

SECTORAL AND WELFARE EFFECTS OF THE GLOBAL ECONOMIC CRISIS ON UGANDA: A RECURSIVE DYNAMIC CGE ANALYSIS



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Abstract

This paper analyses the impact of the global economic and financial crisis on Uganda notably on macro-economic aggregates, sectoral output and household welfare, and the potential role of fiscal policy and reform in mitigating the impacts. We find that second round effects from a reduction in financial inflows such as remittances, foreign direct investments and overseas development assistance, as well as reduction in international demand from cash crops such as cotton, tea and coffee, could lead to a reduction in economic growth by 0.6 percentage points on average annually over the period 2008-2010 compared to a baseline reflecting pre-crisis conditions. A surge in regional exports and early counter-cyclical policies in particular are found to dampen the most adverse impacts of the crisis. The paper also shows that the impact of the government's expansionary 2009/2010 budget could return growth to pre-crisis levels and illustrates how a re-prioritization of government expenditure away from expenditure on administration to more productive sectors of the economy, combined with reforms to improve the efficiency of public spending, could lift long-term growth and reduce poverty, especially in rural areas, even more.

Keywords: Sub-Saharan Africa, Uganda, global economic and financial crisis, computable general equilibrium (CGE)

JEL classification: C68, D58, E62, F15, H62, I32

Disclaimer: Opinions in this paper are those of the authors and not the institutions they work for.

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I. INTRODUCTION

There is growing evidence that the global economic and financial crisis, which started in the fall of 2008 in the US and quickly spread to other advanced economies, will have large negative impacts on developing countries that are particularly vulnerable to changes in the external environment (United Nations, 2009; International Monetary Fund, 2009; World Bank, 2009). While the limited integration into the global capital markets may have initially shielded low-income countries from the effects of the collapsing housing and financial markets in much of the developed world, second order effects from reductions in trade, foreign direct investments, remittances and overseas development assistance are likely to be severe. The potential impacts are particularly adverse given the limited fiscal space to pursue counter-cyclical policies or stimulus packages in many developing countries. Moreover, the economic and financial crisis comes at a time when many developing economies were already struggling under the pressures from an increase in global food prices and the spike in energy prices early in 2008. These challenges in the global economic environment could roll back decades of gains in economic and social development especially in sub-Saharan Africa, and there is mounting concern that macro-economic reform processes in many countries could slow or even reverse, which would exacerbate the negative consequences on longer term economic development.

This paper studies the potential impacts of the global economic and financial crisis on Uganda, a small open economy in sub-Saharan Africa, one of the fastest growing economies on the continent and among the most successful countries when it comes to reducing poverty and making progress towards other Millennium Development Goals. Uganda is also widely regarded as one of the most ardent economic reformers in the developing world (World Bank, 2007; Dijkstra and van Donge, 2001).

The analysis in the paper focuses on: (i) describing the main transmission mechanisms of global economic developments onto the local economy; (ii) determining the likely

impact of the economic crisis on the key sectors of the economy; (iii) assessing the welfare impacts of the crisis especially in terms of poverty reduction, and; (iv) exploring policy options for mitigating the impacts of the crisis. To assess the economy-wide impacts, we use a recursive dynamic Computable General Equilibrium (CGE) model, which we subject to a series of scenarios reflecting different routes of transmission of the global crisis onto the local economy. These scenarios are designed to reflect the prevailing high degree of uncertainty regarding the depth and duration of the crisis as well as the impact of counter-cyclical policies announced by the Government of Uganda. We are also able to discern the disparate impacts of changes in commodity prices which have especially benefited producers of goods destined for regional markets but worked against producers of Uganda's main cash crops.

To preview our results we find that at the national level, the overall impact of the changes in the global economic environment in 2008/2009 is found to reduce growth by an average of 0.6 percent annually compared to a pre-crisis baseline. Moreover, the incidence of poverty is estimated to be 1percentage points higher. However, we also find that the agriculture sector, which is the main source of income for most rural poor, is currently being cushioned by increasing regional prices for food products of which Uganda is a net-exporter. As a result, the actual adverse impact on overall poverty levels is limited as long as regional demand remains high. Our simulations also show that the expansionary budget introduced in June 2009 for the fiscal year 2009/2010 is likely to lift growth to pre-crisis levels, which illustrates the importance of counter-cyclical policies. Since taxes were not raised in this budget and domestic borrowing is discouraged due to its crowding out effects, we assume that the additional spending is going to be financed by foreign borrowing. We also run a simulation under an alternative set of budget priorities which show that by further prioritizing spending away from administration to agriculture, health and education, fiscal policy would be even more effective in raising economic growth and could even surpass the pre-crisis

baseline. This is a clear indication of the benefits that could accrue from continued fiscal policy reforms.

Our analysis should be of general interest to policy-makers in developing countries who are concerned about the impacts of the crisis and measures to mitigate these impacts. For Uganda the analysis is particularly important as it comes at a time when authorities are in the process of designing a new five-year National Development Plan that focuses on sustaining economic growth and provide “prosperity for all”. While the country’s future growth process is likely to benefit from continued economic liberalization and increased stability in the north of the country and the rest of the region, we argue that mitigating the worst impacts of the economic and financial crisis and laying the foundation for future growth will require a more interventionist approach by the Government when it comes to macro-economic and structural policies. The rest of paper is organized as follows. Next, we describe the recent economic experience of Uganda and the impact of the global economic crisis on Ugandan economy. Then, we briefly describe the methodology and data used after which we present a series of results and simulations from the analysis. Finally we conclude with a discussion of policy implications.

II. UGANDA AND THE GLOBAL CRISIS

This section briefly reviews the impact of the global crisis on the financial sector, the real economy and government revenue and debt. This descriptive analysis is the basis for the subsequent design of scenarios to analyse the short to medium impacts of the crisis and the potential impact of policy responses.

Financial sector impacts

Because the global financial and economic crisis has its roots in the financial systems of the developed countries, and since the African economies and in particular Uganda's financial system is not linked to that of the developed world, some commentators and government officials at the start of the crisis suggested that sub-Saharan African countries like Uganda would not be affected. However, whereas it is true that much of the damage to financial institutions in the major economies was a result of the sharp decline in the value of complex securities they were trading in, and it is thought that the Ugandan banking institutions that did not get involved would be spared, the slowdown in the economic activity may impact on their loan portfolios. It is likely that non-performing loans will increase and damage the bank balance sheets. The other impact of the crisis on the financial sector in the country has been the drop in the demand for Government Securities as investors retreat to safer destinations like the USA. For example, Bank of Uganda had to suspend a number of Treasury bill auctions in the first quarter of 2009.

Moreover the structure of the Uganda's banking sector where about 80% of the banking business foreign-owned¹ poses a potential risk to the economy since local banks may face difficulty as the result of their parent companies withdrawing funds to support operations abroad (International Monetary Fund, 2009). But as of now, there is no much evidence that any domestic banks have been affected in that respect. This is partly

¹ The foreign-owned banks are from South Africa, UK, Nigeria and Kenya.

because most local banks are licensed subsidiaries of foreign banks, rather than branches, which makes it easy to detect potential risks of capital withdrawal through Central Bank supervision.

The impact on the financial markets, however, has been severe with a large number of foreign investors retreating to the safer markets in the developed world, especially to the US treasury bills. This has not only affected the market for Uganda Treasury bills but also the stock market, resulting in for example the All Share Index of the Uganda Stock Exchange falling by 29.4% over the period September 2008 to February 2009 compared to an increase of 4.4% in the similar period in the previous financial year. Although this has been largely blamed on the exit of foreign investors, the dip was also a result of the panic sale by the local retail investors as the economic crisis hit the real domestic economy, with the number of local investors decreasing by 26% compared to a 5% decrease by foreign investors. It should be understood, however, that even if the number of foreign investors exiting the market appear small, most of them are large institutional investors, which cumulatively might add up to a big capital withdrawal. There has since been a slight rally with the index gaining some ground between February and April 2009, but this seems to have been short-lived.

The real economy

The impact on the real economy of the crisis has so far been rather benign. Ministry of Finance, Planning and Economic Development (2009b) estimates that economic growth in financial year 2008/2009 was 7%, which is lower than the 9% recorded for the previous fiscal year, but quite robust compared to the sub-Saharan Africa average of just 2.4%. Table 1 shows the breakdown of growth by sector from which it is clear that Uganda's sustained economic growth is relatively broad-based and that the main driver of growth in 2008/2009 was the services sectors and especially transport and communication. The service sectors grew by 9.4% in 2008/2009 but since it accounts for more than half of total GDP it contributed more than two-thirds (69%) of overall growth.

Wholesale and retail, and the financial sectors also contributed to growth as did sectors for real estate, manufacturing and food crop production.

Table 1: Sector contributions to economic growth 2008/2009 (%)

	Sector share in 2007	Growth in 2008/09	Sector share in 2008/09	Absolute contribution to growth	Relative contribution to growth
Agriculture, forestry and fishing	21.0	2.6	21.5	0.5	7.5
Cash crops	2.1	1.7	2.1	0.0	0.5
Food crops	11.1	2.9	11.4	0.3	4.4
Live stock	1.5	3.0	1.5	0.0	0.6
Forestry	3.5	3.3	3.6	0.1	1.6
Fishing	2.7	-0.1	2.7	0.0	0.0
Industry	23.3	3.8	24.2	0.9	12.3
Mining	0.3	9.2	0.3	0.0	0.4
Manufacturing	7.0	7.2	7.5	0.5	7.2
Electricity supply	2.1	4.2	2.2	0.1	1.2
Water supply	2.5	4.1	2.6	0.1	1.4
Construction	11.3	2.2	11.5	0.2	3.4
Services	50.1	9.4	54.8	4.8	69.0
Wholesale and retail	14.3	7.6	15.4	1.1	15.7
Hotels and restaurants	4.0	7.9	4.3	0.3	4.6
Transport and communications	6.4	20.0	7.7	1.4	20.6
Financial services	3.0	21.1	3.6	0.7	10.3
Real estate	7.1	5.7	7.5	0.4	5.7
Other business services	1.6	8.8	1.7	0.1	2.1
Public admin and defense	3.2	4.7	3.4	0.1	2.1
Education	6.8	4.8	7.1	0.3	4.6
Health	1.5	8.1	1.6	0.1	1.8
Other services	2.2	12.3	2.5	0.3	4.1
Adjustments	5.6	9.5	6.1	0.5	7.8
Total	100	7.0	107	7.0	100

Source: Uganda Bureau of Statistics (2008); Ministry of Finance, Planning and Economic Development (2009b).

