Agglomeration, Growth and Regional Equity: An Analysis of Agriculture- versus Urban-led Development in Uganda

Paul Dorosh and James Thurlow

International Food Policy Research Institute

Abstract

Traditional development models focus on the sector rather than location of growth. Advocates of agriculture-led strategies emphasize agriculture's strong growth linkages and ability to raise rural incomes. The new economic geography literature, however, provides theoretical support for urban industry-led development, which generates positive agglomeration effects of concentrating populations and economic activity. This debate is important for sub-Saharan Africa, where agriculture dominates but where rapid urbanization is occurring. We use an empirically-calibrated economywide model with migration and agglomeration to estimate impacts of three investment strategies for Uganda – a fast growing country with wide rural/urban and regional disparities. First, our results indicate that a transport corridor connecting poorer northern regions to the rapidly growing south provides marginal benefits to northern households since northern producers are constrained by low productivity. Secondly, investing in southern urban centers to harness agglomeration effects accelerates national growth, but has little effect on other regions' welfare because of weak growth linkages and small migration effects. Finally, raising agricultural productivity, while less effective at stimulating national growth, generates broad-based welfare improvements. Thus, even after accounting for migration and agglomeration gains from urban-led development, improving agricultural productivity is necessary to significantly reduce poverty and promote regional equity in Uganda and similar developing countries. [203 words in abstract]

Keywords: Economic Growth; Poverty; Agricultural Development; sub-Saharan Africa; Spatial Economics

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I. Introduction

Since the work of Kuznets in the 1960s (Kuznets, 1966), the structural transformation of economic output from agriculture to industry and services has been recognized as a normal pattern of economic growth. This early analysis of structural transformation was essentially non-spatial, focusing on sectors rather than locations, though in fact economic growth typically involves more rapid growth in cities than in small towns and rural areas. More recently, the new economic geography literature (e.g. Fujita, Krugman and Venables, 2001) has emphasized the importance of location in the growth process, highlighting gains in total factor productivity (TFP) achieved through agglomeration economies and the dynamics of spatial growth.

These sectoral and spatial issues figure prominently in current debates on development policy in poor countries with large agricultural sectors, particularly in sub-Saharan Africa. Advocates of public investments to accelerate agricultural growth emphasize upstream and downstream growth linkage effects in agricultural inputs; processing of agricultural products; and increased consumer demand for all goods and services (Adelman, 1984; Haggblade, Hazell and Reardon, 2007). The agricultural sector has also been regarded as an important source of foreign exchange earnings, government fiscal revenues, and savings for industrial investments (Johnston and Mellor, 1961). Moreover, agricultural growth has been shown to have a greater poverty-reducing effect than non-agricultural growth, particularly in the poorest countries (Ravallion and Datt, 1996; Timmer, 2002; Diao et al., 2007; World Bank, 2007).

However, because of income-inelastic demand for agricultural products (Engel's Law), the share of agriculture in total output tends to decline as per capita incomes rise. Similarly, because of price-inelastic demand for agricultural products, technical change in agriculture can result in a decline in farmer gross revenues as higher levels of output are more than offset by falling prices (Timmer, 2002). By contrast, income and (absolute magnitudes of) own-price elasticities of industrial products are generally larger, thus mitigating potential demand constraints. Technical change in some industrial sectors can also be self-reinforcing, due to economies of labor specialization and movements up the value chain of production. [1] In addition, increasing returns to scale in industrial production, imperfect substitution across industrial products, and externalities arising from producers locating near their suppliers and customers, may result in agglomeration economies – gains in TFP enjoyed by firms in areas with a higher concentration of economic activities (Fujita, Krugman and Venables, 2001). Thus, the view that

[1] It should be noted though, that in many developing countries, long-term technical change in agriculture has been faster than that in industry (Martin and Mitra, 2001).

urban industrial growth, rather than rural agricultural growth, is the most effective engine of growth – a common view in the 1950s and 1960s (e.g. Lewis, 1954) – has again gained in popularity with additional theoretical support from the new economic geography literature (World Bank, 2008).

This paper analyzes the implications of agriculture- and urban-led growth in Uganda, one of the fastest growing countries in sub-Saharan Africa, but a country with wide regional disparities in per capita incomes. Southern Uganda led by industrial growth around the capital city, Kampala, has enjoyed rapid increases in per capita incomes over the last decade contributing to a decline in overall national poverty (see Table 1). However, agricultural GDP per capita has actually fallen over this period, rural household income growth has been slow, and rural poverty remains high. Moreover, Uganda's northern region, where a quarter the population lives, has not participated in the growth process, in large measure because internal conflict has, until recently, undermined development efforts in the region, leaving many inhabitants displaced (Collier and Reinnikka, 2001). Thus, while poverty declined outside of the northern region, the high levels of poverty in the north have remained virtually unchanged.

[Insert Table 1 around here]

In this paper, we explore three alternative strategies to address persistent rural poverty and the north-south divide, each with unique spatial and development implications in terms of economic density (urbanization and agglomeration effects), economic distance (transport costs) and spatial distribution of welfare (see World Bank, 2008). The first option we analyze is to develop a road corridor that reduces transport costs between major urban centers in the northern and southern regions, and between northern and international markets. The second option is to reinforce the growth process in Kampala, thereby harnessing agglomeration economies and creating employment opportunities for migrants. The third option is to invest in improving agricultural productivity to directly raise rural incomes in both the north and the south. To analyze these investment options, we use a dynamic regional computable general equilibrium (CGE) model that captures the economic linkages between the northern/southern regions and rural/urban areas. Section II describes Uganda's economic structure and the regional model, Section III presents the model results, and Section IV concludes.

II. Regional and Rural-Urban Linkages in Uganda

Despite the poor performance of Uganda's agricultural sector over the last decade, it still accounts for one-third of national gross domestic product (GDP) and four-fifths of total employment (see Table 2). Agricultural exports generate two-thirds of foreign earnings, which mainly finance imported manufactures. Local manufacturing has grown rapidly, but generates only ten percent of GDP, half of which is agro-processing. Strong linkages thus exist between rural-based agriculture and urban-based manufacturing. Accordingly, the economic model

developed for our analysis disaggregates Uganda into sub-national regions to capture regional rural-urban linkages and the spatial impacts of alternative growth strategies.

