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GROWTH AND WELFARE EFFECTS OF MACROECONOMIC SHOCKS IN UGANDA

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By Edward Batte Sennoga and John Mary Matovu

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Any enquiries can be addressed in writing to the Executive Director on the following address:

Economic Policy Research Centre
Plot 51, Pool Road, Makerere University Campus
P.O. Box 7841, Kampala, Uganda
Tel: +256-414-541023/4
Fax: +256-414-541022
Email: eprc@eprc.or.ug
Web: www.eprc.or.ug

TABLE OF CONTENTS

ABSTRACT

Growth and Welfare Effects of Macroeconomic Shocks in Uganda[1]

Using a computable general equilibrium model, this paper examines the growth and welfare effects of three macroeconomic shocks in Uganda during the period 2010-17: changes in terms of trade, changes in international oil prices, and changes in development assistance inflows. Our analysis reveals four key findings. First, the largely positive impact of these three shocks on agriculture and services appears to offset the negative impact on industry leading to minimal deviations in real GDP growth from the business-as usual scenario. Moreover, the three shocks only lead to short-term as opposed to permanent deviations from trend growth in real GDP. Second, the three shocks are transmitted to the domestic economy and real GDP growth through changes in the terms of trade, exchange rate, and cost of production. Third, household welfare decreases and remains below the business-as-usual scenario during the entire simulation. Fourth, the poverty reduction rate is lower under the three external shocks compared to the business-as-usual scenario.

Keywords: Sub-Saharan Africa, Uganda, Macroeconomic Shocks, Economic Growth, Employment and Household Welfare, Computable General Equilibrium

JEL classification: D58, E62, I32

1 The findings, interpretations, and conclusions expressed in this paper are entirely those of the authors. They do not necessarily represent the view of the African Development Bank, its Executive Directors, or the countries they represent. This paper is still work in progress and therefore not for citation. Comments on this paper should be addressed to Edward Sennoga (e.sennoga@afdb.org).

1. INTRODUCTION

1.1 Macroeconomic volatility and the associated output and welfare effects

Macroeconomic volatility has varied impacts on growth and business cycles and such impact is particularly detrimental in developing countries (Loayza and Raddatz 2007). Some of the more studied causes of macroeconomic volatility include fluctuations in terms of trade which are estimated to account for up to 50% of all output fluctuations (Easterly et al. 1993, Hnatkovska and Loayza 2005, Ahmed 2003, and Raddatz 2005). Domestic conditions including policy buffers, efficiency of factor and product markets, and quality of institutions have the potential to mitigate or amplify the impact of the resulting shocks (Caballero and Krishnamurty 2001). Rodrik (1998) argues that social conflicts and domestic conflict management institutions can determine the severity of macroeconomic shocks and the ability of countries to respond to these volatilities.

The impact of external shocks on economic output and other outcomes such as poverty is intuitive, particularly for developing countries including in Africa. For these countries in particular, commodities which are prone to price fluctuations account for over 70% of total exports (Raddatz 2008). Between 2007 and 2011, primary commodities including oil, natural gas and metals accounted for over 80% of intra-Africa exports for Algeria, Angola, Mali, Mauritania, Niger, and Nigeria (UNCTAD 2013). Thus, swings in commodity prices can lead to significant changes in fiscal and Balance of Payment balances, with potentially far reaching impacts on macroeconomic stability.

The role of external shocks in explaining output fluctuations is contingent upon several factors such as policy stability and effectiveness. African countries were relatively resilient to the 2008 global financial and economic crisis in part due to the strong policy buffers that were established following sustained periods of prudent policy design and implementation prior to the onset of the crisis. However, these cushions that relatively minimized the impact of the 2008 global recession have weakened. Fiscal and external balances are weaker, debt levels are trending up, foreign exchange reserve levels are lower, and the fiscal space has diminished. For instance, Africa's overall fiscal balance including grants has deteriorated from 4.6% of GDP in 2006 to -3.6% in 2011. The external account balance including grants has mirrored similar trends, worsening from 6.3% of GDP in 2006 to -0.6% in 2011. The high fiscal deficits limit the space for counter-cyclical measures in case of new external shocks.

This paper focuses on Uganda and seeks to examine the growth and welfare effects of macroeconomic shocks. We identify at least two reasons for pursuing this line of inquiry for Uganda.

First, identifying and quantifying the key external shocks and their importance in explaining output volatility is critical for informing policy responses to smooth out the effects of these shocks as well as structural reforms aimed at reducing Uganda's exposure and vulnerability to these shocks. Second, to examine the potential gains in terms of reduced volatility from implementing programs aimed at smoothing the impact of these shocks.

Uganda's real GDP increased by 6.6% in 2010/11 which is higher than the 5.9% recorded in 2009/10. However, GDP growth decreased to 3.4% in 2011/12 due to several factors such as high and unstable global fuel and commodity prices and drought in some parts of the country. Depreciation of the Uganda Shilling against major currencies and low demand for the country's exports due to weaknesses in the global economy also affected real GDP growth. The resulting economic uncertainty contributed to a slowdown in industry and service sectors. A fragile global economic environment and the domestic economic slowdown affected export growth, domestic consumption and investment.

It is apparent that getting to the bottom of the sources of volatility is as important for Uganda as for other developing countries especially given the significance of income fluctuations as well as the limited ability to hedge against these fluctuations. Just like any other typical developing country, Uganda possesses shallow financial markets and countercyclical fiscal and monetary policy responses are usually impeded by various structural bottlenecks. This constraints several of efforts aimed at smoothing out the impact of external shocks.

The rest of this paper is organized as follows. Section 2 reviews literature and identifies gaps and Section 3 presents the methodology, data used and simulations. In Section 4 we discuss the findings, while Section 5 concludes with policy recommendations.

2. SOME RELATED LITERATURE

Ramey and Ramey (1995) are among the first authors to empirically document the macroeconomic volatility and welfare nexus in developing countries, with subsequent work being undertaken by Fata (2002), Acemoglu et al. (2003) and Hnatkovska and Loayza (2005). These papers confirm that the impact of economic volatility on welfare in particular through reduced economic growth is more pronounced in poor countries with limited ability to implement counter cyclical fiscal measures.

Collier and Goderis (2009) and Berg et al. (2011) also report that negative external shocks have significant adverse effects on short- and medium-term growth through their impact on aggregate demand, external and fiscal balances. There is some evidence that these effects are asymmetric suggesting that while negative shocks necessarily reduce growth, the positive shocks do not necessarily positively impact on long-run growth, especially in resource-rich countries with weak institutions (Collier and Goderis, 2007).

The impact of external shocks measured particularly in terms of trade shocks on output volatility has been examined in the literature using various quantitative and multi-sector equilibrium approaches. Kose (2002) finds that world price shocks play an important role in driving business cycles in small open developing economies. His results confirm the results of earlier work by Mendoza (1995) and Kose and Riezman (2001).

Some studies have examined the relationship between terms of trade shocks and variations in GDP growth using vector auto-regression (VAR) models. Ahmed (2003) finds that changes in the terms of trade and external output only play a moderate role in driving output fluctuations in six Latin-American countries. Raddatz (2008) also finds that terms of trade changes have a small effect, explaining an estimated 13% of output volatility for a typical African country. Broda (2004) reports that terms of trade shocks can explain 30% of the real output volatility in the long run in countries with fixed exchange rates against 10% for countries with floating exchange rates.

Cross-country and panel data analysis has also been used to examine the relationship between trade shocks and GDP volatility. Easterly and Kraay (2000) find a positive relationship between income volatility and terms of trade volatility in a cross-country analysis. Rodrik's (1998) cross country study finds a positive relationship between trade and GDP volatility. However, Rodrik (2001) finds that the relationship between terms of trade and GNP volatility is positive but insignificant for Latin American economies. Hausman and Gavin (1996) also focus on Latin American countries and their findings reveal that terms of trade shocks have a weaker effect on GDP volatility in countries with a more flexible exchange rate compared to countries with a pegged the exchange rate regime, confirming findings by Broda (2004).

Another set of studies have examined output volatility in partner countries as a potential determinant of domestic volatility. Ahmed (2003) uses a VAR model that includes the volatility of aggregate real GDP of a country's eight largest trading partners as a measure for external shocks. Calderon et al. (2005) includes the standard deviation of the trade-weighted annual growth of the main trading partners. Bacchetta et al., (2009) use the trade-weighted annual growth of all trading partners as a measure of external shocks. These studies conclude that output volatility in partner countries has a positive effect on exporters' GDP volatility. Jansen et. al (2009) examine the role of foreign demand shocks in partner countries in explaining economic volatility in exporting countries. They find that the correlation between trading partners' business cycles is more important in determining exporter's GDP volatility compared to the volatility of demand in individual export markets.

Computable General Equilibrium (CGE) and micro-simulation models have also been deployed in a sequential approach to assess the effects of various macroeconomic policies and shocks on households. This approach has

been used by Decaluwe et al. (1998), Decaluwe et al. (1999), Agénor et al. (2006), Cockburn (2006), Cogneau and Robilliard (2006), and Bourguignon and Savard (2008) to investigate the distributional effects of macroeconomic changes. CGE models have also been combined with micro-simulation models to investigate the impact of macroeconomic shocks on households across the entire income distribution. This is the approach applied by Robilliard et al. (2002) for Indonesia, Bussolo and Lay (2003) for Colombia, Savard (2003) for the Philippines, and Claudio (2004) for Colombia. These studies indicate that macroeconomic volatility negatively affects growth. Households are impacted by the resulting effects primarily via the following channels: (i) financial markets through reduced access to credit, erosion of savings and asset values; and (ii) labor markets through reduced employment, wages and remittances. The other channels include (i) product markets through lower growth and production, and relative price changes; and (ii) government and non-governmental services though reduction in and/ or rationalization of spending on public and private education, health and social protection services.

