intermediate level, composite labor and composite capital are aggregated to form value added. Finally, value added is combined in fixed proportions with intermediate inputs to make gross output.

Trade - The treatment of trade in the model is standard. We assume that the relationship between the rest of the world and the domestic economy is determined by an imperfect substitutability between imported and domestically produced goods and services on the consumption side (Armington hypothesis). Similarly, local producers divide their output between the home and export markets; the shares vary with the ratio of domestic prices to exports process. Thus, allocation between domestic and foreign markets for demand and supply respond to relative prices of foreign goods defined by exogenous international (import and export) prices, the real exchange rate and the local tax levels.

Model closure - Non-agricultural capital is sector-specific and exogenously set at the base year level for the first period of time. Land is mobile across agricultural sub-sectors except for the production of oil seeds, enset and cash crops where land is sector specific. The three other categories of labor are used in agricultural and non agricultural production. Administrative and professional, unskilled and skilled labor categories are fully mobile across all sectors. Agricultural labor is mobile in agricultural sub-sectors. Both agricultural and non-agricultural wages adjust to ensure full employment. This is one of the limitations of the model. By adopting the full employment assumption, we consider unemployment as fixed. Unemployment stood at 4% in 2007 (Census 2007). Unemployment is an urban phenomena reaching as high as 34% in urban setting while remaining at 2.1% in rural areas.

All commodity markets follow the neoclassical market-clearing system in which each market is cleared when the total endogenous demand equals the total supply through price adjustment. Our numeraire is the nominal exchange rate. World import and export prices are set fixed following the small price-taking economy hypothesis. Current account balance (in nominal terms) is set fixed at the first period and increases yearly with population growth rate.

Other variables that grow at the population growth rate are: minimum consumption of commodities in the LES demand equations, government current real expenditure, public investment by category and by public sector industry, and changes in inventories. Total investment expenditure is equal to the sum of agents' savings. For the savings-investment account, real investment adjusts to changes in savings (i.e., savings-driven investment). Also, the sum of the different forms of investment expenditure is equal to total investment. Real public investment is fixed and increases yearly at the population growth rate.

Calibration of parameters - Based on the SAM, the production technologies across all sectors are calibrated to their current situation, including each sector's use of primary inputs, such as land, labor and capital, and intermediate inputs. Exogenous production and trade elasticities including substitution and transformation elasticities have been obtained through the EDRI.

Poverty analysis within the CGE framework - The study uses the IFPRI Extended standard recursive dynamic CGE modeling system, Version 2.00 for its poverty analysis. It endogenously estimates the impact of the simulation scenarios on poverty. The study investigates this by using a "top-down" approach where changes in the CGE model are imported in the household data. It uses micro data from the very recent 2009/10 HICES of CSA for information on households' detailed expenditure. There are 6 representative groups in the model, disaggregated by rural zones, small and big urban centers, and poor/non-poor status.

In this "top-down" approach each household questioned in HICES 2009/10 is linked directly to the corresponding representative household in the model. The representative households in the CGE model and the SAM are distinguished by location and income level. The mapping exercise is based on these two levels of categorization. In this formulation of the model, changes in representative households' consumption in the CGE model component are passed down to their corresponding households in the survey. Only commodities used in the calculation of the poverty line are considered. In the next step, real total consumption expenditures are recalculated in the survey. This new level of per capita expenditure for each survey household is compared to the exogenously given poverty line, and standard poverty measures are recalculated. Poverty changes are then evaluated using the standard measures. The Foster Greer and Thorbecke (FGT) measures are applied.

$$P_\alpha = \frac{1}{Nz^\alpha}\sum_{j=1}^{J}(z - y_j)^\alpha$$

where j is a subgroup of individuals with consumption below the poverty line (z), N is the total sample size, y is expenditure of a particular individual j and α is a parameter for distinguishing between the alternative FGT indices[4]. This poverty extension enables us to calculate poverty incidence, poverty depth and the severity.

[4] When $\alpha=0$ the expression simplifies to J/N, or the headcount ratio. This is a measure of the incidence of poverty. When $\alpha=1$ the expression gives us poverty depth measured by the poverty gap. When $\alpha=2$ the expression gives us the severity of poverty measured by the squared poverty gap.

The 3781 Birr per year and per adult poverty line used in this study is directly adopted from MoFED (2013). The method used for setting a poverty line is the cost of basic needs method. First the food poverty line is defined by choosing a bundle of food typically consumed by the poor which gives the minimum caloric requirement (2,200 kcal). An allowance for essential nonfood items is also included. Then this bundle is valued at local prices (or it is valued at national prices if the desire is to get a uniform poverty line across regions and groups). In the micro-simulation, consumption is used as the metric to measure poverty. Consumption is a better measure of longer-term household welfare because it is subject to less temporal variation than income. Also, in Ethiopia, consumption is likely to be measured more accurately than income.

Simulations

Simulations – The base scenario consists in simulating a 6% sustained agriculture growth as targeted in the CAADP. The first two simulations consist in introducing international oil and fertilizer price changes observed since 2009/10. The third simulation introduced a devaluation of the national currency. The last scenario combines the first three simulations. Further details of the simulations are presented below.

Base scenario: CAADP scenario

For the reference scenario, we introduce shocks on agricultural TFP taking as a reference the approach by Dorosh, P. and Thurlow, J. (2009) which is the starting point of this research. Applying the same level of annual growth rate of TFP, we are able to obtain a 5.53 % and 5,61 % annual agricultural growth rate for 2014/15 and 2019/20. This is close to the values in Dorosh, P. and Thurlow, J. (2009) where agriculture grew at 5.98 % annually until 2014/15 under the CAADP scenario[5]. After developing a reference scenario in which productivity follows its trend and agriculture grows at less than 6%, Dorosh and Thurlow make the assumption that Ethiopia can meet its crop yield and livestock productivity targets. In their "All agriculture" scenario, they exogenously shock agricultural productivity based on the above assumption. On the basis of their simulation results, they conclude that if Ethiopia can meet its productivity targets, then a 6% agricultural growth rate is plausible. Following Dorosh and Thurlow, we do not take into account the means by which the productivity increases can be achieved. Although, Ethiopia has already attained the 6% growth target, it is to be noted that the sources of growth are not necessarily a direct result of increased factor productivity. The choice of an agriculture centered reference scenario is justified in the Ethiopian case by the following.