[Insert Table 2 around here]

North-south regions and major urban centers

In our analysis, we first divide Uganda into North and South.[2] The 2002 population census is then used to identify major urban centers with populations above 50,000 people, which includes Kampala (1.7 million people out of a total of 27 million). Since Kampala is the core of Uganda's industrial economy, it is a separate region in the model. The two major cities in the north are Gulu and Lira with a combined population of 200,000 people (see Table 3); the southern major urban centers have a total population of 524,000 people. Thus, the five regions in the model are North rural; North urban; South rural; South urban; and Kampala. A major transport route connects the southern urban centers with Kampala and foreign markets, while a less developed corridor connects northern and southern regions.

[Insert Table 3 around here]

Production is disaggregated across the five regions using Uganda's district agricultural database, 2005/06 national household survey (UNHS3) and 2001/02 industrial census (Uganda Bureau of Statistics, 2002; 2006). The northern regions contain 23 percent of the population but account for only 11 percent of national GDP (see Table 1). Accordingly, northern per capita GDP is US$147 per year compared to a national average of US$310. The North region, predominantly rural and dominated by agriculture, is a net exporter of agricultural goods (e.g., cotton and forestry), mining and electricity. The South region is much larger, and unlike in the north, there is a sharp rural-urban divide. Southern per capita GDP is closer to the national average at US$271. However, average per capita GDP in southern urban centers is US$1075, reflecting the South's higher-earning sectors, such as formal manufacturing and private services. The South is also a net exporter of agricultural goods (e.g., maize, horticulture, coffee and livestock). Most agricultural outputs are supplied to urban centers for processing and traded with other regions. Finally, Kampala, the fifth region in the model, forms the economic core of Uganda. The capital city contains only 6 percent of the population, but generates 22 percent of national GDP, and has an average per capita GDP of US$1098 per year, more than seven times that of northern rural areas.

The core regional general equilibrium model

Table 4 presents the equations of a simple closed-economy CGE model that illustrates the functioning of internal migration and agglomeration effects in our analysis. The model is

[2] Uganda consists of four administrative regions. The 'South' in our analysis includes Central, Eastern and Western administrative regions, while the 'North' includes only the Northern administrative region.

recursive dynamic and so can be separated into a static 'within-period' component, where producers and consumers maximize profits and utility, and a dynamic 'between-period' component, when the model is updated based on previous period results to reflect changes in migration and labor supply, capital and technology accumulation, and agglomeration effects.

[Insert Table 4 around here]

In the static component of the model, producers in each sector *s* and region *r* produce a level of output *Q* in time period *t* by employing the factors of production *F* under constant returns to scale (exogenous productivity α) and fixed production technologies (fixed factor shares δ) (eq. [1]). Profit maximization implies that factor payments *W* are equal to average production revenues (eq. [2]). Labor supply *L* and capital supply *K* are fixed within a given time period implying full employment of factor resources. Labor market equilibrium is defined at the regional level so that labor is mobile across sectors but wages vary by region (eq. [6]). National capital market equilibrium implies that capital is mobile across both sectors and regions and earns a national rental rate (i.e., regional capital returns are equalized) (eq. [7]).

Factor incomes are distributed to households in each region using fixed income shares based on households' initial factor endowments (eq. [3]). Total household incomes *Y* are then either saved (based on marginal propensities to save υ) or spent on consumption *C* (according to marginal budget shares β) (eq. [4]). Savings are collected in a national savings pool and used to finance investment demand *I* (i.e., a savings-driven investment closure) (eq. [5]). Finally, a single commodity price *P* equilibrates national product markets, which avoids having to model interregional trade flows (eq. [8]).[3]

The model's variables and parameters are calibrated to observed data from a regional social accounting matrix that captures the initial equilibrium structure of the economy in 2005.[4] Parameters are then adjusted over time to reflect demographic and economic changes and the model is re-solved for a series of new equilibriums for the ten-year period 2005-2015. Two dynamic adjustments occur between periods: internal migration and changes in factor supply; and agglomeration effects and technical change.

Internal migration and factor supply

Between periods workers can migrate across regions in response to wage differentials. In the migration function (eq. [9]), *M* is the share of the labor force in region *r* that migrates to region *r'* during time period *t* in response to regional wage differences at the end of the previous time

[3] A consumer price index weighted by the aggregate household consumption basket is the model's numéraire.

[4] A social accounting matrix (SAM) is a consistent database capturing all monetary flows in an economy in a given year. It contains information on the production technologies and demand structures of detailed sectors, regions and households, as well as government revenues/expenditures and foreign receipts/payments. Various datasets were used to build the 2005 regional SAM for Uganda, including national accounts; district agricultural production data; 2002 population census; 2001/02 industrial census; 2005/06 national household survey; government financial accounts; and customs and excise trade statistics. The data was reconciled using cross-entropy estimation techniques (see Robinson, Cattaneo and El-Said, 2001). The estimation code and data is available from the authors.

period (t-1). M in the first period (t=1) is calibrated to reproduce the observed migration rate λ from the population census by multiplying observed relative wages by a compensating wage differential μ so that the second term in the migration function is unity.[5] While the direction of migration flows is predetermined by census data, their magnitudes vary with relative wages. In equation (9), if, over time, wages in region r' rise faster than in region r then M rises above its base rate λ. This is subject to the elasticity τ reflecting the responsiveness of migration rates to changing relative wages. Ultimately, total labor supply L in a region depends on labor supply in the previous period; an exogenous population growth rate σ; and the sum of all migration flows to and from other regions (eq. [10]).

The model endogenously determines the national rate of capital accumulation and supply of capital K (eq. [11]). The level of investment from the previous period is converted into new capital stocks using a fixed capital price κ. This is added to previous capital stocks after applying a fixed rate of depreciation π. New capital is allocated to regions and sectors endogenously in order to equalize capital returns. Since migrant workers tend to raise the relative returns to capital in their destination region, new migrants to a region will attract a larger allocation of new capital stocks and cause a faster rate of capital accumulation in that region.