A key conclusion from these studies is that a complete analysis of the complex relationship between macroeconomic volatility either induced by public policy or shocks and welfare that is tailored to all the key features of developing countries is still missing.

This paper seeks to bridge this gap for Uganda by examining the growth and welfare effects of the macroeconomic shocks experienced during the period 2011-2013 using a CGE model that links national accounts data – described in a Social Accounting Matrix – with microeconomic information from the 2009/10 household survey. This approach facilitates the evaluation of the impact of changes in macroeconomic conditions on output and welfare across specified household clusters or representative household. Analysis of the growth and household welfare outcomes of macroeconomic shocks and/or the implementation of public policies requires an economy wide model that also incorporates information on household characteristics such as their income and spending. A CGE framework is one of the approaches that are better suited to examine microeconomic trends in an economy wide macroeconomic framework. To the best of our knowledge, no other study has undertaken a similar analysis for Uganda using such an approach.

3. METHODOLOGY AND DATA

We use a recursive dynamic CGE model[1] for Uganda based on the 2009/10 Social Accounting Matrix (SAM). We draw on a number of strengths from the CGE modeling framework in our analysis. First, the model simulates the functioning of the economy as a whole and tracks changes in economic conditions and how these changes are transmitted through price and quantity adjustments in a range of markets. Second, since the basis of the CGE model is a SAM, we are able to discern the effects of the changes in economic conditions on individual sectors of the economy. Third, the model is linked to household survey data (macro-micro link) which facilitates the assessment of the impact of macroeconomic changes on household welfare (Vos and Sánchez, 2010)[2]. The price changes derived from the model are linked to the household level data through the Linear Expenditure System which is used to derive new expenditures in each simulation[3]. The version of the 2009/10 SAM used in this paper identifies only one household, a representative household, and thus, it is not possible to undertake distributional analysis. Finally, the recursive dynamic nature of our model implies that the behavior of its agents is based on adaptive expectations, rather than on the forward looking expectations that underlie inter-temporal optimization models. Since a recursive model is solved one period at a time, it is possible to distinguish between the *within-period* component and the *between-period* component, where the latter governs the dynamics of the model. The CGE model used in this study is based on a standard CGE model developed by Lofgren, Harris, and Robinson (2002) and adapted to Uganda by the Economic Policy Research Center. This is a real model where the financial or banking system is not considered. GAMS software is used to calibrate the model and perform the simulations.

3.1 Social Accounting Matrix

Consistent with other conventional SAMs, the 2009/10 Uganda SAM is based on a block of production activities, involving factors of production, the representative household (RH), government, stocks and the rest of the world (ROW)[4]. The various commodities (domestic production) supplied are purchased and used by RH for final consumption (42 percent of the total) and 34 percent is demanded and used by producers as intermediate inputs. Only 7 percent of domestic production is exported, while 11 percent is used for investment and stocks and the remaining 6 percent is used by government for final consumption.

RH derives 64 percent of its income from factor income payments, while the rest accrues from government, corporations and ROW. The government earns 32 percent of its income from import tariffs – a relatively high proportion, but a characteristic typical of developing countries. It derives 43 percent of its income from ROW, which includes international aid and interest. The remainder of government's income is derived from taxes on products (14 percent), income taxes paid by RH (6 percent) and corporate taxes (5 percent)

3.2 Production and commodities

For all activities, producers maximize profits, which are defined as the difference between earned revenues and the cost of factors and intermediate inputs, given their technology and the prices of inputs and outputs. The production technology is a two-step nested structure. At the bottom level, primary inputs are combined to produce value-added output using a constant elasticity of substitution (CES) function[5]. At the top level, aggregated value added is then combined with intermediate inputs within a fixed coefficient (Leontief) function[6] to produce the final output. Profit maximization yields the demand for intermediate goods, labour and capital. The detailed disaggregation of production activities captures the changing structure of growth after the onset of macroeconomic volatility.

The allocation of domestic output between exports and domestic sales is determined using the assumption that domestic producers maximize profits subject to imperfect transformability between these two alternatives. The production possibility frontier of the economy is defined by a constant elasticity of transformation (CET) function

between domestic supply and exports.

On the demand side, a composite commodity is made up of domestic demand and final imports and it is consumed by RH, enterprises, and government. The Armington assumption[7] is used here to distinguish between domestically produced goods and imports. For each good, the model assumes imperfect substitutability (CES function) between imports and the corresponding composite domestic goods. The parameters for CET and CES elasticity used to calibrate the functions in the CGE model are exogenously determined.

3.3 Factors of production

There are 6 primary inputs: 3 labour types (disaggregated according to education level – less than completed secondary education, completed secondary education, and completed tertiary education), capital, cattle and land. Wages and returns to capital are assumed to adjust so as to clear all the factor markets. Labor with secondary education and below as well as self-employed labor is mobile across sectors while capital is assumed to be sector-specific. Within the model, producers instantly adjust to changes in rates of returns for factors of production for each sector. The model does not take into account adjustment costs of switching resources between sectors.

3.4 Institutions

There are three institutions in the model: RH, enterprises and government. RH receives its income from primary factor payments. It also receives transfers from government and ROW and pays income taxes which are proportional to its incomes. Savings and total consumption are assumed to be a fixed proportion of RH's after-tax income. Consumption demand is determined by a Linear Expenditure System (LES) function[8]. The structure/ composition of RH is assumed to remain unchanged over the simulation period. Firms receive their income from remuneration of capital; transfers from government and ROW; and net capital transfers from RH. Firms pay corporate tax to government which is proportional to their incomes.

Government revenue is composed of direct taxes collected from RH and firms, indirect taxes on domestic activities, domestic value added tax, tariff revenue on imports, factor income to the government, and transfers from ROW. The government also saves and consumes.

3.5 Macro closure

Equilibrium in a CGE model is captured by a set of macro closures. Aside from the supply-demand balances in product and factor markets, three macroeconomic balances are specified in the model: (i) fiscal balance, (ii) the external trade balance, and (iii) savings-investment balance. For fiscal balance, government savings are assumed to adjust to equate the difference between government revenue and spending. For external balance, foreign savings are fixed, with exchange rate adjusting to clear foreign exchange markets, in line with Uganda's flexible exchange rate regime. For savings-investment balance, the model assumes that savings are investment driven and adjust through a flexible savings rate. The savings rate adjusts endogenously to investments. The investments are established exogenously to maintain the total savings - investments balance. In the factor markets, the returns/ rents to the various factors clear the market. For the labor market, demand for labor is endogenous while supply is exogenously determined by population growth. The model is calibrated to replicate the baseline unemployment/ underemployment rate whose lower bound is established at 5%. Above this rate, changes in the wage rate lead to changes in the demand for labor across sectors.

3.6 Recursive dynamics

To appropriately capture the dynamic aspects of external shocks on the economy, the model is extended through the inclusion of recursive dynamics, following the approached applied in previous studies on Botswana and South Africa (Thurlow, 2007). The recursive dynamics are captured by assuming that investments in the current period are used to build the new capital stock for the next period. The new capital is allocated across sectors according to the profitability of the various sectors. The labour supply path under different policy scenarios is exogenously provided from a demographic model. The model is initially solved to replicate the 2009/10 SAM.

3.7 Limitations of the model

CGE models have some weaknesses (Thurlow, 2008). The main criticism of the model is that its core formulation is closely tied to the Walrasian ideal of equilibrium (Dervis *et al*, 1982). In a pure neoclassical setting, producers and consumers react passively to prices in order to determine their demand and supply schedules. Markets are therefore assumed to clear through the interaction of relative prices, such that equilibrium is achieved in both goods and factor markets. This model accommodates prices in relative terms and therefore cannot adequately address issues related to inflation.

3.8 Simulations

Our analysis is based on a series of scenarios each representing an exogenous change in economic conditions and also compared to a baseline scenario of business as usual. Running scenarios allows 'controlled experiments' of various types of impacts. These impacts are then ascertained in terms of changes in: average sectoral growth patterns, various components of the external account and measures of household welfare. These changes are then compared to the baseline. The baseline scenario assumes no specific changes to policy and the absence of external shocks. Consistent with the growth patterns in 2010, we calibrate the model to generate about 6.2% real GDP growth under the baseline for the simulation period. The government finances its activities from domestic and foreign sources in a manner that is designed to be compatible with macroeconomic stability.

We compare the baseline to three simulations: (i) changes in terms of trade (***tot***); (ii) movements in international oil prices (***poil***); and (iii) changes in development assistance inflows (***faid***). A fourth simulation (***'tpa'***) combines all these shocks to examine their combined impact on real GDP growth and household welfare.