Agriculture plays a significant role in Ethiopia. The agricultural sector contributed up to 50 % of GDP on average until 2002/03. Its share gradually decreased to 42 % in 2009/10 and has lowered to 41 % in 2010/11. Agriculture is the main driver of growth although the services sector is gaining influence since 2006/07. Agriculture and allied activities grew at 13.5 % in 2004/05 with a less sustained pace over the following five years reaching 7.6 % in 2009/10. Agriculture growth picked up in 2010/11 reaching 8.4% annual growth. Cereals dominate Ethiopian agriculture, accounting for about 66 % of agricultural GDP. Livestock production accounts for about 27 % of agricultural GDP and draught animal power is critical for all farming systems. Forestry accounts for about 7% of agricultural GDP.

Agriculture is the largest employer in the economy. A significant proportion of the labor force works in agriculture and related activities and earns living from these activities. The 2005 Labor Force Survey shows that agricultural activities absorb 80.2 % of the total population and the share is close to 90 % in rural areas where more that 80 % of the total population resides.

Agriculture is also the largest source of exports (over 80 %), and thus foreign currency inflow which enables the country to import vital raw materials and inputs, including those essential for agricultural

[5] Agricultural real GDP growth is lower in our reference scenario as we apply a lower population growth rate based on more recent data from the Central Statistical Authority (2.6% annually rather than the 3% applied in the Dorosh and Thurlow model).

production. Coffee has long been the major source of export income in Ethiopia but its share has decreased in recent years owing to greater diversification. Exports of coffee, oilseeds, chat and flower together accounted for 63.2% and 57.6 % in total export earnings in 2009/10 and 2010/11.

The agricultural sector also plays a central role in the production and provision of food. It is a sector that can contribute to alleviating poverty if food prices fall as a considerable share of income is spent on food (52%).

At the policy level, agriculture is believed to be a source of broader economic growth through its backward and forward production linkages as well as its consumption linkages with non-agricultural sectors of the economy. Agriculture is one of the poverty-oriented strategic sectors along with education, health, roads and water, identified by the government and has been benefiting from important public resources and investment.

In view of the importance of agriculture and of the Ethiopian governments' policy orientations, we believe it is reasonable to expect that the necessary steps will be taken for Ethiopia to attain its agricultural productivity targets. Moreover, the issue addressed in this paper is not whether or not the productivity targets can or will be attained, but rather, assuming they are attained, will they result in the expected growth and poverty reduction if, at the same time, there is high inflation due to higher import prices.
This double argument serves to justify your choice of baseline scenario. On the other hand, among the limitations of the paper, you should mention that, following Dorosh and Thurlow, you do not take into account the means by which the productivity increases can be achieved: they are heaven-sent.

Inflation scenarios: introduction of international oil (SIM1) and fertilizer (SIM2) price shocks and currency devaluation shock (SIM3)
The first set of simulations consists in introducing international price changes for oil and fertilizer. Data are taken from the World Bank and corresponding changes in world import prices of oil and fertilizer are applied for the second period and onwards. We focus on import prices as both commodities and not produced but only imported in the Ethiopian case. Regarding fertilizer, Ethiopia imports two types of fertilizer: DAP and Urea. DAP represents 65% of fertilizer sales while Urea represents 35%. For the simulation, we calculate average price changes between the two types of fertilizer. The following table summarizes the shocks.

Table 1 – International price scenario for oil, fertilizer and other commodities

	Annual prices (nominal)		**% change from previous year**		**% change from constant price reference scenario**					
	Crude oil, average ($/bbl)	DAP + Urea ($/mt)	Crude oil	DAP + Urea	SIM1: World import price of Crude oil	SIM2 : World import price of DAP + Urea	SIM3 : All world import and export prices including	SIM4: World import price of Crude oil	SIM4 : World import price of DAP + Urea	SIM4 : All other world import and export

							Crude oil and DAP + Urea			prices
2009	61.8	297.3								
2010	79.0	426.4	27.8%	43.4%	27.8%	43.4%	20.0%	53.4%	72.1%	20.0%
2011	104.0	549.6	31.6%	28.9%	68.3%	84.9%	20.0%	101.9%	121.8%	20.0%
2012	105.0	492.7	1.0%	-10.4%	69.9%	65.7%	20.0%	103.9%	98.9%	20.0%
2013	105.0	408.0	0.0%	-17.2%	69.9%	37.2%	20.0%	103.9%	64.7%	20.0%
2014	105.7	412.8	0.7%	1.2%	71.0%	38.8%	20.0%	105.2%	66.6%	20.0%
2015	102.0	417.5	-3.5%	1.1%	65.0%	40.4%	20.0%	98.1%	68.5%	20.0%
2016	100.7	416.1	-1.3%	-0.3%	62.9%	40.0%	20.0%	95.5%	68.0%	20.0%
2017	100.1	414.8	-0.6%	-0.3%	62.0%	39.5%	20.0%	94.4%	67.4%	20.0%
2018	99.6	413.4	-0.5%	-0.3%	61.2%	39.1%	20.0%	93.4%	66.9%	20.0%
2019	99.1	412.0	-0.5%	-0.3%	60.4%	38.6%	20.0%	92.4%	66.3%	20.0%
2020	98.7	410.7	-0.4%	-0.3%	59.7%	38.1%	20.0%	91.7%	65.8%	20.0%

Source: World Bank Commodity Price Data (Pink Sheet) - Annual prices. 2009 to 2012 and projections from 2013 onwards (http://econ.worldbank.org/WBSITE/EXTERNAL/EXTDEC/EXTDECPROSPECTS/0..contentMDK:21574907~menuPK:7859231~pagePK:64165401~piPK:64165026~theSitePK:476883.00.html)

Devaluation – Assessing the effects of this recent intervention aimed at boosting the country's exports would be interesting. Exports may indeed increase (and the government has set ambitious targets for 2014/15) but such a policy may have severe adverse effects on the local economy if the devaluation is to translate into imported inflation. The NBE intervened to devaluate the nominal exchange rate by 20% in September 2010. This is simulated in SIM3. As the nominal exchange rate is the numeraire, we introduce the devaluation scenario by shocking international prices of imports and exports by 20% for all tradable commodities. To account for changes in transfers from and to the rest of the world, we introduce a shock which allows us to increase by 20% the transfers.

In the last scenario, SIM4, we combine SIM3 with SIM1 and SIM2. The devaluation now includes international oil and fertilizer price increments. World import prices of oil and fertilizer are subject to an additional 20% increase above the changes in the international market in the second period.