Agglomeration effects and technical change

TFP is represented by the production function's shift parameter α (eq. [1]). Three factors determine the rate of unbiased technical change in the model (eq. [12]). The first is an exogenous growth rate γ that is calibrated so that overall GDP growth matches observed rates. The second factor is endogenous sectoral factor reallocations, as factors move from lower to higher productivity sectors/regions in response to changing output and factor demands. Finally, the third factor accounts for agglomeration effects caused by changes in the density of economic activity within a region. Following Henderson and Wang (2005), we assume that agglomeration spillovers are a positive function of a region's population density. More specifically, if the total labor supply in region r in time period t rises relative to the previous period then the final term in the technical change equation (eq. [12]) is greater than one and the region's overall level of TFP rises (i.e., positive spillovers occur in all sectors). The elasticity ε governs the size of

[5] For example, the population census reports that 11,750 workers migrate each year from southern rural areas to Kampala, which is equivalent to 0.24 percent of the rural South's total labor force of 4.8 million workers (λ = 0.0024 in eq. [9]). According to UNHS3, Kampala workers earn US$1723 on average each year while southern rural workers earn US$446, implying an initial wage ratio of 3.86. The compensating wage differential for this regional pairing is the inverse of the initial wage ratio (μ = 0.26) such that M and λ are initially equal.

agglomeration effects and is assigned the value 0.08 based on estimates reported in Rosenthal and Strange (2004).[6]

Combined with the model's treatment of internal migration, this specification of agglomeration effects implies that a region's TFP expands relative to other regions if it is net recipient of migrant workers. Moreover, accelerating exogenous TFP growth in a particular region increases its factor returns, causing it to attract a larger number of migrant workers and creating additional positive agglomeration effects. Given the sparse population of rural areas and the concentration of industry in urban areas, we only allow agglomeration in the model's three urban regions. The model therefore captures the potentially virtuous cycle of migration and agglomeration associated with urban-led growth (World Bank, 2008).

Extensions to the Uganda model

The simple model illustrates the functioning of migration and agglomeration effects in our analysis. However, the Uganda model drops some of the simple model's assumptions.[7] We use constant elasticity of substitution (CES) production functions that allow factor substitution based on relative factor prices (i.e., δ is no longer fixed). The model disaggregates GDP across 67 sectors in each of the 5 regions. Intermediate demand in each sector, which was excluded in the simple model, is determined by fixed technology coefficients. Regional labor markets are further segmented across three occupation-based categories capturing sector-specific skill-intensities. Full employment is still assumed for skilled and semi-skilled workers, but upward sloping supply curves capture underemployment amongst unskilled workers. Agricultural land is separated from capital, is region-specific, and grows at an exogenous rate.[8] Finally, capital is separated into 'formal' and 'informal' and is immobile across sectors.[9] New capital from past investment is allocated to regions/sectors according to profit rate differentials under a 'putty-clay' specification (see Dervis, De Melo and Robinson, 1982 p. 177).

The Uganda model still assumes national product markets for most commodities. However, interregional transaction cost margins now capture transport costs between rural/urban

[6] Calculations using econometric estimates of agglomeration effects on TFP indicate that agglomeration effects on output growth are relatively small, particularly in countries with rapid economic growth. For example, GDP per capita in East Asia and the Pacific grew by an average 7.6 percent per year during 2000-2006 (i.e., annual GDP and population growth of 8.6 and 0.9 percent respectively). Average annual urban population growth over this period was 3.2 percent. Using an agglomeration-productivity elasticity of 0.1, which is above the range of agglomeration effects of city size of 0.03-0.08 reported in Rosenthal and Strange (2004), agglomeration effects raised TFP in urban activities by 0.32 percent per year. Assuming urban activities account for 70 percent of all economic activity, then the agglomeration effect on economywide TFP was 0.22 percent per year (i.e., 0.32 × 0.70). This is only about 3 percent of annual per capita GDP growth (i.e., 0.22 / 7.6). Nonetheless, the absolute magnitude of this effect is quite large, adding an additional US$8 billion in economic growth each year. The implication of these calculations is that while agglomeration effects may be a crucial determinant of the spatial location of industries and people, they are not a major driving force for economic growth. Instead, the standard factors explaining aggregate growth – trade, technical change and investments in physical and human capital – appear to be more significant.

[7] The Uganda model and data and sensitivity analysis on key model parameters is available from the authors.

[8] Since land cannot migrate across regions, the second term in equation (10) is zero and total supply is exogenous.

[9] Using data from the industrial census and household survey, we assume that smallholder farmers, lower-skilled workers in own enterprises, and small businesses with fewer than ten employees are in the informal sector. Only formal capital profits pay corporate taxes and post-tax profits accrue mainly to higher-income urban households.

and north/south regions, thereby defining region-specific market prices and generating demand for trade and transport services. Regional markets exist for certain non-traded commodities (e.g., construction and trade services) for whom a unique price equates regional demand and supply. International trade is modeled by allowing national-level production and consumption to shift imperfectly between domestic and foreign markets depending on the relative prices of imports, exports and domestic goods (i.e., using constant elasticity of transformation and substitution functions). Uganda is a small country, so world prices are fixed and the current account balance is maintained by a flexible real exchange rate (i.e., a price index of tradable-to-nontradable goods). Production and trade elasticities are from Dimaranan (2006).

Households maximize a Stone-Geary utility function such that a linear expenditure system determines consumption and permits non-unitary income elasticities. The latter were econometrically estimated using UNHS3.[10] Households are disaggregated across the five regions and farm/non-farm and poor/non-poor groups. Within the southern rural region we further separate farm households into coffee/non-coffee producers. Households pay taxes to government based on fixed direct and indirect tax rates. Tax revenues finance exogenous recurrent spending resulting in an endogenous fiscal deficit (i.e., public spending can crowd out private investment). Finally, the model includes a micro-simulation module in which each household in UNHS3 is linked to its corresponding representative household in the CGE model. Changes in households' real consumption spending on each commodity are passed down from the model to the survey, where total per capita consumption and poverty measures are recalculated.

The model captures the sectoral and spatial structures and linkages of the Ugandan economy. It includes the benefits of agricultural growth cited by the proponents of agriculture-led development, such as agriculture's upstream and downstream production/demand growth linkages and export opportunities. It also addresses constraints to agriculture, including income- and price-inelastic demand for agricultural products. Similarly, the model's treatment of migration and agglomeration effects incorporates justifications for urban-led development, particularly the accelerated factor accumulation and technical change caused by the rising density of urban populations. The model's specification and empirical calibration therefore allow us to estimate and contrast regional growth and equity effects associated with agriculture- and urban-led growth scenarios in Uganda.

III. Model Results Comparing Alternative Growth Scenarios

Three investment scenarios are modeled: (i) a transport corridor connecting major northern and southern urban centers; (ii) accelerated growth in Kampala; and (iii) improved rural agricultural productivity. A baseline scenario is first developed to provide a counterfactual against which these alternative scenarios can be compared.

[10] Estimated income elasticities are consistent with Engel's Law (i.e., less than one for most food crops and greater than one for livestock products, processed foods and durable goods).