For 2009/2010 the official estimate for growth in GDP is 6%, which suggests that the expectation from authorities is that Uganda will continue to escape the worst effects of the global crisis. The projected strong economic performance is premised on continued public investment in areas that support increased production, growth in productivity

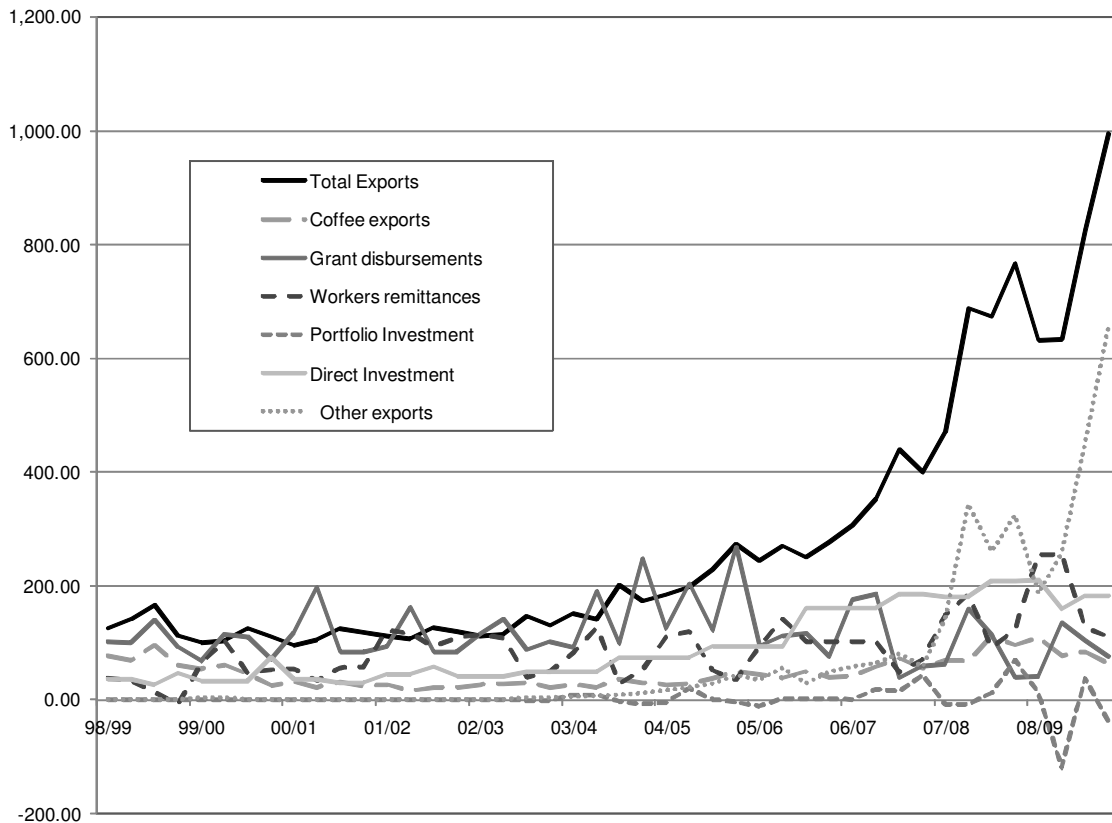
and export promotion. In preparation for our own analysis of the likely impacts of the crisis on overall and sectoral growth, and household welfare the remainder of this section discusses in more detail the channels through which the changes in the global economic environment is affecting Uganda's economy.

Transmission mechanisms

The main transmission mechanisms of the global crisis onto the economy of Uganda is through the effects on the balance of payments, notably through reduction in exports, remittances from overseas workers, international development assistance and foreign direct investments. In addition, changes in international commodity prices which are inter-linked with global economic developments also impacts the local economy. We examine each of these transmission mechanisms in turn. The developments in the main components of the balance of payments are illustrated on Figure 1.

There was a marked contraction in exports growth in the second half of 2008 signifying the effect of the global economic crisis. Exports fell by 17% in nominal terms between 4Q of fiscal year 2007/2008 and 1Q of 2008/2009. However, exports have since recovered registering an overall increase of almost 30% in 4Q 2008/2009 compared to a year earlier. But the impact differs between the exports destined to the international markets (traditional cash crops like coffee, cotton and non-traditional exports like fish and flowers) and regional-bound exports (food products like cereals and pulses). For example the performance of the coffee sector, which contributes nearly 20% of the total exports and with its market mainly in Europe, the worst hit by the crisis after United States of America, has gone down. The value of coffee exports fell by 35% in the year up to 4Q 2008/2009, with declines largely explained by the drop in export price than changes in volumes. Other international-bound exports have also experienced low growth or outright decline due to the economic slump, with the impact most severe in the year 2009.

Figure 1: Selected components of the Balance of Payments (US\$ million)



Source: Bank of Uganda (online statistics accessed October 2009).

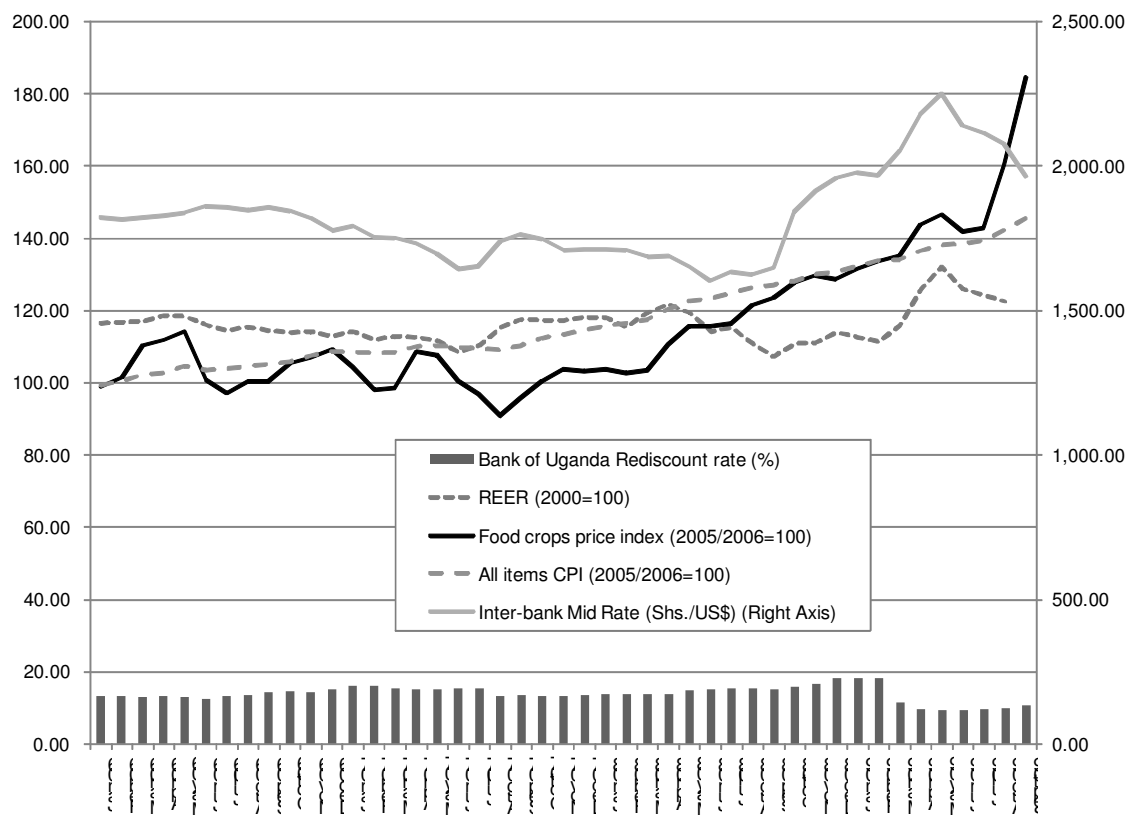
On the other hand, regional trade especially in non-traditional exports such as maize, beans, cement etc has cushioned Uganda from the adverse effects of the crisis. Indeed, in the last quarter of 2008 Uganda witnessed significant increases in non-traditional exports (referred to as “Other exports” on Figure 1) partly due to relatively higher food prices. Exports to the regional market accounted for about 45% of all Uganda’s foreign trade. However, the regional trade is mainly in food crops like maize, beans and other produce which do not usually go to the international market whose prices have been resilient to the global slump.² For example, growth of exports of maize and beans continued to increase from the year 2007 through to 2009 even as the economic crisis became more severe.

² Data on cross border trade is not easily accessible. However, according to the budget speech for the 2009/2010 financial year from the Minister of Finance, Planning and Economic Development, 70% of exports from Uganda to the region are manufacturing goods (Ministry of Finance, Planning and Economic Development, 2009a: page 8).

But even as non-regional exports were suffering from the global slump, the value of imports was increasing mainly due to the depreciation of the shillings that has made imports more expensive. Starting November 2008, there was a sharp increase in imports relative to a year earlier, as a result of the sharp depreciation of the Uganda Shilling arising from the crisis. Imports increased by 43.7% in the period September-December 2008. This has worsened the trade balance.

Private inflows have also been affected with foreign direct investment expected to decline due to the difficulty in raising capital and as foreign firms look more inwards to solve domestic challenges. Direct investments into Uganda have fallen by 12% in the year to 4Q of 2008/2009. In 2Q of 2008/2009 investments fell by almost a quarter compared to the highs of the previous quarter. Portfolio investments also reversed to an outflow of approximately US\$ 110 million in 2008/2009 compared to an inflow of US\$ 66 million the year before. International development assistance to Uganda is highly volatile and the official figures do not capture much of the project aid provided for instance by international NGOs. The balance of payments figures however, suggest that aid the combined value of budget support, project aid and debt relief to Uganda declined by 5.6% in 2008/2009 compared to the year before. Aid levels to Uganda in the current fiscal year are 22.6% lower compared to 2006/2007. Uganda has experienced a rapid increase in the flow of remittances from overseas workers in recent years. However, with the developed world in a recession and layoff of workers escalating, remitted earnings fell by 11% in the fourth quarter of 2008/2009 and official estimates put the overall decline for the year to 24% (Ministry of Finance, Planning and Economic Development, 2009b).

Figure 2: Money and prices



Source: Bank of Uganda and Uganda Bureau of Statistics (online statistics accessed October 2009).

The aggregate impact of the decline in these income and capital inflows was a deterioration of the balance of payments and a depreciation of the Uganda shilling against the dollar and an increase in domestic interest rates. The Uganda Shilling depreciated by nearly 22.5% between September 2008 and March 2009 compared to an appreciation of 4.4% in the corresponding period a year before (Figure 2.)

A weaker shilling will result in higher inflation due to the increase in the price of imports, especially when coupled with the pressure on food prices in East African region. Because of an uptick in inflation above the 5% target, the Bank of Uganda continued to operate a tight monetary policy stance (including an increase in the bank rate) whose effects include high interest rates and thinly spread private sector credit,

which if sustained could have adverse effects on economic growth. While the central bank in March 2009 cut the bank rate by 3.4 percentage points, the response from commercial banks has largely been minimal.

Revenue and debt

High prices of imports and reduced business activity due to increased cost of doing business have resulted into poor performance in tax revenue collection, which has suffered significant shortfall. Overall, revenue collection fell by 12.8% in July-December 2008 compared to the same period in 2007. Other contributory factors to low revenue collection include low local demand and expansion plans by companies in the telecommunications, manufacturing (beer and clay) to name a few, with the main impact on corporate tax and VAT.

It is expected that the government will in the Financial Year 2008/2009 face a revenue shortfall of Shs. 152.1 Billions. Taken together with the decrease in donor budget and project support that is expected to fall by Shs. 10.4 Billions, it is projected that the government will suffer a fiscal deficit of up to 2.2 Trillion Shillings (about a quarter of government expenditure). It is expected that the reduction in tax revenue will affect budget allocation to sectors in the budget for 2009/2010 as is already hinted on in the Background to the Budget (Ministry of Finance, Planning and Economic Development, 2009).

The 2008/2009 budget saw an expansion in the deficit from 2% to 3.5% of GDP compared to the previous year. This expansion is part of the government's renewed focus on expanding investments in economic infrastructure such as roads and power to address some of the constraints on long term growth. As a result the authorities were somewhat ahead of the curve, when it comes to implementing a fiscal stimulus to counter the downturn in demand. There is no change in this policy direction envisaged for the coming years of the medium term budget framework (Table 2) and the budget

deficit is expected to widen to 5.2% by 2011/12. Since the country has had a long standing policy of limiting borrowing from the domestic market which could crowd out the private sector from the credit market, the preferred alternative is to taking on more foreign debt especially if additional concessional financing is not available from donors.