Results

The first section discusses results from the first two scenarios, SIM1 and SIM2, where changes in world prices of oil and fertilizer are simulated. The second section presents the third simulation, SIM3, where a devaluation of the national currency is simulated. The last section discusses results from a combination of SIM1, SIM2 and SIM3. Results for SIM1 to SIM4 refer to percentage changes form the reference scenario: the BAU. Results for the BAU are reported based on percentage changes from the previous year.

Impact of changes in world oil and fertilizer prices

Effects on prices

The first two simulations consist in introducing shocks on world import prices of oil and fertilizer. The simulated changes in international import prices transmit to prices of imports in the local market.

Table 2 — Local prices of Oil and Fertilizer imports
(BAU: % change from preceding year; other scenarios: % change from BAU reference scenario)

Local price of imports										
	Oil					Fertilizer				
	BAU	SIM1	SIM2	SIM3	SIM4	BAU	SIM1	SIM2	SIM3	SIM4
2010/11	-2,1	18,3	-0,2	14,4	36,4	-2,0	-0,8	30,2	14,7	50,2
2011/12	-1,7	45,7	-0,4	14,8	69,8	-1,6	-1,8	59,9	15,1	85,5
2012/13	-1,3	47,5	-0,3	15,2	72,4	-1,3	-1,8	47,0	15,4	70,3
2013/14	-1,1	48,1	-0,2	15,5	73,6	-1,0	-1,7	26,9	15,7	46,5
2014/15	-0,9	49,4	-0,2	15,8	75,4	-0,9	-1,7	28,3	16,0	48,5
2015/16	-0,8	45,7	-0,2	16,0	71,1	-0,8	-1,5	29,7	16,2	50,6
2016/17	-0,7	44,6	-0,2	16,3	70,0	-0,7	-1,4	29,6	16,5	50,7
2017/18	-0,7	44,3	-0,2	16,5	69,8	-0,6	-1,4	29,5	16,7	50,8
2018/19	-0,6	44,0	-0,2	16,7	69,7	-0,6	-1,3	29,3	16,9	50,9
2019/20	-0,6	43,7	-0,2	16,9	69,6	-0,5	-1,2	29,1	17,1	50,9

Accounting for import tariff, local taxes and trade and transport margins, the simulated changes in world prices have resulted in the increase of local prices of imported oil by 49.4% in 2015 and by 43.7% in 2020 compared to their value in the reference scenario. As for fertilizer, local import prices rise sharply till 2013 and increase at a decreasing rate to reach levels higher by 28.3% in 2015 and 29.1% in 2020 compared to the reference situation. Rates of margin applied to oil and fertilizer are particularly high (50% and 45% respectively). Margins are added to the world price of imports, translated into the local currency, including duties on imports. Changes in local prices of imports are of lesser magnitude than international price changes because trade and transport margins have fallen in SIM1, SIM2 and SIM4 (-6.4%, -0.7% and -1.5% respectively in 2015) while it has increased less than proportionately in SIM3 (+4.9% in 2015).

Effects of the local price of imported oil

Changes in import prices affect the volume of imports which decline for oil and slightly less for fertilizer as presented in the table below. These two commodities are not locally produced and therefore, changes in volumes are of less magnitude than changes in prices.

Table 3 – Changes in volume of imported product: results from model scenarios
(BAU: % change from preceding year ; other scenarios: % change from BAU reference scenario)

Volume of imports										
	oil					Fertilizer				
	BAU	SIM1	SIM2	SIM3	SIM4	BAU	SIM1	SIM2	SIM3	SIM4
2010/11	6,5	-5,0	0,1	-6,3	-11,4	5,7	-0,3	-1,3	-0,2	-2,4
2011/12	6,0	-4,9	0,1	-6,5	-11,5	5,3	-0,6	-1,6	-0,5	-3,1

On the demand side, oil is used as a final consumption good by households and as an intermediate input in manufacturing and services sectors. This is the stage where the international price shock transmits to the rest of the economy via changes in prices and demand of intermediate inputs. It is particularly important in the transport and communication sector, the manufacturing of grain mill services and mineral products where it represents 45%, 40% and 32% of total intermediate demand. Overall, petroleum products account for 8.1% (and 10% of the value) of total intermediate demand. The transport sector is affected by changes in prices and supply of oil and in turn, it affects several other sectors as it supplies 18.4% of total intermediate demand (in volume). More specifically, 67% of the volume of intermediate inputs used by wholesale and retail trade services consists of transport services. Although agricultural production is not directly affected by changes in prices and supply of oil, it is indirectly impacted through effects on other sectors of the economy. Table 3 presents changes in GDP in the above mentioned sectors. All production activities that are intensive in petroleum products in their production process contract compared to their performance in the reference scenario. Given the hypothesis of strict complementarity between different categories of inputs and between intermediate consumption and total factor demand (value added), higher prices of intermediate inputs implies higher production cost, hence higher price of output. Those activities producing goods and services for which demand has shifted towards other commodities (following changes in relative prices) tend to contract. Accordingly, these activities reduce their factor demand pushing wages and return to capital downwards.

Table 4 – Sector growth results
(BAU: % change from preceding year; other scenarios: % change from BAU reference scenario)

	2014/15					2019/20				
	BAU	SIM1	SIM2	SIM3	SIM4	BAU	SIM1	SIM2	SIM3	SIM4
Teff**	4,90	-3,28	-1,55	-4,20	-9,42	4,74	-3,19	-1,77	-3,79	-9,06
Barley**	4,65	-2,01	-1,12	-2,25	-5,65	4,51	-2,01	-1,34	-2,05	-5,63
Wheat**	8,83	1,41	-2,39	1,99	-0,82	6,97	-0,18	-2,95	0,30	-4,03
Maize**	4,34	-1,90	-1,13	-2,14	-5,43	4,25	-1,86	-1,30	-1,92	-5,32
Sorghum**	4,39	-1,79	0,00	-1,85	-3,81	4,28	-1,77	-0,01	-1,67	-3,58
Pulses**	3,60	0,15	0,63	0,23	0,85	3,44	0,11	0,67	0,19	0,78
Vegetables and Fruits**	3,48	-0,97	0,15	-1,05	-1,93	3,43	-0,98	0,16	-0,98	-1,86
Oil seeds**	6,40	11,30	2,09	14,90	30,07	5,58	10,34	2,19	12,68	26,29