Baseline scenario

In the baseline scenario, growth in labor and land supply, migration and TFP during 2005-2015 are based on trends for 1992-2005. Uganda's national population and labor supply grow at three percent per year, implying that the national dependency ratio remains constant. Exogenous labor supply growth rates are the same in all regions ($\sigma = 0.03$ in eq. [10]), but total supplies diverge as workers migrate between regions. As described in Section II, the model initially tracks observed migration flows from the population census. In 2005 Kampala had a net annual inflow of 19,200 migrants (4 percent of its workforce) with most migrants coming from rural areas (64 and 23 percent from South and North respectively). Net in-migration causes population growth in Kampala to accelerate, leading to positive agglomeration effects and higher TFP growth. Exogenous TFP growth in the nonagricultural sectors is also higher in Kampala ($\gamma = 0.03$ in eq. [12]) than in rural areas (0.0125) or urban centers in South (0.02) or North (0.015). Exogenous agricultural productivity declines ($\gamma = -0.01$) and regional land expansion is below population growth ($\sigma = 0.02$ in eq. [10]). This baseline calibration reflects slower agricultural and income growth and stagnant poverty reduction in rural areas and in the northern region over the last decade.

Under the above baseline assumptions Uganda's economy grows at 6.1 percent per year, driven mainly by industry and services (see Table 5). Declining agricultural productivity is offset by increased supply of unskilled agricultural labor, such that overall agricultural GDP grows at only 3.4 percent. Slow agricultural and rural nonfarm growth raises food prices and lowers real consumption growth for rural households relative to initial year values.

[Insert Table 5 around here]

Growth is unevenly distributed, with the north growing only a third as fast as Kampala (see Table 6). Strong industrial growth in Kampala widens regional wage gaps, causing more workers to migrate to the capital. Kampala's labor supply grows at an average 6.5 percent per year under the baseline, which is faster than national population growth. This increases the city's population density and causes positive agglomeration effects equal to an additional 0.5 percent TFP growth each year.[11] Rural labor supply also grows above three percent due to rising demand for agricultural products and the assumption of underemployed unskilled labor. This offsets the migration of higher skilled northern workers to southern urban centers. Outmigration does not, however, outweigh population growth and northern urban population densities still rise, causing positive agglomeration effects and faster TFP growth. However, agglomeration effects are small

[11] Kampala's 6.5 percent annual increase in total labor supply means that the ratio of current to previous period workforce is 1.065. The assumed gain in TFP is thus $(1.065)^{0.08} - 1 = 0.5\%$ (see eq. [12] and Table 6). Since national population growth is 3.0 percent each year, this means that inward migration in Kampala accounts for about 0.28 percent TFP growth each year (i.e., 3.5% / 6.5% × 0.5%).

compared to exogenous TFP growth, even in Kampala where there is large inward migration and where agglomeration effects account for only 12 percent of overall productivity growth.[12]

[Insert Table 6 around here]

The baseline scenario is consistent with current growth trends. The economy becomes increasingly concentrated within the southern urban centers, especially within Kampala. Although rural households benefit from economic growth, agriculture's poor performance causes below-average real consumption growth. There is thus rising rural-urban and north-south inequality in the baseline.

Scenario 1: Connecting northern urban centers with Kampala

The first investment scenario simulates an improved transport corridor connecting northern and southern urban centers. This is captured through two adjustments to the baseline scenario. First, northern transaction cost margins capture the cost of supplying goods to southern markets and generate demand for northern trade services. The scenario assumes that the corridor increases northern traders' productivity relative to the baseline scenario. Exogenous TFP growth in the northern urban trade sector is increased substantially (γ rises from 0.02 to 0.11 in eq. [12]), thus lowering the price of northern trade services and reducing interregional transaction costs. Traders in northern rural areas also benefit from the transport corridor, albeit to a lesser extent (γ rises from 0.0125 to 0.0575). Secondly, we assume that overall nonagricultural productivity rises in northern urban areas because of the corridor (γ rises from 0.015 to 0.05).

Increasing traders' productivity causes substantial growth in the northern urban trade sector. A smaller acceleration takes place in northern rural areas. Consequently, the price of trade services falls by a quarter in northern rural areas and a half in northern urban centers. This benefits northern manufacturing, whose products are already traded with the south, but whose market opportunities improve dramatically. Rural nonfarm activities also benefit from lower transaction costs and faster northern urban growth. Overall, the GDP growth rate for northern urban region doubles under the Corridor scenario (see Table 7). Agricultural growth increases only slightly in northern rural areas because demand-linkages remain constrained by low productivity. Consequently, the northern rural growth acceleration remains small.

[Insert Table 7 around here]

The corridor increases northern wages (see Table 8), causing a reversal in migration flows from northern to southern regions, but does not reverse net migration to Kampala, which

[12] As discussed in Section II, TFP growth in the model is determined by an exogenous technical change; endogenous agglomeration effects; and endogenous changes in labor demand towards higher productivity sectors. For example, exogenous technical change and agglomeration effects generate 3.0 and 0.5 percentage points of Kampala's annual TFP growth rate of 4.27 respectively (see Table 6 and footnote 11). Sectoral shifts in labor demand therefore account for the remaining 0.75 percentage points (i.e., 3.00 + 0.52 + 0.75 = 4.27).

has a workforce ten times that of the two northern urban centers. Rising northern urban population densities generate positive agglomeration effects, but these are small compared to exogenous TFP increases (see Table 7). Thus, household welfare changes are significant only in the north, where average household welfare (as measured using per capita 'equivalent variation') rises by an additional 0.8 percentage points per year, from 2.4 percent per year under the baseline scenario to 3.2 percent under the Corridor scenario (see Table 9). These welfare changes are also reflected in poverty outcomes (see Table 10). Poverty declined under the baseline scenario from 31.0 to 24.6 percent during 2005-2015. Under the Corridor scenario, poverty declines further to 23.2 percent, due to increased participation of the northern poorer population in the national growth process. As a result, there are 500,000 fewer people living below the poverty in 2015 under the Corridor scenario than there were under the baseline scenario.

[Insert Tables 8, 9 and 10 around here]

Scenario 2: Investing in metropolitan Kampala

The second scenario allocates investment to Kampala, with the intention of generating enough growth at the national level that other regions also benefit (possibly by increasing employment opportunities for migrant workers). Government spending is increased by 1.5 percentage points each year during 2005-2015 (i.e., about 0.25 percent of GDP). To calculate the direct impact of this additional spending on TFP, we apply a simple spending-to-TFP elasticity. Under the baseline scenario, the ratio of annual TFP growth (1.6 percent) to annual government spending growth (6.0 percent) was 0.27 (see Tables 5 and 7). We apply this elasticity to new government spending and weight it by Kampala's contribution to national GDP in order to arrive at an exogenous TFP increase for Kampala's nonagricultural sectors of 1.3 percentage points each year (γ rises from 0.03 to 0.043 in eq. [12]).[13] As discussed in Section II, we assume that Uganda's government borrows domestically to finance additional spending, thus increasing the fiscal deficit and crowding-out private investment.