The terms of trade changes simulated under the 'Terms of Trade' (***tot***) simulation are informed by central bank data on export and import price indexes between 2010 and 2012. In line with trends in these data, we simulate a 9.52% increase in the average price of Uganda's exports and a 6.07% increase in the average price of imports for the 2013-2016 simulation period[9]. The key exports considered in this simulation include both coffee and non-coffee exports including fish, tobacco, tea, cotton, flowers, and oil re-exports which jointly accounted for over 90% of the total export receipts in 2012. The imports considered in the simulation include the following products: petroleum, chemical, intermediate goods including metal and non-metal products, machinery, textiles, food, forestry, vehicles and other manufactured goods. These products accounted for over 85% of total imports in 2012.

The second simulation (***poil***) examines the impact of changes in international oil prices. The World Economic Outlook (WEO) reports that international oil prices increased by 28% per barrel in 2010, 32% in 2011, and 1% in 2012 before decreasing by 0.9% and 7.5% in 2013 and 2014 respectively. The January 2015 WEO Update projects a 41.1% decrease and a 12.6% increase in oil prices in 2015 and 2016 respectively.

Our third simulation – 'Foreign Aid' (***faid***) evaluates the impact of the 2012 aid-cut backs. We simulate a 50% reduction in aid in 2012, compared to the 2010 aid levels to capture the suspension of development aid in 2012.

In line with the FY 2013/14 and 2014/15 budgets which project that 80% of public spending will be financed by domestic resources, further reductions in aid of 75% (compared to the 2010 levels) are simulated for the period 2013-2016.

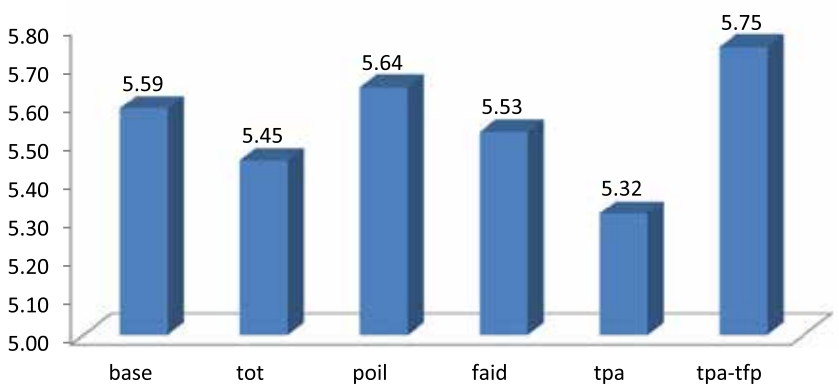
To the extent that the three macroeconomic shocks i.e. changes in terms of trade, oil price fluctuations, and suspension of aid were largely experienced concurrently, we run the ***tot***, ***poil*** and ***faid*** simulations simultaneously, which yields the ***tpa*** simulation. In the section that follows, we examine the impact of these shocks, both individually and collectively on real GDP growth and household welfare.

4. FINDINGS

4.1 Impact on GDP Growth

Figure 1 presents the average real GDP growth rates for the period 2010-17 under the baseline and the four simulations considered here. The ***tot*** and ***faid*** simulations yield average real GDP growth rates that are lower than the baseline. The baseline assumes that the 2010 policy environment and framework is maintained throughout the simulation period and also assumes no external shocks. The average real GDP growth rate under the ***poil*** simulation is higher than the baseline during the simulation period due to the reduction in international oil prices during 2013 to 2015.

Figure 1. Average Real GDP Growth (%) - 2010 - 2017)

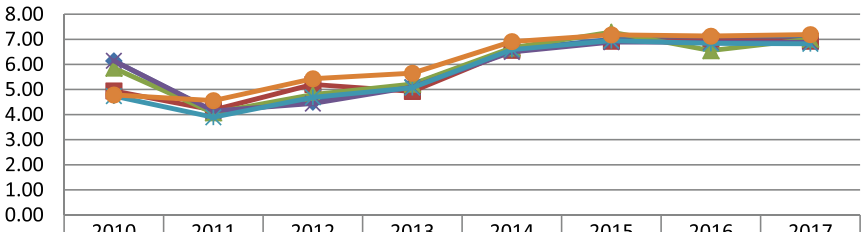


Source: Model simulations and author computations

Two channels in particular could explain the positive relationship between real GDP growth and international oil price reductions particularly for a net oil importer such as Uganda. First, petroleum products, particularly fuel, comprise core inputs into the production process, and thus changes in oil prices will directly affect the cost of production and productivity. Second, falling oil prices are likely to reduce pressure on the non-farm wage rate, contributing to potential reductions in production costs. This can boost growth in the non-agriculture sector. Simulation ***tpa*** combines all three shocks (***faid***, ***poil***, and ***tot***) and examines their joint impact on real GDP growth. Simulation ***tpa-tfp*** assumes a 2.5% increase in total factor productivity (tfp) in simulation ***tpa.*** As illustrated in Figures 1-6, growth in tfp contributes to higher real GDP growth, increases the sectoral contribution to real GDP growth and expedites the post-shock recovery.

Figure 2 illustrates the trends in real GDP growth across the three individual simulations and the combined simulation. Real GDP rises faster under the ***poil*** simulation during the period 2013-15, which coincides with the reduction in international oil prices. However, a more thorough assessment of the channels through which the three shocks affect real GDP growth requires examining the trends in sectoral contributions to GDP growth[10]. This impact is illustrated in Figures 3-5.

Figure 2. Real GDP Growth (year-over-year, %)

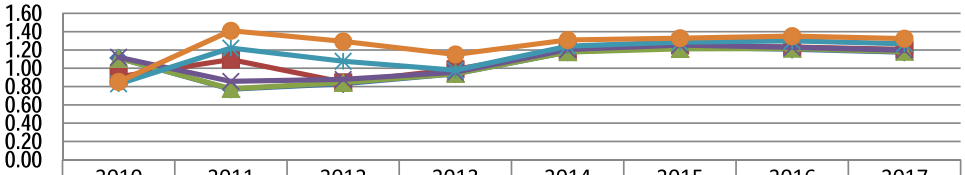


	2010	2011	2012	2013	2014	2015	2016	2017
base	6.14	4.12	4.50	5.20	6.60	7.00	7.00	7.00
tot	4.94	4.18	5.20	4.92	6.56	6.93	6.94	6.93
poil	5.86	4.07	4.80	5.22	6.66	7.29	6.55	7.01
faid	6.14	4.14	4.44	5.09	6.49	6.89	6.88	6.88
tpa	4.74	3.89	4.69	5.07	6.59	6.94	6.83	6.82
tpa-tfp	4.78	4.56	5.43	5.65	6.91	7.18	7.13	7.19

Source: Model simulations and author computations

Figure 3 indicates that trends in the agriculture sector's contribution to real GDP growth do not differ much across the four simulations and are also similar to the baseline. However, agriculture's contribution to real GDP growth under the ***tot*** simulation increases between 2010 and 2011 before reverting to the path traced by the ***faid*** and ***poil*** simulations for the remainder of the simulation period. This finding could be due to the impact of deteriorating terms of trade on agriculture exports and import substitutable agriculture products. In particular, the deterioration in terms of trade contributes to a depreciation of the local currency which supports growth in exports such as export crops and import substitutable agriculture products. These findings are consistent with data from the central bank. For instance, terms of trade deteriorated by an average of 1.6% between 2010 and 2012 while the Uganda Shilling depreciated by 15.9% against the US Dollar between 2010 and 2011.

Figure 3. Agriculture- Contribution to real GDP growth (%)



	2010	2011	2012	2013	2014	2015	2016	2017
base	1.11	0.77	0.83	0.94	1.18	1.23	1.21	1.18
tot	0.91	1.10	0.85	0.99	1.19	1.25	1.23	1.21
poil	1.11	0.77	0.84	0.94	1.18	1.21	1.21	1.18
faid	1.12	0.86	0.88	0.96	1.20	1.25	1.23	1.20
tpa	0.83	1.22	1.08	0.98	1.24	1.29	1.30	1.27
tpa-tfp	0.85	1.41	1.29	1.15	1.31	1.33	1.35	1.32

Source: Model simulations and author computations

However, the drought driven food shortages and the resulting surge in food inflation experienced during the second half of 2011 appear to have more than offset the impact of terms of trade changes on agriculture sector growth. This could explain the reduction in this sector's contribution to real GDP growth in 2012. The impact of the drought on the agriculture sector is reflected in the escalation in food prices. Annual headline inflation increased from 5% in January 2011 to 30.5% in October 2011 with annual food inflation increasing from 3.5% to 45.8%. The simulation that combines all three shocks (***tpa***) mirrors the trends in the individual shocks but shows that overall, the contribution of the agriculture sector to real GDP growth is higher as a result of the shocks compared to the baseline.