Cash crops (Sugar cane & beet, tea, chat, plant-based fibers, cotton)**	5,97	2,29	0,75	3,51	7,18	6,07	2,33	0,86	3,33	6,98
Enset**	4,08	-1,59	-1,38	-1,84	-5,20	4,27	-1,59	-1,59	-1,68	-5,21
Other crops**	3,73	0,81	-1,16	1,41	0,75	3,43	0,65	-1,15	1,04	0,17
Coffee**	9,04	5,74	1,83	7,00	15,08	9,48	5,70	2,02	6,52	14,47
Livestock, dairy & animal products	4,75	-0,79	0,47	-1,01	-1,26	4,81	-0,70	0,51	-0,77	-0,88
Forestry and fishing	4,69	-3,04	0,13	-4,91	-8,25	4,50	-3,05	0,14	-4,89	-8,16
Mining and quarrying	8,67	-1,93	0,45	-9,28	-11,78	7,21	-2,37	0,41	-9,34	-12,18
Agro-precessing	5,81	-0,60	-0,17	0,26	-0,74	5,66	-0,82	-0,22	0,02	-1,22
Dairy	11,31	0,30	-0,27	0,86	0,95	16,02	0,29	-0,27	0,74	0,81
Grain milling products	9,19	1,79	0,00	2,77	4,57	8,61	1,89	-0,03	2,68	4,49
Grain milling services*	8,00	-1,63	-0,33	0,30	-2,06	7,84	-1,79	-0,36	0,22	-2,32
Sugar	6,25	1,03	-0,02	2,23	3,34	5,84	0,91	-0,02	1,98	2,97
Beverages	5,13	-0,82	-0,49	0,64	-0,82	4,99	-1,00	-0,56	0,39	-1,30
Tobacco processing	7,19	-0,90	-0,29	0,00	-1,44	6,85	-1,11	-0,34	-0,21	-1,92
Textile	11,11	6,33	0,07	11,74	18,28	9,82	5,14	0,01	9,23	14,39
Apparel	11,49	8,70	0,01	16,04	24,45	9,40	6,57	-0,08	11,84	17,45
Leather	11,46	4,12	0,56	6,44	11,53	11,31	4,46	0,78	6,35	11,80
Wood	12,63	3,50	0,35	3,41	7,23	14,04	3,17	0,39	2,45	5,83
Paper, publishing, priniting	10,11	3,84	0,26	6,62	10,88	9,55	3,35	0,28	5,51	9,14
Chemicals, rubber, plastic	11,19	1,82	0,12	5,08	7,02	11,42	1,53	0,13	4,52	6,09
Mineral products*	8,22	-3,15	0,40	-5,98	-10,57	6,90	-3,82	0,37	-7,47	-12,49
Basic iron & steel	12,41	2,59	0,28	3,09	5,86	12,55	2,38	0,32	2,52	5,05
Machinery	6,92	2,02	0,38	-10,70	-8,27	5,72	1,57	0,35	-11,47	-9,70
Vehicules	5,92	0,86	0,20	-4,80	-3,96	5,22	0,45	0,18	-5,56	-5,22
Other manufacturing	10,45	2,31	-0,06	3,10	4,82	10,35	1,61	-0,12	1,93	2,83
Electricity, gas, steam and hot-water	7,03	-0,34	0,01	0,51	0,12	6,67	-0,41	0,02	0,41	-0,10
Activity of collecting(fetching) free water	6,93	5,23	-0,94	8,83	17,28	6,94	6,49	-0,80	9,04	19,05
Collection purification and distribution of Water	6,72	-1,24	-0,06	-1,58	-4,17	6,03	-1,57	-0,09	-1,79	-5,04
Construction*	7,21	-2,18	0,65	-13,06	-15,57	6,17	-2,80	0,61	-13,23	-16,31
Wholesale and retail trade*	6,33	-0,73	-0,02	-2,00	-2,72	6,36	-0,61	0,01	-1,66	-2,29
Hotel	5,22	-1,73	-0,68	-0,89	-3,44	5,09	-1,87	-0,77	-0,97	-3,72
Transport, storage & communication*	6,28	-2,03	0,08	1,16	-1,20	5,84	-2,29	0,09	0,79	-1,84
Financial intermediation	6,42	-1,49	-0,01	-1,83	-3,81	6,09	-1,70	-0,03	-2,01	-4,21
Real Estate, Renting and Business	8,21	-0,02	-0,01	0,03	-0,01	7,85	-0,02	-0,01	0,03	-0,01
Public administration	2,75	-1,45	-0,11	-0,50	-2,31	2,76	-1,46	-0,13	-0,50	-2,32
Education	3,25	1,37	-0,10	0,84	2,43	3,29	1,36	-0,10	0,89	2,41
Health & social work	3,71	0,33	-0,37	1,05	1,06	3,75	0,40	-0,40	1,14	1,19
Other services	4,78	0,03	-0,46	2,28	1,77	5,00	0,14	-0,46	2,09	1,68
Agriculture	5,53	0,45	0,15	0,61	1,17	5,61	0,56	0,18	0,74	1,44
Industry	8,89	1,13	0,06	1,81	2,77	8,88	1,00	0,07	1,49	2,31
Services	5,56	-0,71	-0,03	-1,10	-2,02	5,52	-0,78	-0,03	-1,16	-2,17
Total GDP	5,98	-0,15	0,03	-0,25	-0,51	6,04	-0,15	0,04	-0,25	-0,52

Note: * represents sectors where intermediate demand is intensive in petroleum products
**represents agricultural activities using fertilizer as an intermediate input

Effects of the local price of imported fertilizer

Similarly to imports of oil, higher import prices of fertilizer affect the volume of imports which decline. DAP and Urea are not locally produced and therefore, changes in volumes are of less magnitude than changes in prices.

Fertilizer is only used as an intermediate input in agriculture excluding Livestock and Forestry and fishing activities. The impact of changes in fertilizer prices directly transmits to agricultural crop production where it represents on average nearly half of intermediate demand. The transmission mechanism is analogue to that of international oil price shock. Higher intermediate input prices increase production cost. Demand tends to fall as agricultural products are substituted with other commodities for which prices have increased less, remained unchanged or have fallen. Activities producing goods for which demand has shifted towards other commodities tend to contract and reduce their factor demand putting a downward pressure on return to factors.