Faster TFP growth raises Kampala's GDP growth rate from 10.4 to 12.7 percent per year (see Table 7). Since Kampala is a quarter of Uganda's economy, its expansion raises national GDP growth rate by 0.7 percentage points each year. Labor demand rises in the capital city, thus widening the regional wage gap and encouraging greater migration to Kampala (see Table 8). These new migrants mainly come from rural areas in northern and southern regions. Additional in-migration is considerable with new migrants accounting for 8 percent of Kampala's workforce by 2015. This contributes to the rising population density of Kampala, which has positive agglomeration gains.

Faster economic growth in Kampala also reduces growth in GDP in other regions, however, due to increased migration, regional trade competition, and, to a lesser extent, through

[13] Kampala contributes 31.1 percent to national nonagricultural GDP. The increase in government spending is multiplied by the spending-to-TFP elasticity and weighted by Kampala's share of national GDP to arrive at the acceleration in Kampala's nonagricultural TFP growth rate ($1.5 \times 0.27 / 0.31 = 1.3$).

negative agglomeration effects. Nonetheless, slower GDP growth does not reduce welfare outside of Kampala because it is offset by the outmigration of workers and their families, which raise per capita incomes for remaining households (see Table 6). More importantly, however, faster growth in Kampala raises demand for goods produced in other regions, such as food and agriculture, whose prices rise relative to the baseline scenario (see Table 5). Demand linkages cause agricultural growth to accelerate and rural incomes to rise. Increased production in Kampala also lowers prices of manufactures, which benefits consumers in other regions, especially urban households which spend a larger share of their incomes on manufactured goods. Ultimately, most benefits accrue to Kampala households, but only a small share of these fall below the poverty line (see Tables 9 and 10). Thus, while per capita EV amongst poor households rises by 0.65 percentage points each year, it rises by 1.04 percentage points for non-poor households. This means that concentrating growth in Kampala worsens national inequality.

Scenario 3: Improving agricultural productivity in rural areas

Uganda's agricultural sector lags behind the rest of the economy, and northern crop yields for most major crops are especially low. Improving farm technologies is thus a key objective for agricultural policies. In the third investment scenario we increase agricultural TFP growth in both northern and southern rural areas. As with the Kampala scenario, government recurrent spending increases by 1.5 percentage points per year. Using the spending-to-TFP elasticity of 0.27 and weighting for agriculture's contribution to national GDP, agriculture's TFP growth rate rises by 1.3 percentage points (γ rises from -0.01 to 0.003 in eq. [12]).[14] As before, additional government spending widens the fiscal deficit and crowds-out private investment. The Kampala and Agriculture scenarios are comparable since we impose the same sized shock on the model and assume the same financing mechanism.[15]

Raising agricultural productivity raises agricultural growth by 1.25 percentage points each year (see Table 5). Export crops grow most rapidly, because food crops face more stringent market constraints, which cause their prices to decline substantially when production expands. By contrast, export crops rely on foreign markets, where demand constraints are usually less severe. Since agriculture is a large part of the economy, its expansion causes national GDP growth to rise by 0.6 percentage points per year.

Not surprisingly, most growth occurs in rural regions where agriculture is most important (see Table 7). Urban regions also benefit from agricultural growth, which provides inputs into the agro-processing sectors. Demand-linkages from higher rural incomes also raise demand for

[14] Agriculture contributes the same 31.1 percent to total GDP as Kampala does to nonagricultural GDP. Therefore, the exogenous increase in TFP growth is the same 1.3 percentage points in both scenarios, although the sectors affected by this increase differ.

[15] The Corridor scenario is smaller than the Kampala and Agriculture scenarios. Even though TFP in the regions and sectors affected by the corridor grow by an additional 5.1 percentage points each year, they initially contribute only 0.8 percent to national GDP. Applying the simple spending-to-TFP elasticity, this additional TFP growth requires an annual increase in public spending by 0.15 percentage points ($5.1 / 0.27 \times 0.008 = 0.15$). The Corridor scenario is therefore ten percent of the size of either the Kampala or Agriculture scenarios. However, while we cannot compare the magnitude of the Corridor scenario to the other two scenarios, we can compare their distributional implications.

manufactured goods, benefiting urban sectors and causing rural households to diversify into nonfarm activities. Since rural households spend more of their incomes on locally produced goods, import demand is less than in the Kampala scenario. Ultimately, however, the Agriculture scenario generates slightly less economic growth at the national-level than the Kampala scenario because rural growth does not crowd-in as much private investment as urban industrial growth, and agricultural growth does not generate large agglomeration effects or increase exports as much. Falling agricultural prices (due to demand-constraints) and higher urban employment opportunities (due to demand-linkages) cause rural wages to fall relative to urban wages (see Table 8). Increasing agricultural productivity therefore accelerates rural-to-urban migration. However, rural welfare improves more in this scenario because the dominant share of the returns to agricultural growth accrues to poorer and rural households (see Table 9). Urban households, including those in Kampala, benefit from lower food prices and more nonagricultural employment opportunities in agro-processing, especially in the north. Accordingly, there is a large decline in national poverty, despite the Agricultural scenario's smaller effect on national growth (see Table 10), because most poor households reside in rural areas and are reliant on agricultural incomes.

IV. Conclusions

The three scenarios analyzed in this paper (north-south corridor, Kampala-based growth, and investments in agricultural productivity) suggest that the sector and location of investments will be a major determinant of growth, poverty and regional outcomes in Uganda. Reducing north-south transaction costs has only modest effects on regional growth and poverty reduction. Northern households benefit, but national outcomes are limited by the small size of northern urban centers. The benefits of the transport corridor are further constrained by low agricultural productivity, which limits northern farmers' ability to take advantage of new market opportunities.

Investments to accelerate growth in Kampala beyond its already high growth rate over the last decade produce substantial urban growth, but do not generate sufficient economywide growth linkages to substantially improve conditions in rural areas and the northern region. Too few jobs are created for rural-urban migration to have a discernable impact on national poverty reduction, even with increases in TFP driven by positive agglomeration effects. A Kampala-driven growth strategy thus widens the north-south divide and the northern region remains isolated from the national growth process.

The third alternative, improving agricultural productivity, does have a positive impact on growth and poverty reduction in northern Uganda, but is less effective than urban development in generating national growth. Yet, agricultural growth leads to significant and broad-based welfare improvements, especially for poorer and rural households.