Figure 4. Industry - Contribution to real GDP growth (%)

	2010	2011	2012	2013	2014	2015	2016	2017
base	1.02	0.99	0.95	0.92	1.04	1.15	1.22	1.24
tot	2.52	0.15	-0.15	1.49	1.10	1.19	1.23	1.23
poil	1.21	1.03	0.75	0.90	1.00	0.91	1.56	1.24
faid	1.06	1.45	1.18	0.94	1.09	1.18	1.25	1.27
tpa	2.56	0.50	0.19	1.38	1.12	1.06	1.56	1.30
tpa-tfp	2.61	0.81	0.38	1.69	1.25	1.14	1.75	1.46

Source: Model simulations and author computations

In the industry sector, two key findings emerge. First, the contribution of this sector to real GDP growth under the ***faid*** simulation exceeds the baseline scenario and the two other simulations during the period 2011-12 but seems to revert to 'trend' after 2012 (Figure 4). Second, the sector's contribution to real GDP growth decreases across all the other simulations between 2010 and 2012 and the slowdown is more pronounced under the ***tot*** simulation. The first observation (strong contribution of the industry sector to real GDP growth under the ***faid*** simulation) can be explained by the depreciation of the real exchange rate associated with a reduction in development assistance. Exchange rate depreciation supports export-oriented and/or import substitutable manufacturing as imports become expensive while exports become less costly.

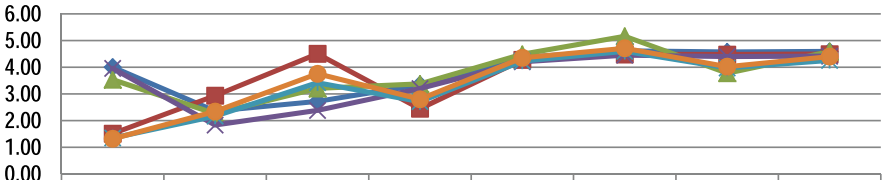
The second observation (industry sector's contribution to real GDP growth decreases across all the other simulations) can be explained by various factors. For instance, rising oil prices in 2010-2012 under the ***poil*** simulation increased the cost of production in industry. The annual manufacturing producer price index published by the Uganda Bureau of Statistics increased from 18.3% in December 2010 to 31.9% in December 2011 before decreasing to -2.2% in December 2012 in line with the trends in international oil prices during this period. Moreover, given that food, rent, fuel and utilities comprise over 40% of Uganda's consumer price index basket, oil price increases are important drivers of inflationary pressures. Thus, the cost of production can also increase when labor responds to rising inflation by demanding an increase in wages to compensate for the higher cost of living.

The increased cost of production in both of these cases can reduce productivity in industry, leading to a decrease in this sector's contribution to GDP. However, industry sector productivity increases in line with the international prices reductions in 2013-15. Understanding the impact under the ***tot*** simulation requires examining data on the two tradable components in the industry sector: manufacturing and mining. Balance of Payment data for 2010-12 reveal a reduction in gold and cobalt export receipts, the key mineral exports, due to lower domestic production and easing international prices respectively. These data also show a 74% increase to USD 388 million in 2012 compared to 2010 in the value of manufactured goods – primarily beverages, intermediate inputs (cement) and light manufactures (sugar, soap and plastic products).

However, detailed data on volumes are not readily available making it difficult to disaggregate the contribution of prices and volumes to this increase. Moreover, the share of these manufactured products in total exports is minimal, averaging 12% between 2010 and 2012. It is also equally plausible that the reduction in the industry sector's contribution to real GDP growth is explained by the positive impact of terms of trade changes on other sectors such as agriculture as illustrated in Figure 3. Jointly, the three shocks – ***faid***, ***poil***, ***tot*** – contribute to a more gradual reduction (simulation ***tpa***) in the contribution of the industry sector to real GDP growth between 2010 and 2012 with this contribution increasing steadily through 2017.

Figure 5 reveals that the service sector's contribution to real GDP growth is similar trends across the four simulations.

Figure 5. Services - Contribution to real GDP growth (%)



	2010	2011	2012	2013	2014	2015	2016	2017
base	4.00	2.36	2.72	3.34	4.38	4.62	4.57	4.59
tot	1.51	2.93	4.50	2.45	4.28	4.48	4.48	4.49
poil	3.54	2.27	3.21	3.37	4.49	5.16	3.78	4.59
faid	3.96	1.83	2.38	3.20	4.21	4.45	4.40	4.41
tpa	1.35	2.17	3.42	2.71	4.23	4.60	3.97	4.26
tpa-tfp	1.32	2.34	3.75	2.80	4.36	4.71	4.02	4.40

Source: Model simulations and author computations

However, three key results standout. First, the reduction in the sector's contribution to real GDP growth between 2010 and 2011 is greatest under the ***faid*** simulation but increases under the ***tot*** simulation. Reductions in external inflows, including development assistance contribute to a depreciation of the real exchange rate which increases growth in export-oriented and import-substitutable sectors. Thus, tradable sectors (export crops, manufacturing and mining) become more attractive for private investors due the reduced relative costs in the export sectors and/or in the import-competitive sectors. The upshot of these factors is that private capital will tend to flow towards the tradable sectors and away from the non-tradable sectors such as domestic oriented services. Thus, given that the service sector is the least tradable, it is plausible that it will be most affected by the reduction in foreign inflows, in particular external development assistance.

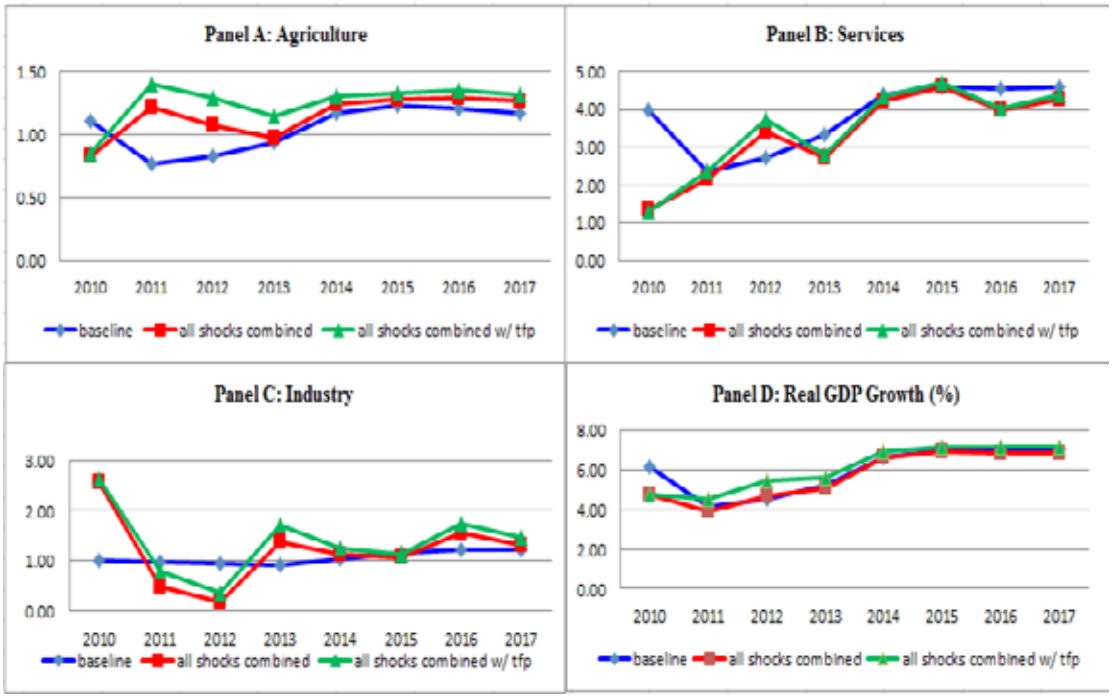
The second key finding relates to the contribution of the services sector to real GDP growth which increases steadily under the ***tot*** simulation during the period 2010 – 2012 before decreasing in 2013. BoP data from the Bank of Uganda indicate that Terms of Trade decreased by 6.9% in 2010, increased by 10.8% in 2011 before decreasing by 8.8% in 2012 and recovering to increase by 0.6% in 2013. It is plausible that the 1.6% average deterioration in the Terms of Trade between 2010 and 2012 bolstered growth in non-tradable sectors including domestic services. This could explain the increase in the service sector's contribution to real GDP growth under the ***tot*** simulation during this period.

The third finding concerns the steady increase in the service sector's contribution to real GDP growth under the ***poil*** simulation in 2013-15, a period also marked by decreasing international oil prices. Growth in domestic purchasing power as a result of the reduced oil prices is one of the factors that explain the increased GDP contribution from the service sector during this period.

Simulation ***tpa*** combines all the three shocks to examine the overall impact on sectoral contribution to real GDP growth. These effects are illustrated in Figure 6 which shows that the sectoral contribution to real GDP 'recovers' following the on-set of shocks in industry and remains higher than the baseline post 2012. For agriculture, the sector's contribution to real GDP growth remains higher than the baseline throughout the simulation period. The services sector's contribution to real GDP growth on the other hand increases steadily between 2010 and 2012, decreasing and falling below the baseline in 2013 before recovering post 2013. In conclusion, the three external shocks considered in this paper affect agriculture, industry and services in diverse ways, with the largely positive impact on agriculture and services during the period 2010-2012 appearing to offset the negative impact

on industry during the same period. This explains the minimal deviations in real GDP growth trends between the baseline and the three shocks during the simulation period. The primary channels through which these shocks are transmitted include exchange rate depreciation and changes in cost of production, both of which affect economic competiveness.