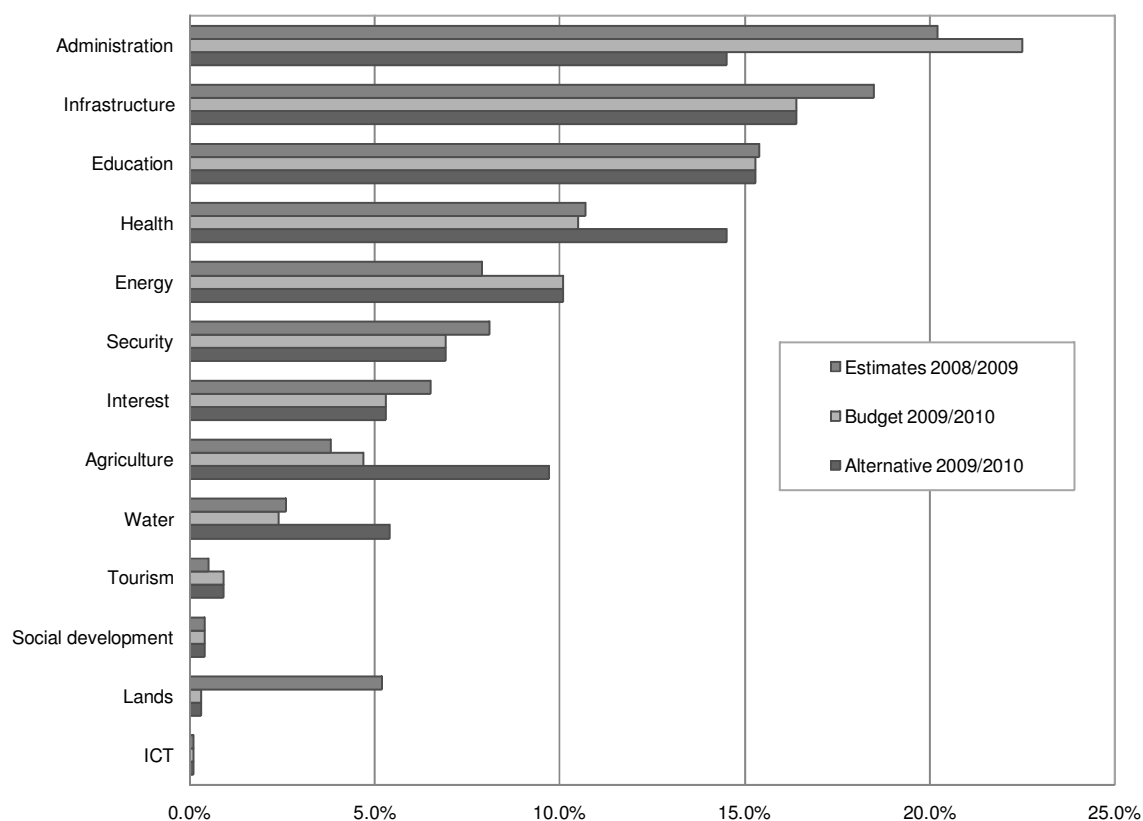
Table 2: Medium term budget (% of GDP)

	Outturn 2005/06	Outturn 2006/07	Outturn 2007/08	Budget 2008/09	Outturn 2008/09	Estimate 2009/10	Projection 2010/11	Projection 2011/12
Revenue and grants	17.34	15.23	16.98	19.29	17.77	17.72	16.54	15.81
Revenue	12.53	10.57	14.12	13.95	13.29	13.88	14.09	14.43
Grants	4.82	4.66	2.86	4.58	4.48	3.84	2.45	1.37
Expenditure	19.04	16.73	18.98	22.78	21.17	21.62	21.04	21.01
Recurrent expenditure	11.98	9.38	12.53	11.70	11.28	10.92	10.22	10.51
Wages and salaries	4.65	3.85	4.81	4.46	4.17	4.00	3.94	3.94
Development expenditure	6.74	6.59	5.92	10.10	8.90	10.58	10.78	10.47
Net lending and investment	-0.16	0.18	-0.71	-0.15	-0.06	-0.12	-0.11	-0.09
Domestic arrears	0.49	0.58	1.24	1.12	1.05	0.23	0.14	0.12
Deficit Including grants	-1.70	-1.50	-2.00	-3.50	-3.40	-3.90	-4.50	-5.20
Deficit excluding grants	-6.52	-6.16	-4.86	-8.08	-7.88	-7.74	-6.95	-6.57
Financing	1.81	1.50	2.13	3.50	3.56	3.90	4.50	5.20
External financing	1.44	2.76	2.55	2.40	3.59	3.25	3.94	2.90
Domestic financing	3.70	-1.40	-0.42	1.10	-0.03	0.65	0.56	2.29

Source: Ministry of Finance, Planning and Economic Development (2009b) and authors' calculations.

As reflected in Figure 3 the priorities of the government there has been some changes in budget priorities in the 2009/2010 budget compared to the previous fiscal year. Notably spending on Public administration increased partly due to the expansion of the public sector including local governments at the district level. Spending on energy infrastructure is also higher in line with national development priorities. Spending on health and education (as a% of GDP) has remained almost the same as last years' budget. Agriculture spending as a share of GDP was increased by 1%, but its share is still below the international target of 10%. The "Alternative" set of allocations is used below for illustrative purposes.

Figure 3: Budgetary allocations to sectors



Source: Ministry of Finance, Planning and Economic Development (2009a,b) and authors' calculations.

After this brief description of the impact of the global economic and financial crisis on the Ugandan economy the remainder of this paper is devoted to analyzing the likely longer term impacts and the effectiveness of fiscal policy and reform in terms of sustaining growth and poverty reduction. Next we describe the data and methodology and then we present our findings.

III. METHODOLOGY AND DATA

For the purposes of the analysis we are using a new CGE model for Uganda based on the 2007 Social Accounting Matrix. We draw on a number of strengths from the CGE modeling framework in our analysis. Firstly, the model simulates the functioning of the economy as a whole and track how changes in economic conditions are transmitted through price and quantity adjustments on a range of markets. This is critical given the economy-wide effects of the economic and financial crisis as discussed above. Secondly, the structural nature of the CGE model allows us to analyse separately the impacts of multiple shocks, which is important given the multiple transmission mechanisms of the crisis, and it enables us to discern the impact of the fiscal policy response. Thirdly, since the basis of the CGE model is a Social Accounting Matrix we are able to discern the effects of the changes in economic conditions on individual sectors of the economy. Fourthly, the link of the model to household survey data enables an assessment of the impacts on the welfare of households, which is particularly interesting since this is where the most important policy implications are likely to be found. Finally, the recursive dynamic nature of our model implies that the behaviour of its agents is based on adaptive expectations, rather than on the forward looking expectations that underlie inter-temporal optimisation models. Since a recursive model is solved one period at a time, it is possible to separate the *within-period* component from the *between-period* component, where the latter governs the dynamics of the model. The CGE model used in the present study is based on a standard CGE model developed by Lofgren, Harris, and Robinson (2002). This is a real model without the financial or banking system (See Table A1). The CGE model is calibrated to the 2007 Social Accounting Matrix. GAMS software is used to calibrate the model and perform the simulations.

A Social Accounting Matrix (SAM) is a table which summarizes the economic activities of all agents in the economy. These agents typically include households, enterprises, government, and the rest of the world (ROW). The relationships included in the SAM

include purchase of inputs (goods and services, imports, labour, land, capital etc.); production of commodities; payment of wages, interest rent and taxes; and savings and investment. Like other conventional SAMs, the Uganda SAM is based on a block of production activities, involving factors of production, households, government, stocks and the rest of the world.

The Uganda SAM is a 120 by 120 matrix. The various commodities (domestic production) supplied are purchased and used by households for final consumption (42 per cent of the total), but also a considerable proportion (34 per cent) is demanded and used by producers as intermediate inputs. Only 7 per cent of domestic production is exported, while 11 per cent is used for investment and stocks and the remaining 7 per cent is used by government for final consumption. Households derive 64 per cent of their income from factor income payments, while the rest accrues from government, inter-household transfers, corporations and the rest of the world. The government earns 32 per cent of its income from import tariffs – a relatively high proportion, but a characteristic typical of developing countries. It derives 42 per cent of its income from the ROW, which includes international aid and interest. The remainder of government's income is derived from taxes on products (14 per cent), income taxes paid by households (6 per cent) and corporate taxes (5 per cent).

Investment finance is sourced more or less equally from government (26 per cent), domestic producers (27 per cent) and households (26 per cent), with enterprises providing only 21 per cent. Imports of goods and services account for 87 per cent of total expenditure to the ROW. The rest is paid to ROW by domestic household sectors in form of remittances; wage labour from domestic production activity; domestic corporations payments of dividends; income transfers paid by government; and net lending and external debt related payments.

The extent of household dis-aggregation is very important for policy analysis, and involves representative household groups as opposed to individual households. Pyatt and Thorbecke (1976) argue for a household dis-aggregation that minimizes within-group heterogeneity. This is achieved in the Uganda SAM through the disaggregating of households by rural and urban, and whether households are involved in farming or non farming activities. Moreover, the Uganda SAM identifies three labour categories disaggregated by skilled, unskilled and self employed. Land and capital are distributed accordingly to the various household groups.

Productions and commodities

For all activities, producers maximize profits given their technology and the prices of inputs and output. The production technology is a two-step nested structure. At the bottom level, primary inputs are combined to produce value-added using a CES (constant elasticity of substitution) function. At the top level, aggregated value added is then combined with intermediate input within a fixed coefficient (Leontief) function to give the output. The profit maximization gives the demand for intermediate goods, labour and capital demand. The detailed disaggregation of production activities captures the changing structure of growth due to the crisis.

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 export.

On the demand side, a composite commodity is made up of domestic demand and final imports and it is consumed by households, enterprises, and government. The Armington assumption 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 parameter for CET and CES elasticity used to calibrate the functions used in the CGE model are exogenously determined.

Factor of production

There are 6 primary inputs: 3 labour types, capital, cattle and land. Wages and returns to capital are assumed to adjust so as to clear all the factor markets. Unskilled and self-employed labour is mobile across sectors while capital is assumed to be sector-specific. Unskilled labour is not substitutable for skilled labour. 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.

Institutions

There are three institutions in the model: households, enterprises and government. Households receive their income from primary factor payments. They also receive transfers from government and the rest of the world. Households pay income taxes and these are proportional to their incomes. Savings and total consumption are assumed to be a fixed proportion of household's disposable income (income after income taxes). Consumption demand is determined by a Linear Expenditure System (LES) function. Firms receive their income from remuneration of capital; transfers from government and the rest of the world; and net capital transfers from households. Firms pay corporate tax to government and these are proportional to their incomes.

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

Macro closure

Equilibrium in a CGE model is captured by a set of macro closures in a model. 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 is assumed to adjust to equate the difference between government revenue and spending. For external balance, foreign savings are fixed with exchange rate adjustment to clear foreign exchange markets. For savings-investment balance, the model assumes that savings are investment driven and adjust through flexible saving rate for firms.

Recursive dynamics

To appropriately capture the dynamic aspects of aid on the economy, this model is extended by building some recursive dynamics by adopting the methodology used in previous studies on Botswana and South Africa (Thurlow, 2007). The dynamics is captured by assuming that investments in the current period are used to build on 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. Population growth rates overtime are assumed to be 3.2 percent annually. The model is initially solved to replicate the SAM of 2007.