Overall, the results indicate that if Uganda continues on its current growth path of Kampala- centered growth, regional inequality will worsen and poverty rates will remain very

high in the northern region. This adverse outcome results in spite of an assumption that increased urbanization leads to gains in TFP from agglomeration effects. Only with rapid productivity growth in agriculture, however, is the income gap between north and south substantially narrowed and overall poverty rates in the north reduced. Of course, agricultural productivity growth alone, without substantial urban income growth, would encounter major demand constraints. Thus, increasing agricultural productivity, combined with continued urban investments, should be a major component of any growth strategy aimed at substantially lowering poverty in Uganda and reducing regional income inequalities.

More generally, while urbanization and industrialization are the general pattern of long-term economic growth and structural transformation, our analysis strongly suggests that, for low-income countries where agriculture is still a large share of GDP and where poverty remains concentrated in rural areas, rural-urban migration and positive urban agglomeration effects may be insufficient for rapid reductions in rural and overall poverty. Moreover, urban-led development strategies may exacerbate regional inequities, with important development and political economy implications. Further analysis is, however, needed to better understand agglomeration economies within particular sectors and developing country contexts, especially the quantity and types of public investments needed to enhance them. Such analyses, along with investigations of the spatial implications of alternative growth strategies through general equilibrium analyses of other poor developing countries, is crucial to avoid potentially costly pendulum-like swings in development policy.

References

Adelman, Irma. 1984. "Beyond Export-led Growth." *World Development* 12(9): 937-949.

Appleton, Simon. 2001. "Changes in poverty and inequality." In *Uganda's Recovery: the Role of Farms, Firms and Government*, eds. Paul Collier and Ritva Reinnika. Washington, DC: World Bank.

Collier, Paul and Ritva Reinnikka. 2001. "Reconstruction and Liberalization: An Overview." In *Uganda's Recovery: the Role of Farms, Firms and Government*, eds. Paul Collier and Ritva Reinnika. Washington, DC: World Bank.

Deininger, Klaus and John Okidi. 2003. "Growth and Poverty Reduction in Uganda, 1999-2000: Panel Data Evidence." *Development Policy Review* 21: 481-509.

Dervis Kemal, Jaime De Melo and Sherman Robinson. 1982. *General Equilibrium Models for Development Policy*. New York: Cambridge University Press.

Diao, Xinshen, Peter Hazell, Danielle Resnick and James Thurlow. 2007. "The Role of Agriculture in Development: Implications for Sub-Saharan Africa." Research Report no. 153, International Food Policy Research Institute, Washington DC.

Dimaranan, Betina, ed. 2006. *Global Trade, Assistance, and Production: The GTAP 6 Data Base*, Center for Global Trade Analysis, Purdue University.

Fujita, Masahisa, Paul Krugman and Anthony J. Venables. 2001. *The Spatial Economy: Cities, Regions and International Trade*. Cambridge, MA: MIT Press.

Haggblade, Steven, Peter Hazell and Thomas Reardon. 2007. *Transforming the Rural Non-farm Economy*. Washington, DC: Johns Hopkins University Press.

Henderson, J. Vernon and Hyoung Gun Wang. 2005. "Aspects of the Rural-Urban Transformation of Countries." *Journal of Economic Geography* 5:23-42.

Johnson, Bruce F. and John W. Mellor. 1961. "The Role of Agriculture in Economic Development." *American Economic Review* 51(4): 566-593.

Kuznets, Simon. 1966. *Modern Economic Growth: Rate, Structure and Spread*. New Haven and London: Yale University Press.

Lewis, W. Arthur. 1954. "Economic Development with Unlimited Supplies of Labor." *The Manchester School of Economics and Social Studies* 22(2): 139-191.

Martin, Will and Devashish Mitra. 2001. "Productivity Growth and Convergence in Agriculture versus Manufacturing." *Economic Development and Cultural Change* 49 (2): 403-422.

Okidi, John A., Sarah Ssewanyana, Lawrence Bategeka and Fred Muhumuza. 2005. "Distributional and Poverty Impacts of Uganda's Growth: 1992 to 2003." Research Series no. 46, Economic Policy Research Center, Kampala, Uganda.

Ravallion, Martin and Gaurav Datt. 1996. "How Important to India's Poor is the Sectoral Composition of Economic Growth?" *The World Bank Economic Review* 10(1): 1-26.

Robinson, Sherman, Andrea Cattaneo and Moataz El-Said. 2001. "Updating and Estimating a Social Accounting Matrix Using Cross Entropy Methods." *Economic Systems Research* 13(1): 47-64.

Rosenthal, Stuart S. and William C. Strange, "Evidence on the Nature and Sources of Agglomeration Economies." In *Handbook of Regional and Urban Economics: Volume 4*, eds. Henderson, J. Vernon and Jacques-Francois Thisse. Amsterdam: Elsevier.

Timmer, C. Peter. 2002. "Agriculture and Economic Development." In *Handbook of Agricultural Economics: Volume 2*, eds. Bruce L. Gardner and Gordon C. Rausser. Amsterdam: Elsevier.

Uganda Bureau of Statistics. "Population and Housing Census 2002." http://www.ubos.org/.

_____. "Business Inquiry 2001/02." http://www.ubos.org/.

_____. "National Household Survey 2005/06." http://www.ubos.org/.

World Bank. 2007. *World Development Report 2008: Agriculture for Development*. Washington, DC: World Bank.

_____. 2008. *World Development Report 2009: Reshaping Economic Geography*. Washington, DC: World Bank.

TABLE 1

UGANDA'S POVERTY TRENDS

	1992/93	1999/00	2002/03	2005/06
National poverty headcount (%)	55.7	33.8	37.7	31.1
Rural areas	59.7	37.4	41.7	34.3
Urban areas	27.8	9.6	12.2	13.8
Central region	45.6	19.7	22.3	14.8
Eastern region	58.8	35.0	46.0	36.5
Northern region	72.2	63.6	63.3	60.8
Western region	53.1	26.2	31.4	21.7

SOURCES. – Appleton, S. (2001); Okidi et al. (2005); Uganda Bureau of Statistics (2006).
NOTE. – Rural and urban poverty lines in the 2005/06 survey were US$121 and US$136 per person per year respectively. These poverty lines use the Uganda Bureau of Statistic's definition of urban areas, which includes small towns; for the CGE analysis, we define urban areas as centers with more than 50,000 people.