Figure 6. Sectoral Contribution to Real GDP Growth (%) – all three shocks combined



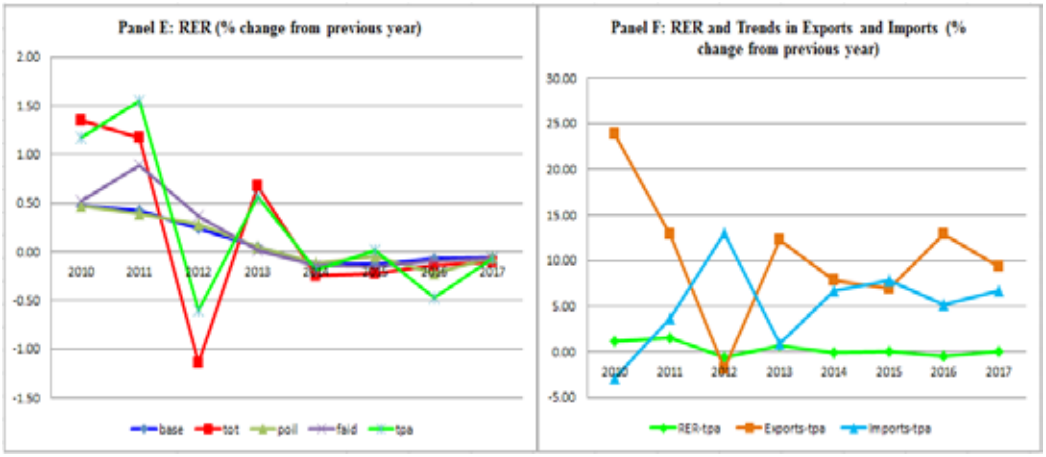
Source: Model simulations and author computations

Simulation ***tpa-tfp*** assumes a total factor productivity (tfp) growth of 2.5%. Figure 6 confirms that tfp growth contributes to higher sectoral and real GDP growth and also expedites the recovery from the three external shocks examined by this paper. Consistent with the findings depicted in Figures 2-5, Figure 6 shows that the three shocks only result in short term deviations in output, with real GDP growth and the trends in the corresponding sectoral contributions returning to the baseline after the shocks, i.e., post 2013.

4.2 Impact on Exports and Imports

The discussion in the preceding section reveals that the impact of the three shocks on real GDP growth is in part transmitted through the tradable sectors in particular the export-oriented and import dependent sectors. This section investigates this linkage by examining the impact of the three shocks on imports and exports and the possible channels through which these shocks are transmitted. Figure 7 illustrates the impact of the three shocks on the real exchange rate (RER) and the RER's correlation with trends in imports and exports. Panel E shows that changes

Figure 7. Impact of shocks on Real Effective Exchange Rate, Imports and Exports



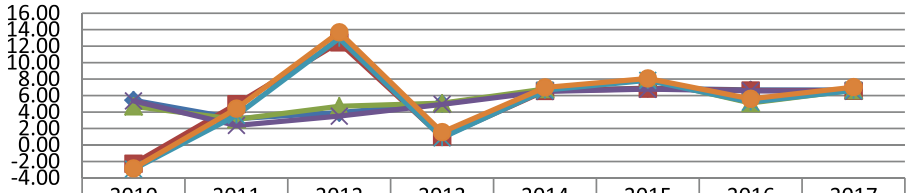
Source: Model simulations and author computations

In the terms of trade (simulation ***tot***) are the major drivers of the movements in the RER with deterioration in the terms of trade leading to a decrease in the RER or real depreciation of the Uganda Shilling and vice-versa.

Consistent with data from the Bank of Uganda, the combined shocks (simulation ***tpa***) lead to an increase in the RER or a real appreciation of the Uganda Shilling between 2010 and 2011 which increases imports and reduces exports. In spite of the negative growth in the RER or real depreciation of Uganda Shilling between 2011 and 2012, exports continue decrease and imports sustain their upward trend in 2012 (Panel F), with these trends reversing after 2012. This suggests that trade responds to exchange rate movements with a lag.

Figure 8 indicates that the growth rate of imports decreases in the ***poil*** and ***faid*** simulations between 2010 and 2011 followed by a gradual increase post-2012. Changes in purchasing power and the exchange rate are among the key drivers of the import trends depicted in Figure 8 under the ***poil*** and ***faid*** simulations respectively.

Figure 8. Growth in Imports (year-over-year, %)



	2010	2011	2012	2013	2014	2015	2016	2017
base	5.44	3.20	3.92	5.02	6.63	6.88	6.68	6.65
tot	-2.28	4.95	12.46	0.99	6.56	6.84	6.61	6.58
poil	4.69	3.12	4.71	5.06	6.80	7.96	5.10	6.66
faid	5.36	2.38	3.51	4.93	6.50	6.78	6.56	6.53
tpa	-2.94	3.60	12.95	0.88	6.66	7.85	5.21	6.63
tpa-tfp	-2.84	4.42	13.70	1.56	7.00	8.08	5.61	7.03

Source: Model simulations and author computations

Bank of Uganda data confirm that the Uganda shilling depreciated by 21% against the US Dollar during the first three quarters of 2011 which slowed the growth rate of imports. The 12% appreciation of the local currency against the US Dollar between October 2011 and July 2012 explains the reversal in the decline of the growth rate for imports. Moreover, monetary policy measures – particularly the increase in the Central Bank Rate[11] to reduce the inflationary pressures experienced during the second half of 2011 – contributed to an increase in portfolio

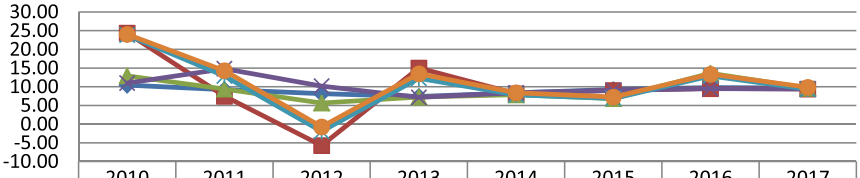
inflows[12]. These increased inflows contributed to the appreciation of the local currency against the dollar and other major currencies during the second half of 2011 and during 2012. This explains the gradual increase in import growth after 2011 under the ***faid*** simulation.

The reduction in oil prices in 2012 and 2013 relative to the 2010-11 period increases purchasing power which leads to increased household consumption. Given that consumer goods account for 30% of total imports, a rise in consumption will contribute to an increase in imports. Moreover, lower oil prices boost production in various sectors including in industry which increases intermediate and capital goods imports. These two factors explain the rise in import growth under the ***poil*** simulation after 2011.

Under the ***tot*** simulation, imports grow at an increasing rate between 2010 and 2012, with this growth rate decreasing in 2013 before picking up after 2013. The appreciation of the Uganda Shilling and increase in the Terms of Trade during this period could explain the import trends under the ***tot*** simulation between 2010 and 2012.

Figure 9 shows that the trends in export growth are also consistent with changes in the value of the local currency against the US Dollar and other major currencies in 2011 and 2012.

Figure 9. Growth in Exports (year-over-year, %)



	2010	2011	2012	2013	2014	2015	2016	2017
base	10.42	9.20	8.12	7.38	8.34	9.23	9.76	9.63
tot	24.36	7.47	-5.73	15.03	8.12	9.03	9.52	9.40
poil	12.93	9.39	5.66	7.22	7.84	6.83	13.61	9.62
faid	10.97	14.83	10.16	7.16	8.37	9.01	9.50	9.38
tpa	23.81	12.87	-1.94	12.27	7.82	6.87	12.88	9.34
tpa-tfp	24.04	14.30	-0.72	13.48	8.38	7.24	13.36	9.86

Source: Model simulations and author computations

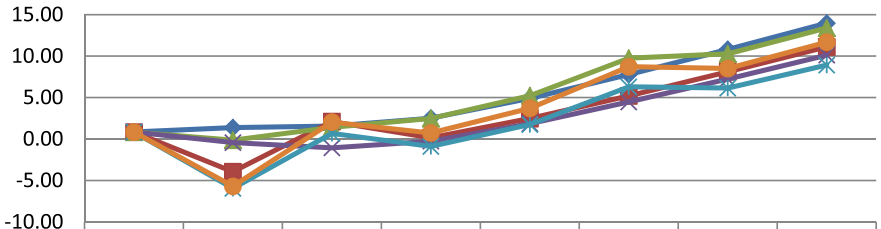
As would be expected, depreciation of the exchange rate during the first three quarters of 2011 resulted in a rise in the export growth rate under the ***faid*** simulation. However, the appreciation and subsequent stability of the Uganda Shilling starting in Q4 2011 and during 2012 respectively contributed to a slowdown in the growth rate of exports. The ***tot*** simulation also depicts trends in export growth that are consistent with the appreciation of the Uganda shilling against major currencies and deteriorating Terms of Trade – terms of trade decreased by an average of 1.6% – during the period 2010-12.

In summary, our findings confirm that the changes in terms of trade are a major channel through which the three external shocks examined here are transmitted to real GDP growth. Changes in terms of trade and the resulting adjustments in the exchange rate also directly affect exports and imports. In line with the impact on real GDP growth (see Figures 1-6), the three external shocks only lead to short-term deviations in trade, with exports and imports reverting to the baseline after 2013. This result is consistent with findings by Collier and Goderis (2009) and Berg et al. (2011) among others.

4.3 Effects on Household Welfare

Figures 10 and 11 illustrate the impact of the three external shocks on household welfare as measured by the equivalent variation (EV)[13] and changes in real per capita consumption respectively. Both of these measures indicate that household welfare declines in 2011 following the on-set of the shocks and but gradually increases during the simulation period post-2012. However, household welfare, as measured by the equivalent variation, remains permanently below the baseline ***base*** under the ***tot***, ***faid*** and ***tpa*** simulations.