Limitations of the model

CGE modeling is an important tool for policy-analysis given that it is able to isolate the effects of individual policies, while explicitly specifying the causal mechanisms through which policies influence the economy. The sectoral and institutional detail of the CGE model allows for a more detailed analysis of policies than is typically possible with macro-econometric models. Finally, CGE models have an advantage over partial equilibrium analysis in that they offer an economy-wide assessment of policies, including the concurrent effects of policy-changes on production, employment, and

poverty and nequality. However, as well documented in the literature CGE models have also some weaknesses (Thurlow, 2008). The main criticism of the static 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. The model accommodates prices in relative terms and therefore cannot adequately address issues related to inflation. In addition, this model does not include the banking sector. However, the channels through which the global crisis is affecting developing countries is not through commercial banks exposure—rather, it's mainly through reductions in financial inflows and depreciating local currencies. Another limitation to the analysis is that in modelling the micro linkages we are not distinguishing between households that are net-buyers or net-sellers of various food crops, which is a weakness in terms of the assessment of welfare effects.

Scenarios

Our analysis is based on a series of scenarios each representing an exogenous change in economic conditions and are compared to a baseline scenario of no changes in prices. Running scenarios allows us to conduct a sort of controlled experiment of various types of impacts. These impacts are then ascertained in terms of average sectoral growth patterns and changes in poverty rates and compared to the baseline.

This baseline scenario assumes that business continues as usual with no specific changes made to policy. We assume that growth in total factor productivity (TFP) for all sectors is about 1 percent and this generates about 6.6 percent for 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. The main results of the BASE scenario are summarized in Table 3.

We identify four main channels through which the financial crisis is impacting the Ugandan economy. The first simulation focuses on the reduction on foreign financial inflows including aid, grants, foreign direct investment and remittances. This simulation is labeled FFLOWS. Under this scenario we reduce foreign financial inflows for 2008 by 20 percent. We also assume that this trend will be followed in 2009. In 2010, we expect the reduction in financial inflows to slow down to 5 percent. Thereafter we assume that there will be a complete recovery after 2010 where financial inflows will stop declining and perhaps register a modest pre-crisis growth level of 5 percent.

The crisis has also had varying effects on the export prices. We differentiate between exports to the region and those that are exported beyond the region especially cash crops. The prices for exports traded within the region have weathered the crisis and remained high for food products. On the other hand, export prices for goods bound to markets beyond the region, especially to developed countries that have been hit by the crisis have declined. The simulation for increase in prices of regional exports is labeled EPRICER while the one for the decrease in prices of exports beyond the region is EPRICEW. To separate the effects of the financial crisis on the economy, we combine the reductions in financial inflows and the declining prices on internationally traded commodities. This simulation is named CRISIS. For all the simulations above we use the same baseline fiscal stance as in 2008/09 before the new budget was announced.

The paper implements a simulation taking into account the recent budget allocations to assess the extent to which these allocations would cushion the economy against the crisis (BUDGET). Similar to what other countries like the US has done, we implement a simulation where the government relaxes its fiscal stance by increasing spending and running a higher deficit while at the same time reallocating resources towards priority sectors especially agriculture (ALTERNATIVE).³ For the ALTERNATIVE scenario we assume

³ Administration includes resources spent on the civil service and political appointments at both the central and local governments. The number of districts has increased putting more pressure on the budget to increase spending on this category.

that the government would run a higher deficit also financed by additional foreign borrowing. We also implement a simulation where the increase in government spending is financed domestically and not through foreign borrowing (FISCAL). Lastly, we run a simulation where we combine the ALTERNATIVE scenario with improved efficiency in the public sector.

IV. FINDINGS

In this section we present the findings from the scenarios of the CGE modeling exercise. First we present the impacts on the macro-economic aggregates of the crisis and secondly we present the impacts on sectoral output. Then we explore the impact of various fiscal policy responses before assessing the impacts on household poverty and inequality.

Aggregate impacts

The overall impact of the crisis over the simulation period is expected to be negative with GDP growth falling from 6.6% under the BASE scenario of no crisis to 6.0% under the CRISIS scenario over the short-term 2008-2010 (Table 3).

It is expected that a reduction in foreign financial inflows would lead to the depreciation of the exchange rate Table 4. While this would lead to more competitive exports, prices of imported goods would also increase and there would be spillovers to the domestic price levels. Since most of the manufacturers rely on imported inputs, this would increase the cost of production leading to reduced output and profitability. In addition, the reduction in foreign financial inflows would have a direct impact on private consumption leading to lower aggregate domestic demand. This would have a direct effect on tax collections and thus the government's ability to finance its programs. Indeed from the results, we find a considerable depreciation of the shilling when we assume that foreign financial inflows reduce during 2008-2010 (Table 4). During 2008, the effects of reduced financial inflows had a marginal impact on the economy. That is partly because the crisis started only in the second half of 2008. In 2009, the reduction in output owing to reduced financial inflow is estimated to be 0.4 percentage points compared to the baseline. With the crisis expected to wind off by 2010, Uganda will experience a lower growth path, hitting the bottom in 2010 with a decline of 0.6% before recovering. The growth path over the full review period is indicated on Figure 4. The reduction in financial inflows would also have a direct impact on total absorption

owing to the decline in private consumption and investments. Growth of private consumption and investment reduce by 0.5% and 2%, respectively. We also find a deterioration of the trade balance which would worsen by 0.2% of GDP. Combined with other factors, the trade balance would deteriorate by 0.2% of GDP.

Sectoral impacts

Overall GDP growth is being pulled down primarily by lower growth in the agriculture sectors and the import-intensive industries, notably manufacturing and non-food processing, which are particularly adversely affected by the depreciation of the exchange rate that follow the reduction in financial flows. We find that growth in the manufacturing sector would be 1 percentage point lower during the period 2009-2010 because of the crisis compared to the no-crisis baseline. Manufacturing sector is composed of the food processing and non-food processing sectors. The non-food processing sector is affected the most as a result of the crisis. This is largely because of the increased prices of the imported raw materials owing to the depreciation of the shilling. The comparative loss in output for the non-food processing manufacturing sector during the crisis period is 1.7 percentage points. On the other hand, given that the food processing sector relies on raw materials from the domestic agricultural sector, there is no loss in output during the crisis period.

Table 3: Average Growth Rate by Sectors in % (2008-2010)

	BASE	FFLOWS	EPRICEW	CRISIS	EPRICER
Overall GDP	6.6	6.0	6.5	6.0	6.6
Agriculture	3.9	3.8	2.9	2.8	4.0
<i>Of which</i>					
Cereals	2.0	2.2	2.5	2.7	2.3
Root Crops	4.2	4.0	4.2	4.0	2.4
Pulses	2.1	2.2	2.3	2.4	6.9
Matooke	4.4	4.2	4.4	4.2	2.7
Horticulture	4.9	4.6	5.0	4.6	3.6
Crops	2.5	2.6	(2.7)	(2.6)	1.9
Livestock	3.6	3.6	3.9	3.9	3.2
Forestry	4.6	4.2	4.5	4.1	5.0
Fishing	6.2	6.4	1.9	1.7	6.2
Industry	6.5	4.1	6.3	4.0	6.7
<i>Of which</i>					
Mining	6.9	4.7	6.8	4.6	7.2
Manufacturing	6.5	5.5	6.5	5.4	6.5
Food Processing	6.2	5.9	6.2	5.8	6.0
Meat Processing	3.5	3.5	3.9	3.9	3.0
Fish Processing	6.2	6.4	1.9	1.7	6.2
Grain Processing	6.3	6.4	6.4	6.5	6.0
Feed Processing	3.9	3.8	4.2	4.1	3.6
Other Food Processing	5.7	5.4	5.8	5.5	5.2
Beverages and Tobacco	7.0	6.4	6.9	6.3	7.2
Non-Food Processing	6.8	5.1	6.8	5.1	7.1
Textiles and Clothing	6.6	6.1	6.5	6.0	6.9
Wood and Paper	4.5	3.0	4.5	3.0	4.5
Fertilizer	5.1	4.8	2.3	2.0	4.9
Other chemicals	7.1	6.3	7.0	6.2	7.4
Machinery & equipment	6.9	4.5	7.0	4.6	7.0
Furniture	6.3	4.2	6.2	4.0	6.7
Other manufacturing	7.2	4.9	7.2	4.9	7.4
Utilities	7.7	6.9	7.4	6.7	8.1
Construction	6.0	2.3	5.9	2.2	6.3
Services	7.8	7.9	8.2	8.3	7.6
Private	9.6	9.7	10.1	10.2	9.4
Trade	5.9	5.3	5.6	5.0	6.1
Hotels & catering	25.0	26.3	27.7	28.9	22.8
Transport	7.2	6.4	7.1	6.3	7.4
Communications	6.5	6.0	6.4	5.9	6.7
Banking	5.7	5.6	5.8	5.6	5.6
Real estate	8.0	7.3	7.8	7.1	8.3
Community services	6.3	5.7	6.1	5.6	6.7
Public	2.3	2.1	2.2	2.1	2.4

Source: Authors' calculations.

The greatest impact is on the construction sectors, which is assumed to be particularly sensitive to the reduction in remittances from foreign workers. This sector has been expanding in the recent past with its contribution to GDP increasing to 12% in 2008 from 8% in 2001. The sectors growth rate has on average been about 13% over the last five years. The growth in the sector has been partly financed by remittances sent by Ugandans abroad. The construction sector is expected to contract by 4 percentage points less under the CRISIS scenario compared to the baseline. The services sectors hold up pretty well in the way the current model is calibrated. However, if the negative impact on the tourism industry is prolonged this may turn out to be too optimistic.

The results also illustrate the disparate impacts of the changes in global and regional prices for Ugandan exports. Falling international prices for commodities such as coffee, tea and cotton depress agricultural sector growth whereas the increase in regional prices for non-traditional exports tends to boost agricultural growth. The main cash crops for Uganda include coffee, cotton, tea and tobacco whose prices have declined by about 10%. It is expected that in 2009 these prices will continue to decline as the recession-hit developed markets are not expected to have recovered. Consequently under the PRICEW scenario there is a marked decrease in growth of the cash crop sectors of 8% for coffee, cotton, tea and tobacco sectors. This dampens overall growth in the agricultural sector which declines by about 2 percentage points compared to the no-crisis baseline, although there is a positive impact on cereals and pulses due to resource shift. Cereal production is higher by 1 percentage points. The sensitivity of export crops to the changes in international prices is illustrated on Figure 4.

It should be noted that Uganda has managed to diversify into other non-traditional exports including flowers and fish processing. The demand for luxury items like flowers has declined in the developed world. This has had considerable effects on the flower

sector declining by 0.4% in 2009. Likewise fish processing shows a significant decline of 5%.⁴ Fish processing also reduces by a similar magnitude.

Table 4: Impact of crisis on macroeconomic aggregates (Average change in % 2008-2016)

	BASE	FFLOWS	EPRICEW	CRISIS	EPRICER
Absorption	5.72	4.99	5.79	5.07	6.23
Consumption	6.35	5.85	6.44	5.94	6.87
Investment	5.75	3.86	5.79	3.91	6.46
Exports	11.59	11.49	11.27	11.15	10.28
Imports	6.64	5.77	6.75	5.88	7.84
Real exchange rate	-1.34	-1.06	-1.30	-1.03	-2.69
Nominal exchange rate	-1.40	-1.10	-1.48	-1.19	-3.07
Investment to GDP	-0.32	-0.52	-0.33	-0.53	-0.42
Private Savings to GDP	0.00	0.00	0.00	0.01	0.00
Foreign Savings to GDP	-0.50	-0.70	-0.50	-0.71	-0.56
Trade Deficit to GDP	-0.88	-1.07	-0.87	-1.06	-0.94
Import duties to GDP	-0.03	-0.04	-0.03	-0.04	-0.05
Direct Taxes to GDP	0.00	0.00	0.00	0.00	-0.02

Source: Authors' calculations.