TABLE 2

UGANDA'S NATIONAL ECONOMIC STRUCTURE

	Share of total (%)				Export-intensity (%)	Import-intensity (%)
	GDP share	Employ-ment	Exports	Imports		
National GDP	100.0	100.0	100.0	100.0	8.6	17.6
Agriculture	31.1	79.3	40.3	2.9	14.5	2.2
Export crops	3.0	-	21.1	0.0	81.0	0.0
Manufacturing	8.5	1.5	28.7	79.0	9.7	41.2
Food processing	4.1	0.9	16.4	7.7	9.1	9.3
Other industry	15.5	4.3	2.7	0.8	6.0	4.3
Private services	44.9	15.0	28.3	17.4	10.0	11.3
Public services	14.1	2.8	0.0	0.0	0.0	0.0

SOURCE. – Uganda 2005 social accounting matrix.
NOTE. – Export-intensity is the share of exports in domestic production; import-intensity is the share of imports in domestic demand.

TABLE 3

UGANDA'S REGIONAL DEMOGRAPHIC AND ECONOMIC STRUCTURE

	Northern region		Southern region		Kampala	Uganda
	Rural	Urban	Rural	Urban		
Population (millions)	5.98	0.20	18.81	0.52	1.65	27.16
Population share (%)	22.0	0.7	69.2	1.9	6.1	100
Workers (millions)	1.48	0.04	4.80	0.16	0.48	6.96
Skilled	0.04	0.00	0.20	0.03	0.05	0.31
Semi-skilled	0.29	0.02	0.90	0.08	0.30	1.59
Unskilled	1.16	0.02	3.71	0.05	0.14	5.07
GDP per capita (US$)	147.4	220.7	271.1	1074.8	1098.4	310.0
Total GDP shares (%)	10.5	0.5	60.7	6.7	21.6	100
Agriculture	16.1	0.1	83.4	0.4	0.1	100
Export crops	21.8	0.0	78.2	0.0	0.0	100
Manufacturing	3.2	0.8	24.6	12.7	58.7	100
Agro-processing	3.8	1.0	27.9	15.4	51.9	100
Other industry	12.5	0.6	58.8	7.8	20.3	100
Private services	6.8	0.7	46.0	7.9	38.7	100
Public services	8.5	1.0	66.6	13.2	10.7	100

SOURCE. - Uganda 2005 social accounting matrix; Uganda Bureau of Statistics (2006).

TABLE 4

SIMPLE CGE MODEL EQUATIONS

Static model equations

Production function	$Q_{srt} = \alpha_{srt} \prod_f F_{fsrt}^{\delta_{fsr}}$		(1)
Factor payments	$W_{frt} \cdot \sum_s F_{fsrt} = \sum_s \delta_{fsr} \cdot P_{st} \cdot Q_{srt}$		(2)
Household income	$Y_{hrt} = \sum_{fs} \theta_{hf} \cdot W_{frt} \cdot F_{fsrt}$		(3)
Consumption demand	$P_{st} \cdot D_{hsrt} = \beta_{hsr} \cdot (1 - \upsilon_{hr}) \cdot Y_{hrt}$		(4)
Investment demand	$P_{st} \cdot I_{st} = \rho_s \cdot \sum_{hr} \upsilon_{hr} \cdot Y_{hrt}$		(5)
Labor market equilibrium	$\sum_s F_{fsrt} = L_{frt}$	*f is labor*	(6)
Capital market equilibrium	$\sum_{rs} F_{fsrt} = K_{ft} \quad and \quad W_{frt} = W_{fr't}$	*f is capital*	(7)
Product market equilibrium	$\sum_{hr} D_{hsrt} = \sum_r Q_{srt} + I_{st}$		(8)

Regional labor migration

Migration rate	$M_{frr't} = \lambda_{frr'} \cdot \left(\mu_{frr't} \cdot \frac{W_{fr't-1}}{W_{frt-1}}\right)^{\tau}$	*f is labor*	(9)
Labor supply	$L_{frt} = L_{frt-1} \cdot (1 + \sigma_{fr}) + \sum_{r'} \left(L_{frt-1} \cdot M_{fr'rt} - L_{fr't-1} \cdot M_{frr't}\right)$		(10)

Capital accumulation

Capital supply	$K_{ft} = K_{ft-1} \cdot (1 - \pi) + \frac{P_{st-1} \cdot I_{st-1}}{\kappa}$	*f is capital*	(11)

Agglomeration effects

Technical change	$\alpha_{srt} = \alpha_{srt-1} \cdot (1 + \gamma_{sr}) \cdot \left(\frac{\sum_f L_{frt}}{\sum_f L_{frt-1}}\right)^{\varepsilon}$	*f is labor*	(12)

Subscripts

f	Factors
r	Regions
s	Sectors
t	Time periods

Endogenous variables

D	Household consumption demand quantity
F	Factor demand quantity
I	Investment demand quantity
K	National capital supply
L	Regional labor supply
M	Migration rate between regions r and r'
P	Commodity price
Q	Output quantity
W	Average factor return
Y	Total household income

Exogenous parameters

α	Production shift parameter (factor productivity)
β	Household average budget share
γ	Exogenous productivity growth rate
δ	Factor input share parameter
ε	Elasticity of productivity w.r.t. factor supply
θ	Household share of factor income
κ	Base price per unit of capital stock
λ	Base migration rate (share of origin's labor force)
μ	Compensating wage differential
π	Capital depreciation rate
ρ	Investment commodity expenditure share
σ	Exogenous factor supply growth rate
τ	Elasticity of migration rate w.r.t. wage differential
υ	Household marginal propensity to save

TABLE 5

MACROECONOMIC RESULTS

	Initial, 2005 (%)	Baseline scenario	Corridor scenario	Kampala scenario	Agriculture scenario
		Average annual growth rate, 2005-2015 (%)			
			Point deviation from baseline result		
Total GDP	100.0	6.11	0.06	0.67	0.60
Agriculture	31.1	3.44	0.05	0.13	1.25
Export crops	3.0	2.09	0.02	-0.19	1.85
Manufacturing	8.5	7.90	0.12	0.93	0.34
Other industry	15.5	7.11	0.01	0.27	-0.16
Private services	30.8	7.45	0.04	0.91	0.27
Public services	14.1	5.93	0.13	1.26	1.28
Public consumption	14.4	6.00	0.15	1.50	1.50
Private consumption	75.3	5.53	0.07	0.63	0.86
Rural households	53.0	4.69	0.09	0.36	0.91
Urban households	22.3	7.30	0.03	1.14	0.77
Investment demand	22.6	7.16	-0.02	-0.04	-0.41
Export demand	14.1	7.26	0.00	0.53	-0.01
Import supply	-26.5	6.44	0.04	0.72	0.42
		Final year value, 2015			
Consumer price index	1.000	1.035	1.037	1.029	1.017
Food price index	1.000	1.157	1.160	1.161	1.084
Real exchange rate	1.000	0.984	0.986	0.953	1.000

SOURCE. – Results from Uganda CGE model

NOTE. – Exchange rate index is foreign currency units per local currency unit (decline is appreciation).