Figure 10. Equivalent Variation per capita (% of base year consumption spending per capita)



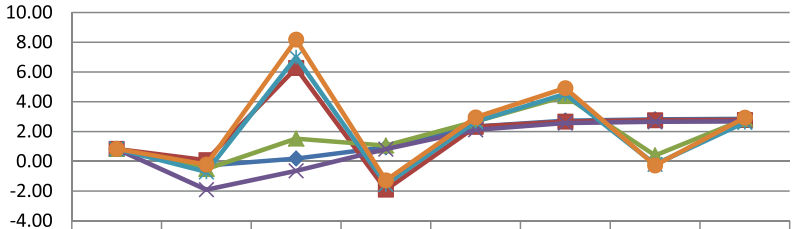
	2010	2011	2012	2013	2014	2015	2016	2017
baseline	0.83	1.36	1.55	2.51	4.91	7.77	10.81	13.96
tot	0.83	-3.94	2.10	0.15	2.47	5.20	8.11	11.11
poil	0.83	-0.14	1.40	2.48	5.22	9.74	10.26	13.39
faid	0.83	-0.44	-1.07	-0.26	1.85	4.47	7.24	10.11
tpa	0.83	-5.95	0.67	-0.89	1.75	6.29	6.14	8.91
tpa w/ tfp	0.83	-5.70	2.04	0.73	3.70	8.72	8.50	11.68

Source: Model simulations and author computations

As discussed earlier, the steep rise in oil prices between 2010 and 2011 and the depreciation of the Uganda Shilling against the US Dollar during this period[14] contributed to the reduction in household welfare under the ***poil*** and ***faid*** simulations relative to the baseline in 2010-11. Household welfare increases starting 2012 under the ***poil*** simulation in line with the receding international oil prices in part due to the resulting increase in purchasing power especially given that food, rent, fuel and utilities account for over 40% of the consumer price index basket. However, household welfare continues to fall under the ***faid*** simulation in 2012 reflecting the impact of the reduced aid inflows on the exchange rate. The Uganda Shilling depreciated by 8% against the US Dollar between July and December 2012, which as discussed earlier, increased the relative price of imports, negatively affecting household welfare. Stability in the exchange rate during 2013 explains the gradual rise in household welfare under the ***faid*** simulation after 2013.

Terms of trade increased by 10.8% in 2011, increasing imports and household welfare especially since consumer goods comprise over 30% of total imports. However, improved terms of trade can also lead to appreciation of the exchange as was the case in Uganda starting in October 2011. Appreciation of the exchange rate reduces export competiveness and has the potential of driving capital away from the tradable (export crop agriculture, manufacturing – food and agro-processing, and mining) to the non-tradable (construction and domestic-oriented services) sectors. To the extent that the agriculture sector employs over 65% of Uganda's workforce, the resulting limited expansion in agriculture (see Figure 12 Panel G) reduces household welfare under the ***tot*** simulation compared to the baseline in 2010-11.

Figure 11. Growth in hourshold real per-capita consumption (%)



	2010	2011	2012	2013	2014	2015	2016	2017
baseline	0.83	-0.28	0.19	0.95	2.34	2.73	2.82	2.85
tot	0.83	0.07	6.27	-1.91	2.32	2.67	2.76	2.78
poil	0.83	-0.52	1.53	1.06	2.68	4.38	0.40	2.84
faid	0.83	-1.90	-0.64	0.82	2.12	2.57	2.65	2.68
tpa	0.83	-0.71	7.00	-1.55	2.67	4.53	-0.20	2.62
tpa w/ tfp	0.83	-0.22	8.18	-1.28	2.95	4.92	-0.28	2.93

Source: Model simulations and author computations

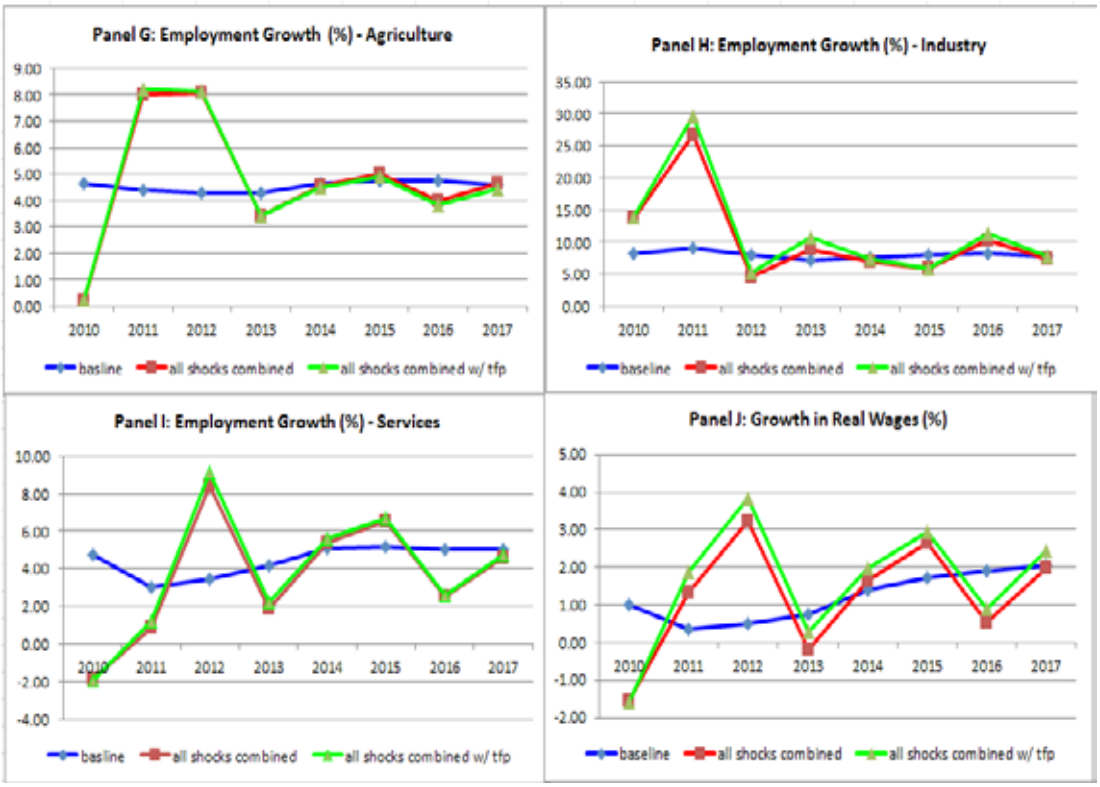
Figure 11 confirms the changes in household welfare depicted in Figure 10. In particular, growth in real per-capita household consumption turns negative in 2011 before recovering post-2013. As with the EV measure of household welfare, the growth in real per-capita household consumption remains below the baseline under the ***tot*** and ***faid*** simulations after 2013. Household welfare increases under the ***poil*** simulation and remains above the baseline between 2013 and 2015 in line with the falling international oil prices. Growth in real per-capita household consumption also remains below the baseline under the ***tpa*** simulation (which examines the joint impact of all three shocks) except in 2012, 2014 and 2015. The reduction in international oil prices during 2014-15 appears to offset the negative impact of the changes in terms of trade on household consumption.

In summary, the three external shocks examined in this paper affect household welfare at the on-set of the shocks in 2010/2011 and also result in lower welfare under two simulations ***tot*** and ***faid*** after 2013. Jointly, these shocks contribute to lower household welfare except in 2012, 2014 and 2015 as illustrated under the ***tpa*** simulation relative to the baseline. The rise in household welfare in 2012 under the ***tpa*** simulation relative to the baseline is due to the combined effects of the appreciation of the Uganda Shilling starting in Q4 2011 and the increase in Terms of Trade in 2011. Falling international oil prices in the period 2014-15 drive the increased per capita household consumption relative to the baseline during the same period.

4.4 Impact on Employment and Real Wages

The employment and real wage trends in Figure 12 illustrate a positive correlation between employment and real wages during the simulation period. Labor supply is assumed to be exogenous and thus, the discussion here focuses only on the sectoral evolution of employment. The rise in real wages between 2010 and 2012 is followed by employment growth in agriculture and services. Employment growth in the agriculture sector moderates between 2011 and 2012 and declines after 2012 while employment in industry decreases after 2011. Job growth in all three sectors and the growth in real wages recover and return to the baseline after 2013.