Table 4 presents the simulation results on agricultural sectors. Without any exception, all agricultural food crop activities contract. The latter employ about 35% of total agricultural labor and use around 40% of total land. In contrast, activities producing cash crops, which are export intensive, grow. The latter have more competitive products on the export market as prices have fallen (because of reduced factor cost). The fall in factor cost overrides the rise in intermediate input prices because agricultural production is highly intensive in labor and land rather than intermediate inputs.

In the first two simulations, although projections of international prices of oil and fertilizer indicate a decrease in trend, the decline is not strong enough to override previous price increments which were of a large scope. Overall, oil and fertilizer price shocks have little effect on total real GDP as it remains nearly unchanged compared to the reference scenario. At the sector level, agriculture is slightly growing due to the expansion in export intensive activities (see Table 9). The industrial sector is also pulled by export intensive activities essentially dairy and meat, textile, clothing, apparel and leather products where exports increase by more than 10%. The services sector is contracting a little. Despite higher prices of intermediate inputs, factor cost reduced allowing some activities to expand due to increased export demand. However, those activities that do not export tend to contract in particular all food crop agricultural sectors.

In sum, the international oil and fertilizer price shocks do not negatively affect the economy's growth potential. The simulated imported inflation has a limited impact on private investment. In SIM1, private investment in real terms is 1.9% lower in 2014/15 and 2.8% lower in 2019/20 relative to its level in the reference scenario where investment was increasing by an average of 8%. In SIM2, the private investment in real terms is 0.9% and 0.8% higher in 2014/15 and 2019/20 compared to levels in the reference scenario. This is likely to affects the growth potential of the economy, in particular that of the manufacturing and services sectors, highly capital-intensive. At this stage, the slowdown in private investment growth in SIM1 has affected real GDP growth although the scope is very small.

Effects on poverty

Households receive income from the employment of factors in the production process. Other sources of income are transfers from other agents or institutions. Table 5 shows that the two price shocks are likely to diminish return to factors in real terms. The international oil price shock results in the decline of the return to all factors except land. This means that such shocks are likely to transmit directly or indirectly to most of the production activities. Return to land increases pulled by the expansion in export-oriented activities (oil seeds, coffee and cash crop) where land is sector specific. The international fertilizer price shock essentially affects agricultural (and allied) activities. Only factors utilized in agricultural production have returns that have fallen compared to levels in the reference scenario. Other factors have returns that remained unchanged or increased a little.

Table 5 – Results on return to factors of production in real terms
(% change from BAU reference scenario)

	2014/15				2019/20			
	SIM1	SIM2	SIM3	SIM4	SIM1	SIM2	SIM3	SIM4
Agricultural labor	-1,8%	-2,0%	0,4%	-3,6%	-1,7%	-2,1%	0,2%	-3,7%
Administratie & proffessional labor	-8,0%	0,0%	-11,1%	-19,3%	-8,1%	-0,2%	-10,2%	-18,6%
Skilled labor	-5,9%	0,5%	-8,4%	-14,3%	-5,8%	0,4%	-7,5%	-13,3%
Unskilled labor	-6,7%	0,3%	-12,0%	-18,2%	-6,8%	0,2%	-10,8%	-16,8%
Capital	-8,6%	0,2%	-9,8%	-18,6%	-8,8%	0,1%	-9,2%	-18,2%
Land	2,4%	-1,4%	6,1%	7,6%	2,5%	-1,3%	5,7%	7,4%
Livestock	-3,3%	-1,2%	-1,6%	-6,0%	-3,0%	-1,1%	-1,3%	-5,3%

Changes in agricultural and non agricultural factor income affect households depending on their endowments. Owing to the drop in factor income, all categories of households are affected by a loss of real income following the international oil price shock (Table 6). Disposable income declines the most for higher-income households in small urban settlements. These households earn 44% of their income from capital where return has declined the most and 31% from skilled labor income where wages have also dropped sharply. For the lower-income households in small urban settlements, 78% of their income is earned from non agricultural labor for which wages have dropped. In line with its impact on return to factors, the international fertilizer price shock only affects rural households and in particular lower-income ones as they are highly endowed with agricultural labor (relative to land and livestock).

Table 6 – Results on real household disposable income
(% change from BAU reference scenario)

	2014/15				2019/20			
	SIM1	SIM2	SIM3	SIM4	SIM1	SIM2	SIM3	SIM4
Lower-income rural households	-2,7%	-1,5%	-1,0%	-5,4%	-2,6%	-1,6%	-0,9%	-5,2%
Higher-income rural households	-4,0%	-1,0%	-3,0%	-8,2%	-3,9%	-1,1%	-2,7%	-7,7%
Lower-income households in small urban settlements	-5,7%	0,3%	-8,1%	-13,7%	-5,7%	0,2%	-7,4%	-13,0%
Lower-income households in large urban settlements	-5,6%	0,3%	-6,5%	-12,1%	-5,6%	0,2%	-6,0%	-11,6%
Higher-income households in small urban settlements	-6,9%	0,3%	-8,6%	-15,6%	-7,0%	0,2%	-8,0%	-15,0%

Higher-income households in large urban settlements	-5,8%	0,2%	-6,0%	-11,9%	-5,9%	0,2%	-5,6%	-11,6%

In parallel to these income effects, there are price effects that also affect the consumption level and pattern of representative households. The CPI has dropped in SIM1 and SIM2 and agricultural commodities prices have fallen even more compared to levels in the reference scenario (Table 7). These commodities hold an important share in the consumer food basket in Ethiopia making the drop in agricultural CPI (and in particular prices of food crops) more essential for maintaining or increasing household consumption.

Table 7 – Results on consumer price index (CPI)
(BAU: % change from preceding year ; other scenarios: % change from BAU reference scenario)

	2014/15				**2019/20**			
	Agriculture	Industry	Services	Total	Agriculture	Industry	Services	Total
BAU	-1,9	-2,2	-3,7	-2,4	-1,1	-1,9	-2,6	-1,7
SIM1	-8,2	-4,5	-9,7	-7,2	-7,6	-4,3	-8,8	-6,7
SIM2	-1,7	-1,2	-1,6	-1,5	-1,7	-1,3	-1,7	-1,5
SIM3	8,4	10,2	3,7	8,0	9,9	11,3	6,0	9,6
SIM4	-1,6	4,3	-7,7	-0,8	0,5	5,6	-4,5	1,3