TABLE 6

MIGRATION AND AGGLOMERATION EFFECTS IN BASELINE SCENARIO

	Uganda	Northern (rural)	Northern (urban)	Southern (rural)	Southern (urban)	Kampala (metro)
Annual GDP growth rate (%)	6.11	3.29	3.74	4.64	5.82	10.44
Labor employment growth rate	4.09	4.11	1.22	3.90	1.92	6.54
Skilled workers	3.00	1.87	1.27	2.38	2.51	6.12
Semi-skilled workers	3.00	1.89	0.30	2.03	1.62	6.73
Unskilled workers	4.48	4.66	2.10	4.38	2.13	6.26
Agricultural land expansion rate	2.00	2.00	2.00	2.00	2.00	2.00
Capital accumulation rate	5.91	5.07	6.96	5.73	5.05	6.45
TFP growth rate	1.64	-0.16	1.96	0.83	1.92	4.27
Due to agglomeration effects	-	-	0.10	-	0.16	0.52
Annual migration inflows (workers)	0	-5,546	-805	-15,055	-1,883	23,289
Migrant share of labor force (%)	0	-0.30	-1.79	-0.25	-1.07	3.51

SOURCE. – Results from Uganda CGE model

NOTE. – Growth rates, migration rates and inflows are annual averages for 2005-2015.

TABLE 7

REGIONAL GROWTH AND AGGLOMERATION EFFECTS

	Average annual employment growth rate, 2005-2015 (%)			
	Baseline scenario	Point deviation from baseline result		
		Corridor scenario	Kampala scenario	Agriculture scenario
National GDP	6.11	0.06	0.67	0.60
Labor employment	4.09	0.12	0.51	0.92
Capital accumulation	5.91	-0.01	0.00	-0.12
TFP growth	1.64	0.03	0.36	0.30
Northern rural GDP	3.29	0.74	-0.18	0.93
Labor employment	4.11	0.41	0.39	0.78
Capital accumulation	5.07	0.68	-0.54	-0.24
TFP growth	-0.16	0.58	-0.21	0.76
Northern urban GDP	3.74	7.60	-0.42	0.43
Labor employment	1.22	2.45	-0.70	-0.01
Capital accumulation	6.96	4.58	-0.03	0.06
TFP growth	1.96	5.65	0.02	0.37
Agglomeration	0.10	0.21	-0.06	0.00
Southern rural GDP	4.64	-0.02	-0.11	0.85
Labor employment	3.90	0.05	0.54	1.09
Capital accumulation	5.73	-0.05	-0.32	-0.18
TFP growth	0.83	-0.02	-0.12	0.73
Southern urban GDP	5.82	-0.01	-0.53	0.33
Labor employment	1.92	0.01	-0.52	0.04
Capital accumulation	5.05	-0.04	-0.73	0.09
TFP growth	1.92	0.00	-0.23	0.33
Agglomeration	0.16	0.00	-0.04	0.00
Kampala GDP	10.44	-0.13	2.33	0.14
Labor employment	6.54	-0.16	0.89	0.17
Capital accumulation	6.45	-0.08	0.73	-0.06
TFP growth	4.27	-0.05	1.89	0.14
Agglomeration	0.52	-0.01	0.08	0.01

SOURCE. – Results from Uganda CGE model.
NOTE. – Agricultural land expansion is two percent per year in all regions and simulations. Agglomeration effects on TFP are only modeled for urban areas (see Section II).

TABLE 8

REGIONAL WAGE RATIOS AND MIGRATION FLOWS

	Initial value, 2005	Final year value, 2015			
		Baseline scenario	Corridor scenario	Kampala scenario	Agriculture scenario
Wage ratios					
Rural / Urban	0.253	0.246	0.245	0.233	0.230
North / South	0.753	0.745	0.764	0.749	0.753
Annual migration inflows (workers)					
Northern rural	-4,498	-6,594	-7,451	-10,162	-7,625
Northern urban	-951	-660	2,115	-1,172	-653
Southern rural	-12,298	-17,811	-17,638	-27,781	-19,730
Southern urban	-1,424	-2,341	-2,304	-4,275	-2,180
Kampala	19,170	27,407	25,278	43,391	30,188

SOURCE. – Results from Uganda CGE model.

TABLE 9

PER CAPITA WELFARE (EQUIVALENT VARIATION) RESULTS

	Initial per capita consumption, 2005 (US$)	Average annual EV growth rate, 2005-2015 (%)			
		Baseline scenario	Point deviation from baseline result		
			Corridor scenario	Kampala scenario	Agriculture scenario
All households	254	4.03	0.11	1.01	1.49
Poor households	92	2.15	0.32	0.65	2.06
Non-poor households	363	4.26	0.07	1.04	1.38
Northern regions	127	2.41	0.83	0.58	1.50
Rural areas	118	2.10	0.68	0.50	1.48
Major urban centers	376	6.39	0.59	1.77	1.72
Southern regions	238	3.26	0.04	0.62	1.49
Rural areas	221	3.11	0.04	0.59	1.48
Major urban centers	860	5.33	0.05	1.27	1.52
Kampala	920	4.57	0.06	1.79	1.36

SOURCE. – Results from Uganda CGE model.

TABLE 10

POVERTY RESULTS

	Initial value, 2005	Baseline scenario	Deviation from baseline result		
			Corridor scenario	Kampala scenario	Agriculture scenario
		Final year poverty headcount, 2015 (%)			
National poverty headcount (%)	31.01	24.55	-1.36	-2.24	-6.02
Rural areas	34.29	27.34	-1.38	-2.54	-6.66
North region	64.10	57.61	-4.65	-2.98	-9.05
South region	26.84	19.78	-0.56	-2.43	-6.06
Urban areas	12.96	9.17	-1.27	-0.58	-2.47
North region	38.81	30.77	-6.31	-1.75	-6.57
South region	7.14	4.31	-0.14	-0.32	-1.55
		Final year number, 2015 (millions of people)			
Population (millions of people)	27.16	36.50	0.00	0.00	0.00
Poor population (millions of people)	8.42	8.96	-0.50	-0.82	-2.20

SOURCE. – Results from Uganda CGE model.

NOTE. – Rural and urban poverty lines in the 2005/06 survey were US$121 and US$136 per person per year respectively. These poverty lines use the Uganda Bureau of Statistic's definition of urban areas, which includes small towns; for the CGE analysis, we define urban areas as centers with more than 50,000 people.