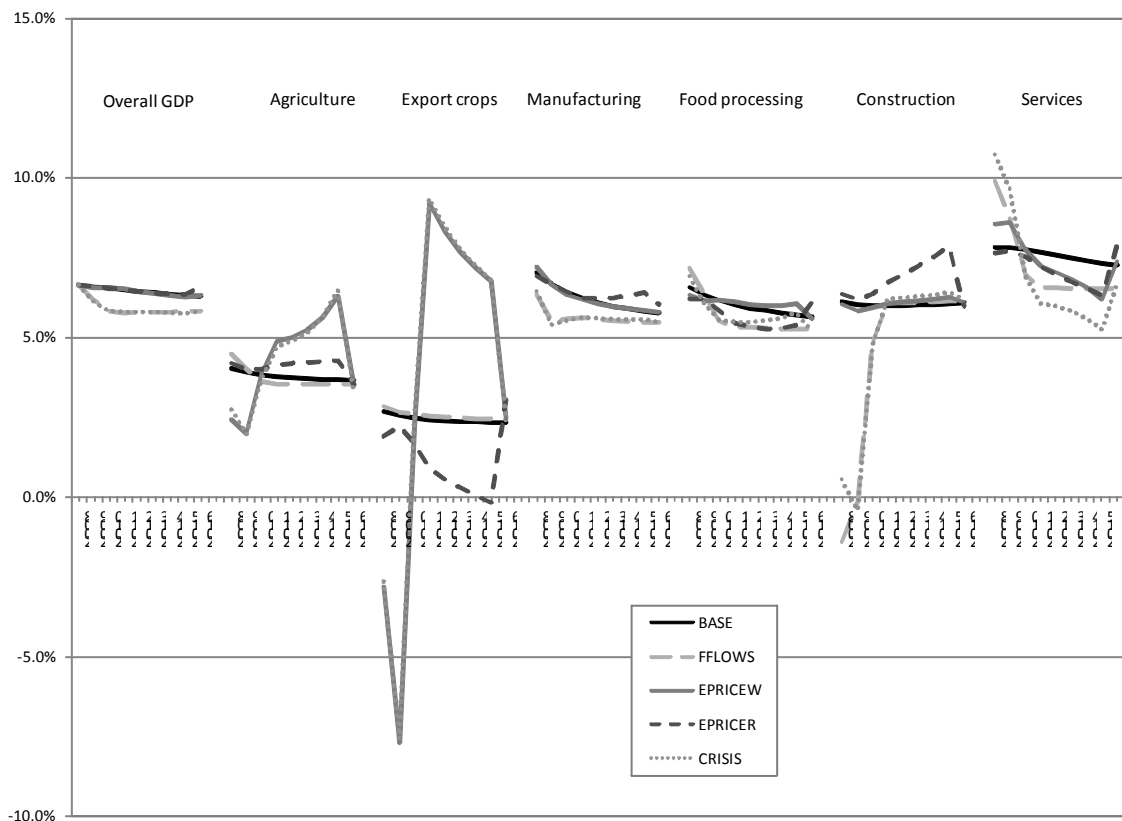
As noted the model is capable of differentiating between cash crops mainly destined for distant markets and food items which are largely traded within the region. The food items traded in the region mainly include maize, beans, groundnuts, vegetables and fruits. The main trading partners for these products are Kenya, South Sudan, and Eastern Congo. Prices of particularly cereals were at the peak during the second half of 2008. This is the same period when the financial crisis became apparent for the Ugandan economy.

The regional increase in prices of food commodities traded in the region has to a limited extent cushioned the agriculture sector against the economic crisis. Under the PRICER scenario cereals and pulses increase by 0.3 and 4.8 percentage points compared to the baseline, respectively. As a result of the increased demand for cereals and pulses, we

⁴ The decline is also partly attributed to the reduction in fish stocks that was already underway before the crisis.

also observe a shift of resources away from crops like bananas and tubers to cereals and pulses. Hence households involved in agricultural activities have to a certain extent been protected from the negative effects of the crisis although our model does not differentiate households between net buyers and net sellers of food items. While the increasing prices of food crops within the region have cushioned the agriculture sector the overall impact on GDP is small owing to the small share in total GDP.

Figure 4: Impact of the crisis (annual change in %)



Source: Authors' calculations.

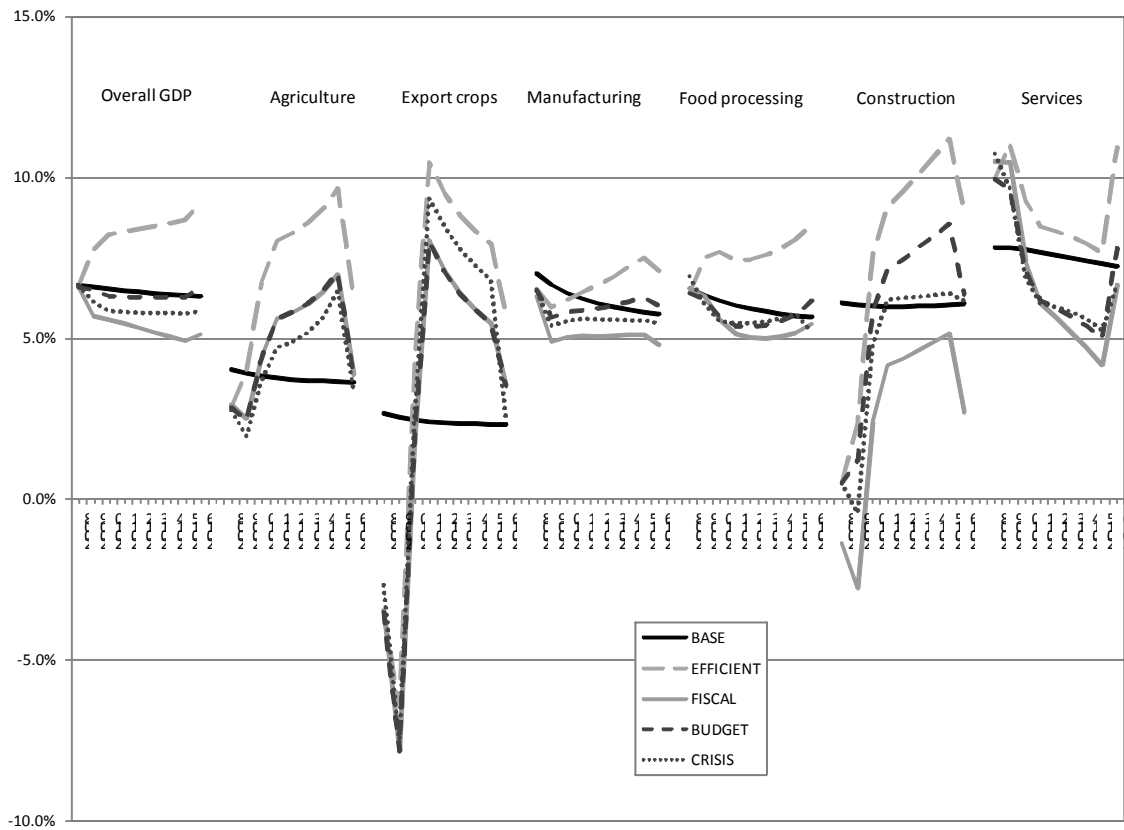
The 2009-10 Budget and Alternative Spending Allocation

There has been renewed attention to the role of counter-cyclical fiscal policies in the aftermath of the global crisis. The next set of simulations assesses the potential impact of fiscal policy and reform in terms of mitigating the impacts of the global crisis and restoring demand. Uganda's fiscal deficit is estimated at 3.4% of GDP in 2008/2009 and

projected to increase to 3.9% in 2009/2010. This compares to a deficit of 1.7% in 2005/2006 (Table 2) and is a reflection of the more aggressive stance taken by authorities pre-crisis to invest in social development and economic infrastructure to boost long-term growth and stimulate social and economic transformation.

As part of our fiscal stance simulations we assume that all the effects of the crisis including the reduced remittances, aid, depreciation and changes in commodity prices are in place. Our first simulation analyzes the effects of the 2009/2010 budget on the economy in light of the global financial crisis. Overall, we find that the impact of the new budget falls short of fully reversing the negative effects of the crisis. With the current spending allocations, the government would recover a 0.3% or half of the lost output due to the crisis over the period 2008/2010. However, over the longer term the BUDGET scenario does restore growth to levels of the no-crisis baseline and above the growth levels associated with the CRISIS as reflected on Figure 5. It is particularly increased allocations to agriculture and energy infrastructure that boosts growth under the 2009/2010 budget.

Figure 5: The impact of fiscal policy and reform (annual change in %)



Source: Authors' calculations.

Moreover, for Uganda to fully benefit from the increasing regional food demand, and to stem the hunger crisis at home, more resources should be allocated to the agricultural sector. In our simulations we assume, perhaps unrealistically but certainly illustrative, that the government takes a radical step by significantly cutting back on public administration (including reducing the number of local administrations). By reducing spending on this category by 8% and allocating these resources to education, health and agriculture, the analysis suggests a further recovery in growth of 1.5%.

Increasing government spending financed by domestic sources to provide a stimulus and increase aggregate demand would indeed worsen the economic situation as reflected in the highly negative effects across all sectors and on overall GDP from the FISCAL scenario as indicated on Figure 5. These impacts would largely be due to the

effects of the deficit on private sector activities through the reallocation of credit from the private sector to the public sector to finance the deficit. Overall, output would even shrink further by an additional 0.5%. While the services sector grows owing to the expansion of the public sector, manufacturing shrink by 0.5%. This scenario is illustrative of the importance of the availability of access to foreign borrowing or concessional financing, and for deepening domestic financial markets.

Lastly, we run a simulation where there is improved allocation is combined with improved efficiency of the public sector. The proposed reallocation of budget resources is indicated on Figure 3 and mainly seeks to reallocate resources away from Administration to Health and Agriculture. Improved efficiency is a rather broad notion and would include several aspects including improved absorptive capacity of public resources within the public sector, use of resources for the planned objectives, improved transparency of public spending and improved governance within the public sector. To implement the EFFICIENT simulation, it is assumed that by addressing all these weaknesses in the public sector this would improve the Total Factor Productivity within the public sector by 1%. Improved efficiency as indicated in Figure 5 would put the economy at a higher growth path. The end-of-period growth rate would be 9.2% compared to the 6.3% baseline and 5.8% under the CRISIS scenario, and all sectors but especially agriculture and construction will experience higher output. Admittedly this is an optimistic and perhaps even unrealistic scenario, but it is illustrative of the kind of impacts fiscal policy reform can have on productivity and long-term growth. Moreover, it is very much in line with the stated objectives of Government to strengthen the quality of service delivery, fight corruption and waste, and ensure “value for money” in the execution of the national budget.

Table 5: Effects of fiscal policies on macroeconomic aggregates (Average change in % 2008-2016)

	BASE	BUDGET	ALTERNATIVE	FISCAL	EFFICIENT
Absorption	5.72	6.07	7.75	5.46	7.81
Consumption	6.35	6.95	8.82	6.67	8.80
Investment	5.75	5.28	6.66	1.03	7.10
Exports	11.59	10.39	13.72	9.34	13.76
Imports	6.64	7.74	10.06	7.02	10.06
Real exchange rate	-1.34	-2.59	-2.89	-2.76	-2.77
Nominal exchange rate	-1.40	-3.09	-3.42	-3.30	-3.28
Investment to GDP	-0.32	-0.61	-0.72	-1.16	-0.64
Private Savings to GDP	0.00	0.01	0.01	0.01	0.01
Foreign Savings to GDP	-0.50	-0.71	-0.78	-0.76	-0.77
Trade Deficit to GDP	-0.88	-1.10	-1.23	-1.18	-1.21
Import duties to GDP	-0.03	-0.06	-0.07	-0.08	-0.06
Direct Taxes to GDP	0.00	-0.03	-0.03	-0.03	-0.03
Debt-Exports ratio (%)	64.57	61.99	60.22	66.43	60.22

Source: Authors' calculations.