Poverty effects measured by FGT indices are presented in Table 8. The micro-simulation results show that poverty is likely to rise due to the international oil and fertilizer price shocks. Potential gains in terms of poverty reduction under the CAADP scenario are offset by imported inflation shock. Despite the above mentioned drop in the CPI, this is not sufficient to enable an increase in household real income and consumption. The impact of the international oil price shock is more severe on urban households where poverty incidence increases from 21.4% under the CAADP reference scenario to 25.1% in 2014/15 and from 15.9% to 19.1% in 2019/20. These households are net food buyers and therefore more exposed to price shocks. As expected, the international fertilizer price shock has a more severe effect on rural households for which poverty incidence increases (from 19.8% in the reference scenario to 20.9% in 2014/15 and from 12.7% to 13.4% in 2019/20). Indeed, 78% of rural lower-income households and 55% of higher-income households earn their income from agricultural factors. The poverty impact of the international oil price shock is much higher compared to the fertilizer price shock. Looking at the number of people below the poverty line, the microsimulation exercise applied to the 2009/10 HICES gives the figure 22.7 million[6]. Without any price shock, the number of poor would be reduced to 13 million in 2020 in the CAADP scenario. However, when introducing the two international price shocks, we find that the number of poor is likely to rise by as much as 1.6 and 1.3 million in 2015 and 2020 in SIM1 and by 823 and 539 thousand in 2015 and 2020 in SIM2.

Table 8 – Results on poverty reduction (FGT indices)

	2009/10	**2014/15**	**2019/20**

[6] The population growth rate applied is 2.6% per year starting from the second period. This is applied to a total survey sample size of 27835 households. Multiplying this by each household size, we obtain a total population of 76.1 million for the first period.

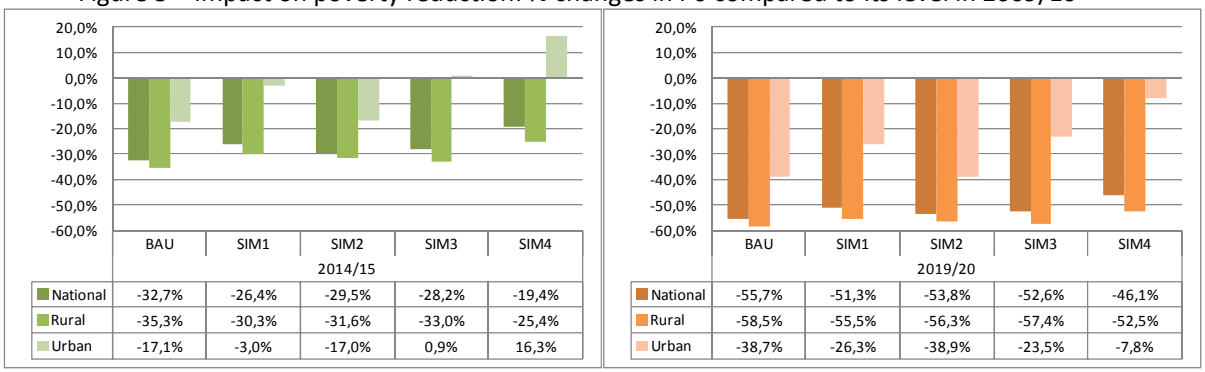
	BAU	SIM1	SIM2	SIM3	SIM4	BAU	SIM1	SIM2	SIM3	SIM4	BAU	SIM1	SIM2	SIM3	SIM4
	P0														
National	29,8	29,8	29,8	29,8	29,8	20,1	22,0	21,0	21,4	24,0	13,2	14,5	13,8	14,1	16,1
Rural	30,6	30,6	30,6	30,6	30,6	19,8	21,3	20,9	20,5	22,8	12,7	13,6	13,4	13,0	14,5
Urban	25,9	25,9	25,9	25,9	25,9	21,4	25,1	21,5	26,1	30,1	15,9	19,1	15,8	19,8	23,9
	P1														
National	7,8	7,8	7,8	7,8	7,8	5,1	5,6	5,3	5,5	6,3	3,3	3,6	3,4	3,5	4,0
Rural	8,1	8,1	8,1	8,1	8,1	5,1	5,5	5,4	5,3	6,0	3,2	3,5	3,4	3,3	3,7
Urban	6,6	6,6	6,6	6,6	6,6	5,1	6,1	5,1	6,5	7,8	3,5	4,2	3,5	4,4	5,4
	P2														
National	3,1	3,1	3,1	3,1	3,1	2,0	2,2	2,1	2,1	2,5	1,2	1,3	1,3	1,3	1,5
Rural	3,2	3,2	3,2	3,2	3,2	2,0	2,2	2,1	2,1	2,4	1,2	1,3	1,3	1,2	1,4
Urban	2,5	2,5	2,5	2,5	2,5	1,8	2,2	1,8	2,4	2,9	1,2	1,5	1,2	1,5	1,9

Table 9 – Results on poverty reduction: number of poor and changes in number of poor

	Total population	Number of poor					Changes in number of poor compared to BAU			
	All scenarios	BAU	SIM1	SIM2	SIM3	SIM4	SIM1	SIM2	SIM3	SIM4
2009/10	76100054	22697619	22697619	22697619	22697619	22697619	0	0	0	0
2014/15	86518028	17368806	18991305	18191964	18536442	20796830	1622499	823158	1167636	3428025
2019/20	98365639	13003331	14292362	13542808	13917672	15820383	1289031	539477	914341	2817052

Poverty depth (the average difference between the income of the poor and the poverty line) and severity (the extent to which some of the poor are very far from the poverty line) decline in the CAADP scenario. This reference scenario is quite promising as the indices P1 and P2 declined faster that the poverty incidence with poverty severity declining faster than poverty depth. The introduction of oil price shocks has a severe impact. The potential impact is the opposite of the results from the CAADP scenario. Oil and fertilizer price shocks may lead to a greater decline in both the depth and the severity of poverty in urban than in rural areas. The latter is likely to be more pronounced in urban areas, suggesting that the urban poorest are among the most vulnerable to the price shock. As for the international fertilizer price shock, it worsens poverty depth and severity in rural settings while P1 and P2 remain unchanged in urban settings.