Figure 12. Impact on Sectoral Employment and Real Wages



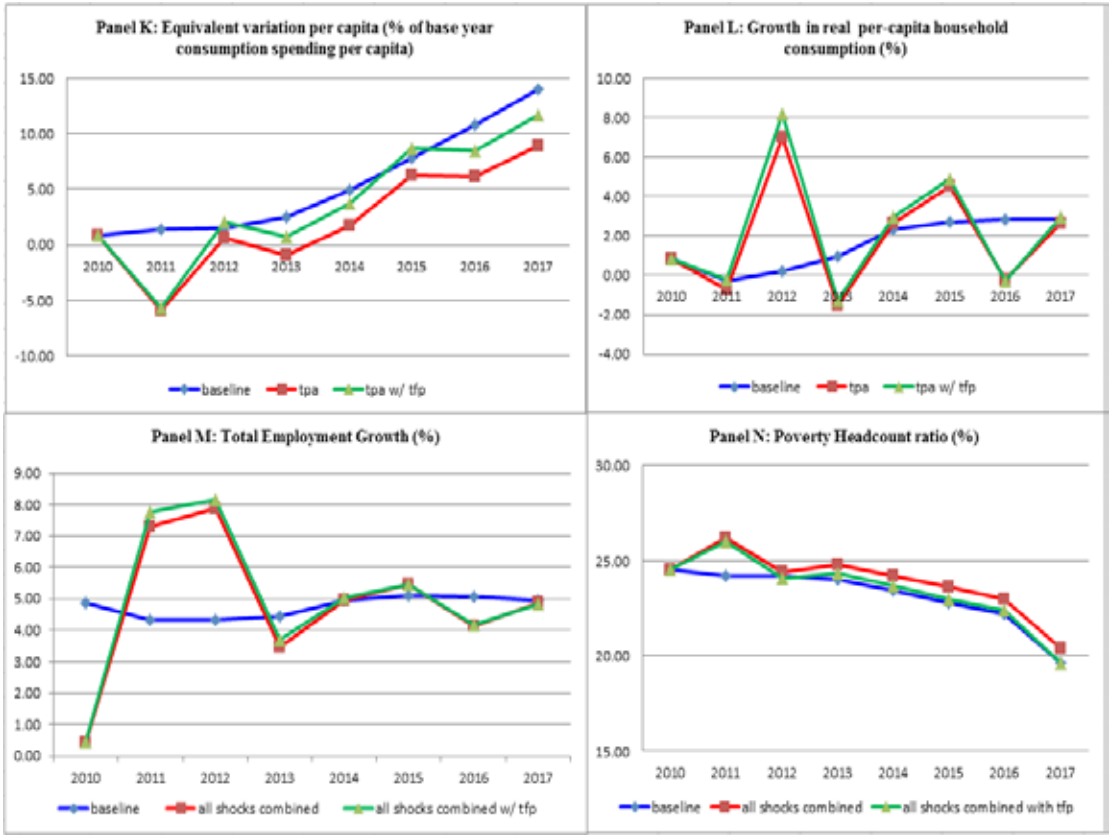
Source: Model simulations and author computations

This finding is consistent with the observed impact of the three shocks on sectoral productivity and contribution to real GDP growth (see section 4.1) and the consequent effects on household welfare and consumption (see section 4.3) during the simulation period. For instance, the reduction in employment growth between 2012 and 2013 also mirrors the reduction in household welfare and consumption during the same period. These reductions are also consistent with the slowdown in the agriculture and services sectors between 2012 and 2013 (see Figure 9). Over 65% of the workforce is employed in agriculture while services contribute over 45% of GDP and thus, slower growth in these two sectors will reduce growth in employment, real wages and household welfare. These findings confirm that the three shocks examined by this paper affect household welfare through two channels: (i) the labor market, via changes in employment and real wages; and (ii) changes in macroeconomic conditions, primarily through changes in international oil prices and fluctuations in the exchange rate which affect consumers' purchasing power.

4.5 Impact on Poverty Reduction

Figure 13 illustrates that the trends in household welfare, household consumption per-capita, employment growth and poverty head count are correlated.

Figure 13. Impact on Household Welfare, Employment and Poverty Reduction



Source: Model simulations and author computations

In particular, Panel N shows that all three shocks combined lead to an increase in the poverty headcount ratio (share of the population below USD 1.25 a day) between 2010 and 2011 with the poverty rate returning to the baseline in 2012 followed by a reduction in poverty after 2013. However, the reduction in poverty headcount is lower under the three shocks compared to the baseline. These findings are also in line with the permanent reduction in household welfare caused by the joint impact of the three shocks as illustrated in Figures 10, 11 and 13. In summary, the three external shocks examined here contribute to longer term reductions in household welfare, consumption, and poverty reduction rates. Growth in total factor productivity reduces the severity of these external shocks and increases household welfare, consumption, employment and the rate of poverty reduction.

5. CONCLUSION

Using a CGE model for Uganda, this paper examines the growth and welfare effects of three macroeconomic shocks: changes in terms of trade, changes in international oil prices, and changes in development assistance inflows. Four key findings emerge from our analysis.

First, the opposite and often offsetting effects of the three external shocks examined affect agriculture, industry, and services in diverse ways. The shocks' largely positive impact on agriculture and services during the period 2010-12 appears to offset the negative impact on industry. Overall, this leads to minimal deviations in real GDP growth trends between the baseline and the simulations with the three shocks. Moreover, the three shocks only result in short-term as opposed to permanent deviations from 'trend' real GDP growth.

Second, these three external shocks are transmitted to the domestic economy and real GDP growth through four primary channels: (i) changes in the exchange rate and the associated effect on the non-tradable (domestic) and tradable (import-dependent and export-oriented) sectors; (ii) changes in the cost of production; (iii) changes in the terms of trade which affect resource allocation/ investment choices in the tradable versus the non-tradable sectors; and (iv) changes in sectoral employment and real wages as a result of the shocks' impact on resource allocation decisions in the tradable versus non-tradable sectors.

Third, the external shocks result in longer term reductions in household welfare, consumption and poverty reduction rates. Household welfare and consumption decrease following the on-set of the shocks in 2010/11 and remain below the baseline scenario during the entire simulation period for two of the three individual simulations (***tot*** and ***faid***) and under the combined simulation (***tpa***) post-2013. International oil price reductions during 2013-15 lead to higher household welfare and consumption compared to the baseline during the same period. The poverty headcount ratio increases between 2010 and 2011, before decreasing and trending towards the baseline scenario after 2012/13. Consistent with the permanent reduction in household welfare and consumption, the rate at which poverty is reduced after the on-set of the shocks is lower compared to the baseline.

Fourth, growth in total factor productivity accelerates the recovery from these shocks, contributes to higher real GDP growth, and increases household welfare, consumption, employment and the rate of poverty reduction.
These findings should be of interest to a diverse audience of policy makers both in Uganda and the region for at least three reasons. First, identifying and quantifying the impact of key external shocks in explaining output volatility and the associated effects on household welfare and poverty is critical for informing counter cyclical policy. Second, such analyses are also important in the design and implementation of structural reforms aimed at reducing exposure and vulnerability to these shocks. Third, examining the potential gains in terms of reduced output and household welfare volatility from implementing counter-cyclical measures can inform the prioritization of reforms.

Our findings – and based on the assumptions that we make in this paper – reveal that policy makers should focus on designing and implementing policies that expand and diversify the export base and reduce the impact of external shocks on the vulnerable and poor. Addressing Uganda's long standing structural imbalance between imports and exports remains critical to ensuring the stability of the exchange rate. This will in turn contribute to the closure of one of the primary channels through which external shocks are transmitted to the domestic economy. Policies such as social safety nets and micro insurance especially in the non-tradable sectors such as subsistence agriculture, construction, and domestic services can offset the long term negative effects of external shocks on household welfare and poverty reduction.

REFERENCES

Acemoglu, D., S. Johnson, J. A. Robinson, and Y. Thaicharoen. 2003. "Institutional Causes, Macroeconomics Symptoms: Volatility, Crises, and Growth." *Journal of Monetary Economics* 50(1):49–122.

Agénor P., A. Izquierdo, and H. Fofack. 2006. "IMMPA: A quantitative macroeconomic framework for the analysis of poverty reduction strategies," in P. Agénor, A. Izquierdo, and H. Jensen, eds.

Ahmed, S. 2003. "Sources of Macroeconomic Fluctuations in Latin America and Implications for Choice of Exchange Rate Regime". *Journal of Development Economics* 72: 181-202.

Bacchetta, M., M. Jansen, C. Lennon, and R. Piermartini. 2009. "Exposure to External Shocks and the Geographical Diversification of Exports". In R. Newfarmer, W. Shaw, and P. Walkenhorst, eds., Breaking into New Markets: Emerging Lessons for Export Diversification. Washington DC, World Bank.

Berg, A., C. Papageorgiou, C. Pattillo, M. Schindler, N. Spatafora, and H. Weisfeld. 2011. "Global Shocks and their Impact on Low-Income Countries: Lessons from the Global Financial Crisis." *IMF Working Paper 11/27.*

Bourguignon F., and L. Savard. 2008. "Distributional Effects of Trade Reform: An Integrated Macro-micro model applied to the Philippines' labour". In F. Bourguignon, L. Da Silva, and M. Bussolo, eds., The Impact of Macroeconomic Policies on Poverty and Income Distribution: Macro-micro Evaluation Techniques and Tools. Houndmills, UK: Palgrave-Macmillan Publishers Limited: 177-212.

Broda, C. 2004. "Terms of trade and exchange rate regimes in developing countries". *Journal of International Economics* 63(1): 31-58.

Bussolo, M., and J. Lay. 2003. "Globalization and Poverty Changes in Colombia", Development Centre, OECD, *Working Papers*, No. 226, December

Caballero, R.J., and A. Krishnamurthy. 2001. "International and Domestic Collateral Constraints in a Model of Emerging Market Crises." *Journal of Monetary Economics* 48(3): 513-548

Calderon, C., N. Loayza, and K. Schmidt-Hebbel. 2005. "Does openness imply greater exposure?" *World Bank Policy Research Working Papers 3733*. Washington DC, World Bank.