Welfare Effects on Household Level

Finally we assess the potential long-term impacts of the crisis on household level in terms of changes in poverty and inequality. We use the standard decomposable class of poverty measures and look at the incidence of poverty (P0), or the poverty headcount, as well as the poverty gap (P1) and the squared poverty gap (P2), which are sensitive to the depth and severity of poverty. We also compute the standard measure of inequality, the Gini-coefficient and for all measures we report 95% confidence intervals in order to determine whether changes and differences are significant at conventional levels of confidence.

The main results are reported in Table 6. The incidence of poverty under the BASE scenario in 2008 is 29%, which is the share of individuals that live in households where the monthly adult equivalent expenditure is below US\$ 21,135.37 in 1997 prices.⁵ Under the BASE scenario poverty levels will fall to 16.5% in 2016 but if unmitigated the

⁵ Poverty estimates are calculated using regional poverty lines made available by the Economic Policy Research Center. For a complete overview of the methodology underlying the poverty line in Uganda see Appleton et al (1999).

economic crisis will dampen the rate by which poverty is reduced. Under CRISIS the poverty level is 17.8% in 2016, slightly and not significantly lower. It is the modeled reductions in financial flows that dampens the degree of poverty reduction whereas the changes especially in regional prices has a positive effect on poverty levels. The estimates also show the potential impact of fiscal policy and reform on poverty levels. Under the proposed expansionary budget the level of poverty in 2016 is estimated at 12.8% which is significantly below the baseline estimate. Under the EFFICIENT scenario whereby fiscal policy is even more expansionary, funds are reallocated to productive sectors of the economy and efficiency in public investments is improved the level of poverty would be half (8.4%) compared to the baseline in 2016. Not only would the incidence of poverty be reduced significantly under this scenario the depth and severity of poverty would fall as well. Conversely, the finding that P1 and P2 increases under the CRISIS scenario is an indication that the longer term impacts of the crisis is particularly severe on the poorest of the poor.

An economic crisis can worsen income distribution especially in credit constrained economies where it is relatively easier for high income groups to withstand shocks by drawing down savings or by using banking facilities. However, poorer households often lack savings or access to financial services that could help them cope with temporary reductions in their income. However, according to our simulations the effects on overall inequality as expressed by the Gini-coefficient are rather benign and none of the changes or differences is statistically significant.

Table 6: Poverty and inequality under difference economic policy scenarios

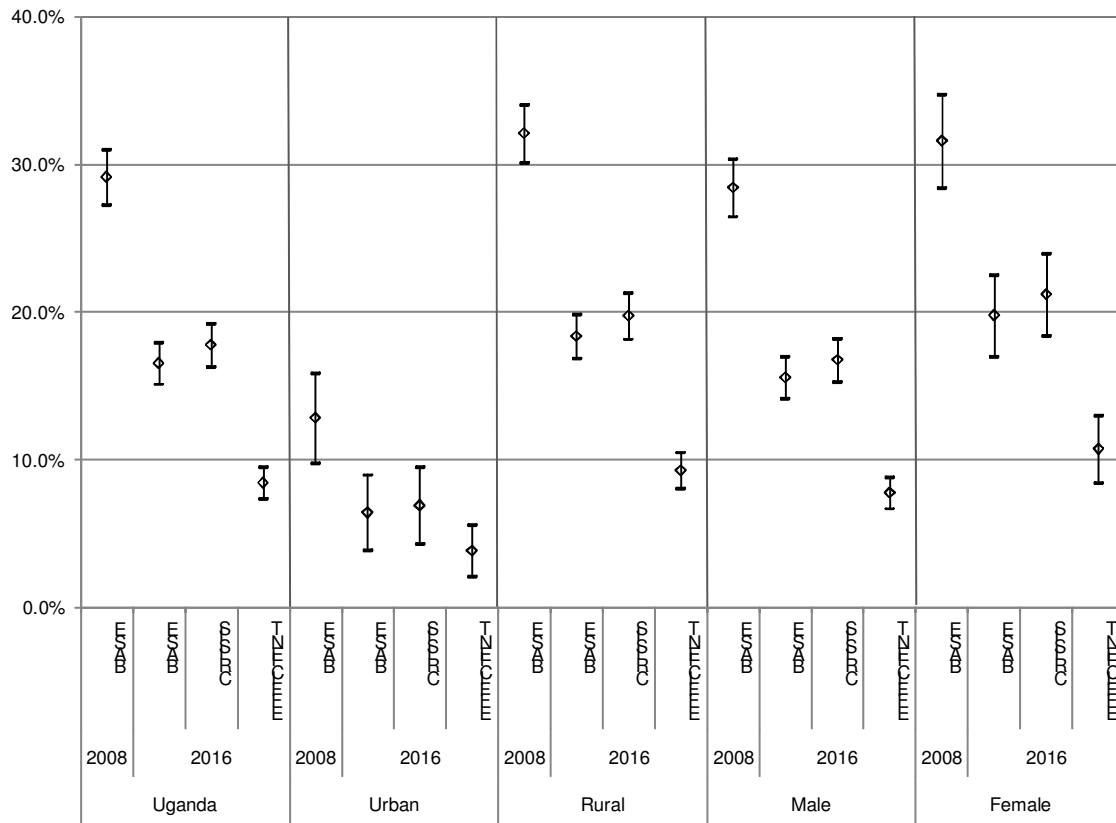
	2008	2016							
	BASE	BASE	FFLOWS	EPRICEW	CRISIS	EPRICER	BUDGET	FISCAL	EFFICIENT
P0	0.2912	0.1652	0.1833	0.1600	0.1776	0.1308	0.1278	0.1379	0.0843
	(0.2725- 0.3100)	(0.1512- 0.1792)	(0.1685- 0.1981)	(0.1462- 0.1738)	(0.1629- 0.1922)	(0.1181- 0.1434)	(0.1153- 0.1403)	(0.1245- 0.1513)	(0.0734- 0.0952)
P1	0.0804	0.0397	0.0450	0.0385	0.0436	0.0318	0.0307	0.0336	0.0181
	(0.0737- 0.0870)	(0.0353- 0.0441)	(0.0403- 0.0498)	(0.0342- 0.0428)	(0.0390- 0.0483)	(0.0278- 0.0357)	(0.0269- 0.0346)	(0.0295- 0.0377)	(0.0152- 0.0209)
P2	0.0320	0.0142	0.0164	0.0137	0.0159	0.0112	0.0109	0.0120	0.0060
	(0.0287- 0.0352)	(0.0122- 0.0162)	(0.0142- 0.0186)	(0.0118- 0.0157)	(0.0137- 0.0180)	(0.0095- 0.0130)	(0.0091- 0.0126)	(0.0102- 0.0139)	(0.0047- 0.0072)
Gini	0.3996	0.4021	0.4014	0.4013	0.4006	0.3930	0.3917	0.3935	0.3916
	(0.3844- 0.4147)	(0.3867- 0.4174)	(0.3861- 0.4167)	(0.3860- 0.4165)	(0.3853- 0.4158)	(0.3783- 0.4077)	(0.3772- 0.4063)	(0.3788- 0.4082)	(0.3770- 0.4062)

Note: P0 is the incidence of poverty in and P1 is the poverty gap in %, P2 is the squared poverty gap. Gini is the gini-coefficient and figures in brackets indicate the 95% confidence range.

Source: Authors' calculations.

There are large differences in poverty levels according to the type of household and the impacts are also different as illustrated on Figure 6, which shows the incidence of poverty according to urban and rural location of the household and according to the sex of the head of the household. At the BASE scenario in 2008 it is clear that poverty levels for rural households and those headed by females are higher than the national average. For all types of households the incidence of poverty is higher under the CRISIS scenario than under the BASE scenario in 2016 (not significant) but lower than under the BASE scenario in 2008 (significant). This is further indication that the main impact of the economic crisis is to slow down the rate of poverty reduction in the long term and not reverse it. The potential impact of the EFFICIENT fiscal policy and reform scenario is particularly effective in terms of reducing rural poverty, which is explained by the greater focus on investment in agriculture. Under this scenario the incidence of poverty in rural areas falls from 30% under the BASE scenario in 2008 to just over 10% in 2016.

Figure 6: The incidence of poverty



Note: The graph shows the incidenc of poverty under various scenarios and for all households, urban and rual households and households headed by males and females. The 95% confidence range is indicated for each data point.

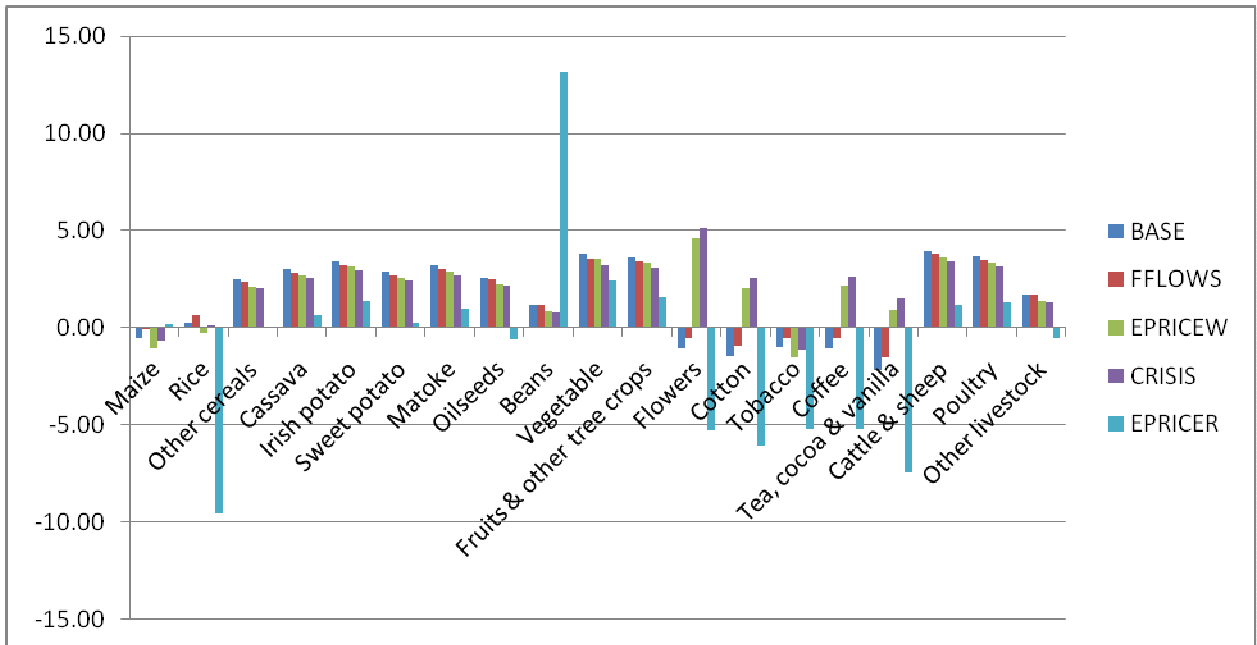
Source: Authors' calculations.

Employment Demand

The effect of the global crisis could also affect the sector demand for labor in various ways. For instance as noted in the figure below, due to reduction in international flows or decline in international prices of commodities, labor would be transferred between activities. For the sectors that are considered to be tradable, it can be noted that there is a reduction in demand for labor especially for crops like maize, and cash crops including cotton, tea and tobacco. This is the case especially for the agricultural sector where there is considerable self employment. On the other hand, it's also notes that

there would be increased demand for labor in sectors where commodities are not traded especially internationally (Fig7). For the case where there is an increase in the regional prices, there would be increased demand for labor to produce maize which is largely traded within the region. Also it's noted that with increased regional prices, there is reduced demand for labor in commodities traded in international markets largely because these products are not traded within the region.