Figure 3 – Impact on poverty reduction: % changes in P0 compared to its level in 2009/10



As reflected by Figure 3, rural poverty declines more than urban poverty in the CAADP scenario. At the national level, we find a cumulative poverty reduction of 32.7% between 2009/10 and 2014/15 and a drop by more than half between 2009/10 and 2019/20. The international oil and fertilizer price shocks do not affect this trend but are likely to undermine the poverty reduction efforts in the country. Looking at SIM1, urban poverty is reduced by only 3% between 2009/10 and 2014/15 while in the reference scenario, the figure reached 17.1% and remained at 17.0% in SIM2. As for urban poverty, it is reduced by 30.3% in SIM1 compared to 35.3% in the reference scenario and 31.6% in SIM2 between 2009/10 and 2014/15. The international oil price shock has relatively less severe effects on poverty reduction efforts in the long runs (-51.3% in SIM1 compared to -55.7% in the BAU and -53.8% in SIM2).

Impact of devaluation

The devaluation of the Birr which reversed to some extent the real exchange rate appreciation of the past few years was aimed at boosting export competitiveness and encouraging import substitution (thereby reducing the pressure on limited foreign currency reserves). SIM3 analyzes the potential impact of this policy. The analysis should take into consideration the fixed current account balance constraint. This implies that, if we consider capital income and transfers fixed (or of little scope), the value of exports must equal the value of imports. For the country to increase imports, it has to be able to export more. Exports will rise if export price paid by the rest of the world are lower than the average world prices and if price elasticity of exports is greater than 1. All price elasticity of exports are greater than 1 regarding agricultural export commodities to the exception of flower. For industrial exports, price elasticity is lower than 1 for four commodities while for services, only one elasticity is greater than 1.

The immediate result of devaluation is the rise in prices of imports followed by a drop in volumes imported. At the aggregate level, demand for imported goods and services drops by 12.1% in 2014/15 and by 11.2% in 2019/20 (Table 10). Imports of agricultural commodities fall the most. Import penetration is very low (4%) regarding agricultural commodities so despite a sharp decline in imports the effect may be limited on local market prices and supply. Supply of manufacturing goods is more likely to be affected considering an import penetration of 56%. As for services, with a 10% import penetration rate, the relatively lower level of reduction in imports may not significantly affect local supply and prices.

Table 10 – Results on volume of exports and imports (%)

		Exports				Imports			
		Agriculture	Industry	Services	Total	Agriculture	Industry	Services	Total
2014/15	BAU	8,7	12,0	5,4	7,9	-3,3	3,9	5,4	4,1
	SIM1	11,5	11,7	-0,5	6,5	-24,4	-5,6	-2,2	-5,2
	SIM2	2,9	1,8	0,2	1,5	-2,1	-0,6	-0,3	-0,5
	SIM3	14,5	18,0	3,2	10,5	-27,2	-14,1	-5,4	-12,1
	SIM4	30,0	33,3	2,6	19,2	-45,3	-19,7	-7,5	-17,1
2019/20	BAU	8,6	11,2	4,9	7,8	0,1	3,7	5,7	4,2
	SIM1	10,2	10,5	-0,7	6,3	-22,8	-5,6	-1,8	-4,9

	SIM2	3,0	1,8	0,2	1,7	-1,9	-0,6	-0,3	-0,5
	SIM3	11,9	15,3	2,8	9,4	-24,1	-13,5	-4,7	-11,2
	SIM4	25,6	28,8	1,9	17,7	-41,1	-19,1	-6,6	-15,9

In parallel to reducing imports, devaluation boosts exports. Export demand expands the most for industrial commodities followed closely by agricultural goods. It is those activities that are export-intensive that expand the most.

The combination of declining imports and increasing exports mean reduced supply on the local market. This pushes market prices upwards. As reflected in Table 7, overall CPI increases by 9.6% in 2019/20 compared to its level in the reference scenario essentially pulled by prices of industrial goods which increase by 11.3%. Agricultural goods also become more expensive prices increasing by 9.9%. Intermediate inputs are also more expensive putting an upward pressure on cost of production.

Overall, agricultural growth remains positive at a level 0.61% higher than the CAADP scenario in 2014/15. The manufacturing sector expands due to its export-intensive activities but also pulled by demand from export-intensive agricultural sectors. In contrast, the services sector contracts by 1.10% reducing total GDP growth by 0.25% in 2014/15. The trend is similar for 2019/20. The services sector is highly affected by levels of private investment which drop by 23.8% in 2014/15 and by 22.5% in 2019/20.

The expansion of export-intensive agricultural activities increases production and therefore demand for factors which impacts agricultural factors' remuneration. Return to agricultural labor and land increase in real terms (Table 5). Returns to other factors of production, and in particular capital and administrative & professional and unskilled labor diminish because of the contraction in services sectors. Output in services declines and results in reduced labor demand. Although services employ 62% of total non-agricultural labor, the sector has low labor-intensity (of 22%) as opposed to capital-intensity. This negatively affects non-agricultural wages as presented in Table 5. Manufacturing activities are relatively more intensive in non-agricultural labor and therefore absorb the excess labor supply and increase output.

Resulting from changes in factor remuneration, disposable income is impacted. All households see their income decline in real terms (Table 6). The effect is more severe for urban households rather than rural ones. This is explained by the difference in factor endowments.

The resulting poverty effects are negative (Table 8). Poverty incidence increases from 20.1% in the reference scenario to 21.4% in 2014/15 and from 13.2% to 14.1% in 2019/20. Looking at the number of poor, the devaluation is likely to increase the number of poor by 1.1 million individuals compared to the CAADP scenario in 2014/15 and by 914 thousand individuals in 2019/20 (Table 9). Poverty severity and depth are also negatively affected (Table 8). As in the case of the international oil price shock, the devaluation is likely to affect more those living in urban settings. Poverty incidence increases from 21.4% in 2014/15 and 15.9% in 2019/20 to 26.1% and 19.8%. Looking at cumulative figure, the devaluation is likely to undermine poverty reduction efforts in urban areas (Figure 3). In 2014/15, we find that poverty incidence is higher than its level in 2009/10 although the trend is reversed by 2019/20.

Impact of devaluation combined with international oil and fertilizer price increment

The last scenario, SIM4, combines the devaluation shock with increases in international oil and fertilizer price increments. Those are three important external sources of inflation that have been identified by the literature. It is well known that other international import and export prices have risen as well but we do not consider those in our analysis. The transmission mechanisms are accounted for when simulating the devaluation shock. The latter applies to all imported and exported goods and services although the shock is of the same scope for all. Furthermore, by accounting for oil and fertilizer shock, we exclude from our analysis the impact of the latter on other prices on the world market.