Claudio, R. 2004. "How Can Tax Policies and Macroeconomic Shocks Affect the Poor? A Quantitative Assessment Using a Computable General Equilibrium Framework for Colombia." CEPAL, Santiago-Chile

Cockburn, J. 2006. "Trade Liberalization and Poverty in Nepal: a Computable General Equilibrium Micro Simulation Analysis", in M. Bussolo and J. Round, eds., Globalization and Poverty: Channels and Policies, London: Routledge, 171-194.

Cogneau, D., and A. S. Robilliard. 2006. "Growth, Distribution and Poverty in Madagascar: Learning from a Micro-Simulation Model in a General Equilibrium Framework", in A. Spadaro, ed., Micro-simulation as a tool for the evaluation of public policies: methods and applications, Bilbao: Fundacion BBVA.

Collier, P., and B. Goderis. 2007. "Commodity Prices, Growth and the Natural Resources Curse: Reconciling a Conundrum." University of Oxford, CSAE WPS/2007-276

_____. 2009. "Structural Policies for Shock-Prone Developing Countries." University of Oxford, *CSAE WPS/2009-03*

Dabla-Norris, E., and Y.B. Gunduz. 2012. "Exogenous Shocks and Growth Crises in Low-Income Countries: A Vulnerability Index". *IMF Working Paper 12/264*

Decaluwe, B., A. Patry and L. Savard. 1998. "Income Distribution, Poverty Measures and Trade Shocks: a Computable General Equilibrium Model of an Archetype Developing Country", in *Cahier de recherche*, No. 98-14, University of Laval, December, CREFA.

Decaluwe, B., J. Dumont and L. Savard. 1999. "Measuring Poverty and Inequality in a Computable General Equilibrium Model", in *Cahier de recherche*, No. 99-20, University of Laval, September, CREFA.

Di Giovanni, J., and Levchenko, A. 2009. "Trade Openness and Volatility". *Review of Economics and Statistics,* 91(3): 558-585.

Easterly, W., Kremer, M., Pritchett, L., and Summers, L. 1993. "Good Policy or Good Luck?: Country Growth Performance and Temporary Shocks." *Journal of Monetary Economics,* 32(3): 459-483.

Easterly, W., and A. Kraay. 2000. "Small States, Small Problems? Income, Growth, and Volatility in Small States". *World Development* 28(11): 2013-2027.

Fata, A. 2002. "The Effects of Business Cycles on Growth." In N. Loayza and R. Soto, eds., Economic Growth: Sources, Trends, and Cycles. Santiago, Chile: Central Bank of Chile.

Hausmann, R., and M. Gavin. 1996. "Securing stability and growth in a shock prone region: the policy challenge for Latin America". *Inter-American Development Bank* Working Paper 315.

Hnatkovska, V., and N. Loayza. 2005. "Volatility and Growth." In J. Aizenmann and B. Pinto, eds., Managing Economic Volatility and Crises. Cambridge, United Kingdom: Cambridge University Press. 65-100.

Jansen, M., C. Lennon, and R. Piermartini. 2009. "Exposure to External Country Specific Shocks and Income Volatility." *Economic Research and Statistics Division, World Trade Organization*. Geneva

Kose, M. A. 2002. "Explaining business cycles in small open economies: How much do world prices matter?". *Journal of International Economics*, 56(2): 299-327.

Kose, M. A., and R. Riezman. 2001. "Trade shocks and macroeconomic fluctuations in Africa." *Journal of Development Economics*, 65(1): 55-80.

Loayza, N., and C. Raddatz. 2007. "The Structural Determinants of External Vulnerability." *The World Bank Economic Review*, 21(3): 359–387. Oxford University Press

Lofgren, H., R.L., Harris, and S. Robinson. 2002. "A Standard Computable General Equilibrium Model in GAMS," International Food Policy Research Institute.

Mendoza, E. G. 1995. "The Terms of Trade, the Real Exchange Rate and Economic Fluctuations." *International Economic Review*, 36: 101-137.

Raddatz, C. 2005. "Are external shocks responsible for the instability of output in low income-countries?" World Bank, Policy Research Working Paper 3680.

Raddatz, C. 2008. "Have External Shocks Become More Important for Output Fluctuations in African Countries?" World Bank.

Ramey, G., and V. Ramey. 1995. "Cross Country Evidence on the Link between Volatility and Growth." *American Economic Review* 85(5):1138–51.

Rodrik, D. 1998. "Where Did All The Growth Go? External Shocks, Social Conflict, and Growth Collapses." John F. Kennedy School of Government. Harvard University

_____. 2001. "Why is there so much economic insecurity in Latin America*?" Cepal Review* 73: 7-29.

Robilliard, A. S., F. Bourguignon, and S. Robinson. 2002. "Crisis and Income Distribution: A Micro-Macro Model for Indonesia," Mimeo, World Bank, Washington, DC.

Savard, L. 2003. "Poverty and Income Distribution in a CGE-household sequential model". Presented at WIDER conference on "Inequality, Poverty, and Human Well-Being", May 30-31, 2003.

Trade and Development Report. 2013. "Adjusting to the Changing Dynamics of the World Economy." United Nations Conference on Trade and Development. September 2013.

Vos, R. and M. V. Sánchez (2010) "A Non-Parametric Microsimulation Approach to Assess

Changes in Inequality and Poverty." DESA Working Paper No. 94, United Nations Department of Economic and Social Affairs, New York.

World Economic Outlook. 2014. "Recovery Strengthens, Remains Uneven." International Monetary Fund, Washington DC. April 2014.

ENDNOTES

1 The complete model specification is omitted here for brevity but is available upon request.

2 This paper adopts the 'top-down' modelling approach following Vos and Sanchez (2010). According to this approach, the outcomes of the CGE model are 'inputs' into the microsimulations but the results of the microsimulations do not feedback into the CGE model. The linkage between the CGE model and microsimulations takes the form of information about prices and wages which is transmitted from the former to the latter via the Linear Expenditure System.

3 For instance, variations in labor demand and supply due to macroeconomic shocks trigger changes in relative wages. These changes are computed in each simulation using the linear expenditure system and used to derive new expenditure levels for households for each simulation.

4 The first SAM for Uganda was developed in 2002 by the Uganda Bureau of Statistics and later updated by the International Food Policy Research Institute in 2007 and 2009/10. The 2009/10 SAM reflects the current production structure of Uganda which has not changed significantly over the past four years.

5 Production is assumed to be subject to constant returns to scale and to diminishing marginal rates of substitution.

6 Elasticity of substitution is set to equal to zero, indicating zero substitutability between aggregate value added generated at the bottom level of production and the intermediate inputs introduced at the top level of production.

7 The Armington assumption presupposes that firms decide first on the quantity of inputs from the rest of the world (imports) and then identify the optimal mix of imported and domestic goods given the import price. This approach therefore assumes that imported intermediate inputs demand is separable from domestic produced intermediate inputs.

8 The Linear Expenditure Function assumes that some minimum level of each good has to be consumed, irrespective of its prices or consumer's income. Thus, a consumer first purchases the minimum or necessary level of each good and the remaining or supernumerary income is then allocated among the goods in fixed proportions. This system is used in this study as it satisfies the two desired economic properties of consumer demand: adding up – the expenditure share-weighted sum of expenditure elasticities summed across all consumer goods is unity – and homogeneity – homogeneity of degree zero in prices and expenditure, indicating that there is no change in demand if all nominal prices and the nominal value of consumption expenditure change in equal proportion.

9 Central bank data report that the export and import price indexes increased by an average of 9.52% and 6.07% respectively between 2010 and 2012. Sensitivity analyses in which the changes in these indexes are varied to 15% and 10% respectively are conducted and the study's conclusions are not affected.

10 The changes in sectoral employment and trends in real wages after the adjustments in sectoral productivity and contribution to real GDP growth as a result of the three shocks examined by this paper are discussed in section 4.4

11 The Central Bank Rate (CBR) was steadily increased from 13% in June 2011 to 23% in November 2011 to rein-in the pent-up inflationary pressures experienced during the same period. With the reduction in inflation, the CBR was reduced gradually to 11% in July 2013.

12 Balance of Payment data from the Bank of Uganda show an increase in portfolio investment from USD -110.52 million in 2010 to USD 259.60 million in 2011 before decreasing to USD 3.35 million and USD -14.49 million in 2012 and 2013 respectively.

13 Equivalent Variation quantifies, at the baseline values, the adjustment in income that would get consumers to the same level of utility or satisfaction as the economic change would if it had happened. A positive economic change, say a price reduction, makes the consumer better off (higher welfare) and thus has a positive EV since the consumer would need to be given additional income to make them as well off without the price fall as they would have been with the price fall.

14 Bank of Uganda (Central Bank) data confirm that the Uganda shilling depreciated by 21% against the US Dollar during the first three quarters of 2011 but appreciated by 12% between October 2011 and July 2012

Economic Policy Research Centre
Plot 51, Pool Road, Makerere University Campus
P.O. Box 7841, Kampala, Uganda
Tel: +256-414-541023/4, Fax: +256-414-541022
Email: eprc@eprc.or.ug, Web: www.eprc.or.ug