Figure 7: Demand for Labor in Selected Activities



V. CONCLUSIONS

In this paper we have identified four main channels through which the changes in the global economy in 2008/2009 have impacted the economy of Uganda: (i) reduction in foreign financial inflows including aid, grants, foreign direct investment and remittances; (ii) depreciation of the exchange rate (as a result of (i)); (iii) changes in exports to the region, and; (iv) changes in exports of goods that are exported beyond the region. It is clear from the analysis presented in the paper that not all these factors emanating from changes in the global economic environment are affecting the economy of Uganda in the same direction and with the same intensity.

We find that second round effects from a reduction in financial inflows such as remittances, foreign direct investments and overseas development assistance, as well as reduction in international demand from cash crops such as cotton, tea and coffee, could lead to a reduction in economic growth compared to the baseline reflecting pre-crisis conditions. Moreover, poverty levels will be higher and there will be large negative effects for the manufacturing and construction sectors. The manufacturing sector is being affected by the depreciating currency, which raises input costs, and the construction sector is particularly vulnerable to the reduction in remittances from overseas Ugandans. We also find that the agriculture sector, which is the main source of income for most rural poor, is currently being cushioned by increasing regional prices for food products of which Uganda is a net-exporter. As a result, the actual adverse impact on overall poverty levels is limited as long as regional demand remains high. However, if regional demand was to begin contracting, for instance as a result of a deepening and protracted global crisis then the impact would be severe. This situation represents both a challenge and an opportunity for policy makers. The challenge is that if the global crisis deepens and prolongs regional demand and prices might be affected

and Uganda may face a new round of negative effects. The opportunity is for the country to relieve supply constraints in the productive sectors of the economy, through investment in economic infrastructure such as transportation and energy supply, and to strengthen measures that facilitate private sector development and eases intra-regional trade.

The paper shows the potentially important role of expansionary fiscal policy in countering the reduced demand following from the fall in financial flows. Here the Government of Uganda appears to have been ahead of the curve as an expansion in the budget deficit was already underway with the 2008/2009 budget and is set to continue in the coming years. This is likely to lead to a build-up of foreign debt as fiscal policy is guided by a rule to limit domestic borrowing in order not to crowd out private investment. However, our analysis also highlights the additional impact that could occur under a reprioritization of public expenditure, which could come as a result of appropriate fiscal policy reforms to ensure a more efficient allocation of expenditure. In fact, our analysis shows such a policy response could more than outweigh the negative impact of the crisis and potentially spur a sustained lift in medium term growth.

While we expect that the country's growth process is likely to continue to benefit from economic liberalization and increased stability in the north of the country and the rest of the region, mitigating the worst impacts of the economic and financial crisis and laying the foundation for future growth will require a more interventionist approach by the Government. A more active role for government in macro-economic and structural policy also requires extra emphasis in needed for putting in place appropriate measures to close capacity gaps, addressing administrative and procedural bottlenecks, and setting up accountability and transparency mechanisms to ensure efficiency and effectiveness in allocation of public funds.

References

- Adam S and. Bevan L. (2002) "Uganda Aid, Public Expenditure, and Dutch Disease", Department of Economics, University of Oxford, Working Paper.
- Appelton, S. (1999) "Changes in Poverty in Uganda 1992-1997." Working Paper Series/99-22 Centre for the Study of African Economies, University of Oxford.
- Atingi-Ego (2005) "Budget Support, Aid Dependency, and Dutch Disease: The Case of Uganda". Paper presented at the World Bank Practitioners' Forum, Cape Town South Africa.
- Barder, O. (2006) "A policy maker's guide to Dutch disease", WP No.91, Center for global Development.
- Barder, O. (2006) "Are the planned increases in aid too much of a good thing?" WP # 90, Center for Global Development.
- DFID (2002) "The macroeconomic effect of aid", a policy paper.
- Garber, D. S. (2004) "Oil, Dutch disease, and development: the case of Chad", University of Wisconsin.
- International Monetary Fund (2009) "The Implications of the Global Financial Crisis for Low-Income Countries," March 2009. Washington D.C: International Monetary Fund.
- Issa, H and Ouattara, B. (2004) "Foreign Aid Flows and Real Exchange Rate: Evidence from Syria," The School of Economics Discussion Paper Series 0408, Economics, University of Manchester.
- Kappel, R., Lay, J. and Steiner, S. (2005) "Uganda: No More Pro-poor Growth?" *Development Policy Review*, 23(1):27-53.
- Lofgren, H., Harris, R. and Robinson, S. (2002) "A Standard Computable General Equilibrium Model in GAMS." Microcomputers in Policy Research No. 5, Washington, D.C: International Food Policy Research Institute.
- McKinley, T. (2005) "Why is the 'Dutch disease' always a disease? The Macroeconomic Consequences of Scaling up ODA", Working Paper No.10. Brasilia: International Poverty Center.
- Millennium Project (2004) "Millennium Development Goals Needs Assessments: Country Case Studies of Bangladesh, Cambodia, Ghana, Tanzania and Uganda". Working Paper.
- Ministry of Finance Planning and Economic Development (2009a) Budget Speech for Financial Year 2009/2010, delivered at the 4th Session of the 8th Parliament of Uganda on 11th of June 2009 at Serena International Convention Centre.
- Ministry of Finance Planning and Economic Development (2009b) National Budget Framework Paper for 2009/2010.
- Nkusu, M (2004) "Financing Uganda's Poverty Reduction Strategy: Is Aid Causing More Pain than Gain?" IMF Working Paper.
- Sackey, H. A. (2001) "External aid inflows and the real exchange rate in Ghana", AERC Working Paper 110.

- Ssewanyana, S. and Okidi, P (2007) "Poverty Estimates from the Uganda National Household Survey III, 2005/2006", Occasional Paper No 34, October 2007. Kampala: Economic and Policy Research Centre.
- Thurlow, J. (2007) "Is HIV/AIDS Undermining Botswana's Success Story?" Implications for Development Strategy, IFPRI Discussion Paper 00697.
- United Nations (2009) "Background Note on the Global Financial and Economic Crisis, Its Impact on Development, and How the World Should Respond," March 2009. New York: Department for Economic and Social Affairs.
- World Bank (2009a) "Swimming Against the Tide: How Developing Countries are Coping with the Global Crisis," Washington D.C: World Bank.
- World Bank (2009b) "World Development Indicators" accessed online June 2009.
- World Bank (2007) "Uganda: Moving Beyond Recovery. Investment and Behavior Change for Growth," Country Economic Memorandum, Volume 1, Summary and Recommendations. Washington D.C: World Bank.

Table A1. CGE model sets, parameters, and variables

Symbol	Explanation	Symbol	Explanation
Sets			
$a \in A$	Activities	$c \in CMN(\subset C)$	Commodities not in CM
$a \in ALEO(\subset A)$	Activities with a Leontief function at the top of the technology nest	$c \in CT(\subset C)$	Transaction service commodities
$c \in C$	Commodities	$c \in CX(\subset C)$	Commodities with domestic production
$c \in CD(\subset C)$	Commodities with domestic sales of domestic output	$f \in F$	Factors
$c \in CDN(\subset C)$	Commodities not in CD	$i \in INS$	Institutions (domestic and rest of world)
$c \in CE(\subset C)$	Exported commodities	$i \in INSD(\subset INS)$	Domestic institutions
$c \in CEN(\subset C)$	Commodities not in CE	$i \in INSDNG(\subset INSD)$	Domestic non-government institutions
$c \in CM(\subset C)$	Aggregate imported commodities	$h \in H(\subset INSDNG)$	Households
Parameters			
$cwts_c$	Weight of commodity c in the CPI	$qdst_c$	Quantity of stock change
$dwts_c$	Weight of commodity c in the producer price index	\overline{qg}_c	Base-year quantity of government demand
ica_{ca}	Quantity of c as intermediate input per unit of activity a	\overline{qinv}_c	Base-year quantity of private investment demand
$icd_{cc'}$	Quantity of commodity c as trade input per unit of c' produced and sold domestically	$shif_{if}$	Share for domestic institution i in income of factor f
$ice_{cc'}$	Quantity of commodity c as trade input per exported unit of c'	$shii_{i'}$	Share of net income of i' to i ($i' \in INSDNG$; $i \in INSDNG$)
$icm_{cc'}$	Quantity of commodity c as trade input per imported unit of c'	ta_a	Tax rate for activity a
$inta_a$	Quantity of aggregate intermediate input per activity unit	\overline{tins}_i	Exogenous direct tax rate for domestic institution i
iva_a	Quantity of aggregate intermediate input per activity unit	$tinsOI_i$	0-1 parameter with 1 for institutions with potentially flexed direct tax rates
\overline{mps}_i	Base savings rate for domestic institution i	tm_c	Import tariff rate
$mpsOI_i$	0-1 parameter with 1 for institutions with potentially flexed direct tax rates	tq_c	Rate of sales tax
pwe_c	Export price (foreign currency)	$trnsfr_{if}$	Transfer from factor f to institution i
pwm_c	Import price (foreign currency)		

Table A1 continued. CGE model sets, parameters, and variables

Symbol	Explanation	Symbol	Explanation
Greek Symbols			
α_a^a	Efficiency parameter in the CES activity function	δ_{cr}^t	CET function share parameter
α_a^{va}	Efficiency parameter in the CES value-added function	δ_{fa}^{va}	CES value-added function share parameter for factor f in activity a
α_c^{ac}	Shift parameter for domestic commodity aggregation function	γ_{ch}^m	Subsistence consumption of marketed commodity c for household h
α_c^q	Armington function shift parameter	θ_{ac}	Yield of output c per unit of activity a
α_c^t	CET function shift parameter	ρ_a^a	CES production function exponent
β^a	Capital sectoral mobility factor	ρ_a^{va}	CES value-added function exponent
β_{ch}^m	Marginal share of consumption spending on marketed commodity c for household h	ρ_c^{ac}	Domestic commodity aggregation function exponent
δ_a^a	CES activity function share parameter	ρ_c^q	Armington function exponent
δ_{ac}^{ac}	Share parameter for domestic commodity aggregation function	ρ_c^t	CET function exponent
δ_{cr}^q	Armington function share parameter	η_{fat}^a	Sector share of new capital
v_f	Capital depreciation rate		
Exogenous Variables			
\overline{CPI}	Consumer price index	\overline{MPSADJ}	Savings rate scaling factor (= 0 for base)
\overline{DTINS}	Change in domestic institution tax share (= 0 for base; exogenous variable)	\overline{QFS}_f	Quantity supplied of factor
\overline{FSAV}	Foreign savings (FCU)	$\overline{TINSADJ}$	Direct tax scaling factor (= 0 for base; exogenous variable)
\overline{GADJ}	Government consumption adjustment factor	\overline{WFDIST}_{fa}	Wage distortion factor for factor f in activity a
\overline{IADJ}	Investment adjustment factor		
Endogenous Variables			
AWF_{ft}^a	Average capital rental rate in time period t	QG_c	Government consumption demand for commodity
$DMPS$	Change in domestic institution savings rates (= 0 for base; exogenous variable)	QH_{ch}	Quantity consumed of commodity c by household h
DPI	Producer price index for domestically marketed output	QHA_{ach}	Quantity of household home consumption of commodity c from activity a for household h
EG	Government expenditures	$QINTA_a$	Quantity of aggregate intermediate input
EH_h	Consumption spending for household	$QINT_{ca}$	Quantity of commodity c as intermediate input to activity a
EXR	Exchange rate (LCU per unit of FCU)	$QINV_c$	Quantity of investment demand for commodity
$GSAV$	Government savings	QM_{cr}	Quantity of imports of commodity c
QF_{fa}	Quantity demanded of factor f from activity a		