As the transmission mechanisms of the three separate shocks have already been discussed, the analysis will focus on major findings. When combining the three shocks, in addition to their SIM1 and SIM2 increases, oil and fertilizer prices are hiked another 20% (Table 1). Imports of oil and fertilizer drop further compared to scenarios SIM1, SIM2 and SIM3 (Table 3). At the aggregate level, devaluation accelerated the drop in imports for all commodities except coal. Imports of agricultural commodities fall the most as import penetration is low (Table 10). Import penetration is 56% regarding industrials goods resulting in a lower decline in demand for imports. Supply of manufacturing goods is greatly affected resulting in a sharp increase in industrial final and intermediate consumption price indexes. Demand for imported services declines the least because of low substitution elasticity (all lower than 1 except for one service) between locally produced services and those imported.

As FOB price of exported commodities have increased relatively less than world prices of exports, the volume of exports increases further in SIM4 due to gains in the anticipated export competitiveness (Table 10). However, this comes at the expense of local supply which reduced by 4.4% for agricultural goods, by 0.5% for industrial goods in 2019/20. Supply of services also declines by 5.6% in 2019/20 mainly driven by the contraction in output pushed down by lower local demand and limited possibilities of increasing exports.

Lower imports and higher exports tend to reduce local production of agricultural goods and services even further in SIM4. Although exports of agricultural products have increased, it is not sufficient to override the decline in demand from the local market. In contrast, output expands in industrial activities. Indeed, exports increase the most for industrial goods and in parallel, local demand increases as demand shifts away from imported goods that are relatively more expensive. Overall, export intensive activities expand further in SIM4 while other sectors tend to contract even further. The former increase their factor demand. However, this is not sufficient to counter the downward pressure on factor remuneration coming from activities that are contracting. Factor income falls in real terms (as prices have risen) to the exception of return to land. The magnitude of changes is higher when the three scenarios are combined (Table 5). This transmits to household income. All households see their income decline in real terms (Table 6). The effect is more severe for urban households.

As expected, the resulting poverty effects are even greater (Table 8). Poverty incidence increases from 20.1% in the reference scenario to 24.0% in 2014/15 and from 13.2% to 16.1% in 2019/20. Looking at the number of poor, the devaluation combined with international oil and fertilizer price

increments is likely to increase the number of poor by 2.8 million individuals compared to the CAADP scenario in 2019/20 (Table 9). Poverty severity and depth are also negatively affected (Table 8). In The devaluation and international oil and fertilizer price shocks are likely to affect more those living in urban settings. Urban poverty incidence increases from 21.4% in 2014/15 and 15.9% in 2019/20 to 30.1% and 23.9%. Looking at cumulative figure, this is likely to seriously undermine poverty reduction efforts both in rural and in urban areas (Figure 3). In 2014/15, we find that urban poverty incidence is 16.3% higher than its level in 2009/10 although the trend is slightly reversed by 2019/20 attaining a total poverty reduction of 7.8% over a period of 10 years. Overall, total poverty increases by as much as 4 percentage points in 2014/15 and by 2.9 percentage points in 2019/20 compared to levels attainable in the reference scenario. Poverty is higher in rural areas where most of the Ethiopian population lives. Although the impact on poverty of the simulation is higher in urban settings, poverty incidence is likely to increase by 1.8 percentage points in urban areas. Poverty depth and severity are also higher in rural settings. These indices are also likely to be greatly impacted increasing by 23.3% and 26.4% in 2019/20 compared to their levels in the reference scenario.

Conclusion

We use a CGE model and a microsimulation to assess the potential impact of high world petroleum and fertilizer prices in combination with a devaluation policy. The major transmission channel of these simulations is through the increase in intermediate input prices followed by a drop in factor cost/remuneration. We find that the impact of these shocks is negligible on overall real GDP growth compared to the reference scenario where a 6% agricultural growth is simulated. However, at the sector level, we find that these price shocks combined with devaluation only favor export-intensive agricultural and manufacturing activities while other sectors tend to contract. This is particularly true for agricultural food crop production activities where output reduces considerably. The services sector is also negatively affected putting a downward pressure on non-agricultural wages as it is the largest employer in the economy.

As for the effect on household income and consumption, we find that world oil price shocks considered alone are likely to circumvent the poverty reduction efforts achievable under a 6 percent agricultural growth scenario. Poverty incidence increases by as much as 2 percentage points in 2014/15 and 1.3 percentage points in 2019/20. Urban households are more affected by higher world prices of imported oil. Furthermore, this type of shock is more likely to transmit to the rest of the economy through direct and indirect effects compared to international fertilizer price shocks where the effect is rather concentrated on agricultural activities. Looking at the devaluation policy alone, poverty incidence increases by 0.9 percentage points. When combining international oil and fertilizer price shocks with devaluation, we find even higher levels of poverty incidence (4 percentage points higher in 2014/15 and 2.9 percentage points higher in 2019/20). Poverty increases significantly more in urban settings reaching a level higher compared to the 6% agricultural growth scenario while rural households are relatively less affected. Poverty depth and severity are also higher in all scenarios.

However, it is to be noted that this paper considers only some external sources of inflation in Ethiopia. Furthermore, this policy intervention may allow to curb the negative effects world petroleum price shocks by boosting the economy through greater export competitiveness but it is effective only to some extent as poverty is rising. It also does not reduce inflation but increases local market prices considerably adding additional upward pressure on high inflation rates. Finally, if high inflation persists, this will increase the real effective exchange rate, which amounts a reevaluation, thereby eliminating competitiveness gains from the devaluation. Such a policy may not be sustainable in the medium and long run.

In sum, international oil and fertilizer price changes are likely to have a significant impact in Ethiopia as the country is a net importer of those commodities. Despite export gains from a devaluation of the national currency, there is a further increase in the inflationary pressure possibly leading to further impoverishment of the already poor segments of population in urban areas and a greater vulnerability to poverty for those near to the poverty line in rural areas. Food production has diminished. This is likely to have a negative effect on food security as output and supply to the local market in major food staples are likely to drop. Furthermore, food production is highly affected by changes in fertilizer prices. The first two periods of the second scenario simulate an increase in world fertilizer prices while the remaining periods simulate a progressive decline in line with projections

from the World Bank. We find that when fertilizer prices are on the rise, food crop production diminishes even more.

Imported inflation is likely to diminish poverty reduction efforts achieved so far and poverty reduction that could be attained under the CAADP agenda. Such price shock may further undermine food security by reducing supply of food crops on the local market. Sustainable and long-term price stabilization policies are necessary in particular those addressing supply side constraints.

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