Table A1 continued. CGE model sets, parameters, and variables

Symbol	Explanation	Symbol	Explanation
Endogenous Variables Continued			
MPS_i	Marginal propensity to save for domestic non-government institution (exogenous variable)	QQ_c	Quantity of goods supplied to domestic market (composite supply)
PA_a	Activity price (unit gross revenue)	QT_c	Quantity of commodity demanded as trade input
PDD_c	Demand price for commodity produced and sold domestically	QVA_a	Quantity of (aggregate) value-added
PDS_c	Supply price for commodity produced and sold domestically	QX_c	Aggregated quantity of domestic output of commodity
PE_{cr}	Export price (domestic currency)	$QXAC_{ac}$	Quantity of output of commodity c from activity a
$PINTA_a$	Aggregate intermediate input price for activity a	RWF_f	Real average factor price
PK_{ft}	Unit price of capital in time period t	$TABS$	Total nominal absorption
PM_{cr}	Import price (domestic currency)	$TINS_i$	Direct tax rate for institution i (i \in INSDNG)
PQ_c	Composite commodity price	$TRII_{i'}$	Transfers from institution i' to i (both in the set INSDNG)
PVA_a	Value-added price (factor income per unit of activity)	WF_f	Average price of factor
PX_c	Aggregate producer price for commodity	YF_f	Income of factor f
$PXAC_{ac}$	Producer price of commodity c for activity a	YG	Government revenue
QA_a	Quantity (level) of activity	YI_i	Income of domestic non-government institution
QD_c	Quantity sold domestically of domestic output	YIF_{if}	Income to domestic institution i from factor f
QE_{cr}	Quantity of exports	ΔK_{fat}^a	Quantity of new capital by activity a for time period t

Table A2. CGE model equations

Production and Price Equations

$$QINT_{ca} = ica_{ca} \cdot QINTA_a \quad (1)$$

$$PINTA_a = \sum_{c \in C} PQ_c \cdot ica_{ca} \quad (2)$$

$$QVA_a = \alpha_a^{va} \cdot \left(\sum_{f \in F} \delta_{fa}^{va} \cdot (\alpha_{fa}^{vaf} \cdot QF_{fa})^{-\rho_a^{va}} \right)^{\frac{1}{\rho_a^{va}}} \quad (3)$$

$$W_f \cdot \overline{WFDIST}_{fa} = PVA_a \cdot QVA_a \cdot \left(\sum_{f \in F} \delta_{fa}^{va} \cdot (\alpha_{fa}^{vaf} \cdot QF_{fa})^{-\rho_a^{va}} \right)^{-1} \cdot \delta_{fa}^{va} \cdot (\alpha_{fa}^{vaf} \cdot QF_{fa})^{-\rho_a^{va}-1} \quad (4)$$

$$QF_{fa} = \alpha_{fa}^{van} \cdot \left(\sum_{f' \in F} \delta_{ff'a}^{van} \cdot QF_{f'a}^{-\rho_{fa}^{van}} \right)^{\frac{1}{\rho_{fa}^{van}}} \quad (5)$$

$$W_{f'} \cdot WFDIST_{f'a} = W_f \cdot WFDIST_{fa} \cdot QF_{fa} \cdot \left(\sum_{f' \in F} \delta_{ff'a}^{van} \cdot QF_{f'a}^{-\rho_{fa}^{van}} \right)^{-1} \cdot \delta_{ff'a}^{van} \cdot QF_{f'a}^{-\rho_{fa}^{van}-1} \quad (6)$$

$$QVA_a = iva_a \cdot QA_a \quad (7)$$

$$QINTA_a = inta_a \cdot QA_a \quad (8)$$

$$PA_a \cdot (1 - ta_a) \cdot QA_a = PVA_a \cdot QVA_a + PINTA_a \cdot QINTA_a \quad (9)$$

$$QXAC_{ac} = \theta_{ac} \cdot QA_a \quad (10)$$

$$PA_a = \sum_{c \in C} PXAC_{ac} \cdot \theta_{ac} \quad (11)$$

$$QX_c = \alpha_c^{ac} \cdot \left(\sum_{a \in A} \delta_{ac}^{ac} \cdot QXAC_{ac}^{-\rho_c^{ac}} \right)^{\frac{1}{\rho_c^{ac}-1}} \quad (12)$$

$$PXAC_{ac} = PX_c \cdot QX_c \cdot \left(\sum_{a \in A} \delta_{ac}^{ac} \cdot QXAC_{ac}^{-\rho_c^{ac}} \right)^{-1} \cdot \delta_{ac}^{ac} \cdot QXAC_{ac}^{-\rho_c^{ac}-1} \quad (13)$$

$$PE_{cr} = pwe_{cr} \cdot EXR - \sum_{c' \in CT} PQ_{c'} \cdot ice_{c'c} \quad (14)$$

$$QX_c = \alpha_c^t \cdot \left(\sum_r \delta_{cr}^t \cdot QE_{cr}^{\rho_c^t} + (1 - \sum_r \delta_{cr}^t) \cdot QD_c^{\rho_c^t} \right)^{\frac{1}{\rho_c^t}} \quad (15)$$

$$\frac{QE_{cr}}{QD_c} = \left(\frac{PE_{cr}}{PDS_c} \cdot \frac{1 - \sum_r \delta_{cr}^t}{\delta_c^t} \right)^{\frac{1}{\rho_c^t-1}} \quad (16)$$

Table A3. CGE model equations (continued)

$QX_c = QD_c + \sum_r QE_{cr}$	(17)
$PX_c \cdot QX_c = PDS_c \cdot QD_c + \sum_r PE_{cr} \cdot QE_{cr}$	(18)
$PDD_c = PDS_c + \sum_{c' \in CT} PQ_{c'} \cdot icd_{c'c}$	(19)
$PM_{cr} = pwm_{cr} \cdot (1 + tm_{cr}) \cdot EXR + \sum_{c' \in CT} PQ_{c'} \cdot icm_{c'c}$	(20)
$QQ_c = \alpha_c^q \cdot \left(\sum_r \delta_{cr}^q \cdot QM_{cr}^{\cdot \rho_c^q} + (1 - \sum_r \delta_{cr}^q) \cdot QD_c^{\cdot \rho_c^q} \right)^{\frac{1}{\rho_c^q}}$	(21)
$\frac{QM_{cr}}{QD_c} = \left(\frac{PDD_c}{PM_c} \cdot \frac{\delta_c^q}{1 - \sum_r \delta_{cr}^q} \right)^{\frac{1}{1 + \rho_c^q}}$	(22)
$QQ_c = QD_c + \sum_r QM_{cr}$	(23)
$PQ_c \cdot (1 - tq_c) \cdot QQ_c = PDD_c \cdot QD_c + \sum_r PM_{cr} \cdot QM_{cr}$	(24)
$QT_c = \sum_{c' \in C'} (icm_{c'c} \cdot QM_{c'} + ice_{c'c} \cdot QE_{c'} + icd_{c'c} \cdot QD_{c'})$	(25)
$\overline{CPI} = \sum_{c \in C} PQ_c \cdot cwts_c$	(26)
$DPI = \sum_{c \in C} PDS_c \cdot dwts_c$	(27)
Institutional Incomes and Domestic Demand Equations	
$YF_f = \sum_{a \in A} WF_f \cdot \overline{WFDIST}_{fa} \cdot QF_{fa}$	(28)
$YIF_{if} = shif_{if} \cdot [YF_f - trnsfr_{rowf} \cdot EXR]$	(29)
$YI_i = \sum_{f \in F} YIF_{if} + \sum_{i' \in INSDNG'} TRII_{ii'} + trnsfr_{i\text{gov}} \cdot \overline{CPI} + trnsfr_{i\text{row}} \cdot EXR$	(30)
$TRII_{ii'} = shii_{ii'} \cdot (1 - MPS_{i'}) \cdot (1 - \overline{tins}_{i'}) \cdot YI_{i'}$	(31)
$EH_h = \left(1 - \sum_{i \in INSDNG} shii_{ih} \right) \cdot (1 - MPS_h) \cdot (1 - \overline{tins}_h) \cdot YI_h$	(32)
$PQ_c \cdot QH_{ch} = PQ_c \cdot \gamma_{ch}^m + \beta_{ch}^m \cdot \left(EH_h - \sum_{c' \in C} PQ_{c'} \cdot \gamma_{c'h}^m \right)$	(33)
$QINV_c = IADJ \cdot \overline{qinv}_c$	(34)
$QG_c = \overline{GADJ} \cdot \overline{qg}_c$	(35)

Table A3. CGE Model Equations (continued)

$$EG = \sum_{c \in C} PQ_c \cdot QG_c + \sum_{i \in INSDNG} \overline{trnsfr}_{i\ gov} \cdot \overline{CPI} \quad (36)$$

System Constraints and Macroeconomic Closures

$$YG = \sum_{i \in INSDNG} \overline{tins}_i \cdot YI_i + \sum_{c \in CMNR} tm_c \cdot pwm_c \cdot QM_c \cdot EXR + \sum_{c \in C} tq_c \cdot PQ_c \cdot QQ_c + \sum_{f \in F} YF_{gov\ f} + \overline{trnsfr}_{gov\ row} \cdot EXR \quad (37)$$

$$QQ_c = \sum_{a \in A} QINT_{c\ a} + \sum_{h \in H} QH_{c\ h} + QG_c + QINV_c + qdst_c + QT_c \quad (38)$$

$$\sum_{a \in A} QF_{f\ a} = QFS_f \quad (39)$$

$$YG = EG + GSAV \quad (40)$$

$$\sum_{r \in CMNR} pwm_{cr} \cdot QM_{cr} + \sum_{f \in F} \overline{trnsfr}_{row\ f} = \sum_{r \in CENR} pwe_{cr} \cdot QE_{cr} + \sum_{i \in INSD} \overline{trnsfr}_{i\ row} + FSAV \quad (41)$$

$$\sum_{i \in INSDNG} MPS_i \cdot (1 - \overline{tins}_i) \cdot YI_i + GSAV + EXR \cdot FSAV = \sum_{c \in C} PQ_c \cdot QINV_c + \sum_{c \in C} PQ_c \cdot qdst_c \quad (42)$$

$$MPS_i = \overline{mps}_i \cdot (1 + MPSADJ) \quad (43)$$

Capital Accumulation and Allocation Equations

$$AWF_{f\ t}^a = \sum_a \left[\left(\frac{QF_{f\ at}}{\sum_{a'} QF_{f\ a't}} \right) \cdot WF_{f\ t} \cdot WFDIST_{f\ at} \right] \quad (44)$$

$$\eta_{f\ at}^a = \left(\frac{QF_{f\ at}}{\sum_{a'} QF_{f\ a't}} \right) \cdot \left(\beta^a \cdot \left(\frac{WF_{f\ t} \cdot WFDIST_{f\ at}}{AWF_{f\ t}^a} - 1 \right) + 1 \right) \quad (45)$$

$$\Delta K_{f\ at}^a = \eta_{f\ at}^a \cdot \left(\frac{\sum_c PQ_{ct} \cdot QINV_{ct}}{PK_{f\ t}} \right) \quad (46)$$

$$PK_{f\ t} = \sum_c PQ_{ct} \cdot \frac{QINV_{ct}}{\sum_{c'} QINV_{c't}} \quad (47)$$

$$QF_{f\ at+1} = QF_{f\ at} \cdot \left(1 + \frac{\Delta K_{f\ at}^a}{QF_{f\ at}} - v_f \right) \quad (48)$$

$$QFS_{f\ t+1} = QFS_{f\ t} \cdot \left(1 + \frac{\sum \Delta K_{f\ at}}{QFS_{f\ t}} - v_f \right) \quad (49)$$

