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Productive public investment in agriculture for economic recovery with rural well-being: an analysis of prospective scenarios for Uganda

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Productive public investment in agriculture for economic recovery with rural well-being: an analysis of prospective scenarios for Uganda

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Preface

The continued advance of the COVID-19 pandemic, and uncertainty about its duration and impacts on health and economies, have created an unprecedented global crisis, inhibiting employment, hindering the fight against poverty, food insecurity and malnutrition, and obstructing efforts to reduce inequality.

While the crisis may not have compromised overall food supply nor severely disrupted agricultural supply chains in Uganda, there is concern that the overall reduction in income will affect household access to food and economic activity and, consequently, increase the number of poor and food-deprived people. Some disruption to value chains may be unavoidable, particularly the supply of inputs for agricultural production, and international trade has been temporarily disrupted by the effect of the pandemic on countries and international transport networks. In addition, agricultural labour supply and demand have diminished due to the pandemic's impacts on workers' health and mobility, and consumers are finding it difficult to purchase some products, largely because of loss of income due to unemployment. There is also the potential for instability in food prices.

Uganda is undergoing an economic transformation and agriculture, as a main contributor to gross domestic product (GDP) and employment generation, plays a major role in this process. The National Development Plan (NDP) III, which was established prior to the pandemic, describes how the country aims to overcome bottlenecks and guides the country towards a middle-income status through sustainable industrialization, employment and wealth creation. The agriculture sector, in particular, is expected to play a central role in the NDP III; the government's vision for the sector is captured in one of its 18 strategic programmes, which focuses on agro-industrialization. However, the NDP III was developed in a context where the COVID-19 pandemic, with all its health, economic and social repercussions, did not yet exist. The implementation of the plan will now have to consider the effects of the pandemic and ensure that it is well-aligned with recovery strategies for the post-COVID-19 era.

The Food and Agriculture Organization of the United Nations (FAO) is committed to supporting the Government of Uganda in addressing the impacts of COVID-19 on the agrifood system both during the pandemic and the post-pandemic recovery. FAO's Agrifood Economics Division in Rome and the FAO Country Office in Uganda have proposed strategic outputs that will provide the Ugandan Government with critical information for strengthening its policies and strategies. These outputs are based on up-to-date information and assessments to ensure the success of measures undertaken to maintain food production and food security during the pandemic and the post-COVID-19 recovery period, contributing to FAO corporative initiatives such as Hand-in-Hand.[1]

This study was carried out within the framework of FAO's support for Uganda, and, as such, it is one of the outputs envisaged. It highlights how public investments can drive growth in agrifood production, with favourable impacts on the economy, well-being and poverty, particularly in rural areas. Using a modelling tool to represent the Ugandan economy, with its multiple sectors and current fiscal constraints, the study ranks the agricultural subsectors that are likely to generate the greatest socio-economic benefits, maximizing the cost-effectiveness of using public resources to improve productivity. This evidence may be vital for decision-making regarding agricultural investment in the post-COVID-19 era within existing national development plans.

[1] Hand-in-Hand is FAO's evidence-based, country-led and country-owned initiative to accelerate agricultural transformation and sustainable rural development to eradicate poverty (SDG 1) and end hunger and all forms of malnutrition (SDG2). The initiative prioritizes countries where national capacities and international support are the most limited or where operational challenges, including natural- or man-made crises, are the greatest. For more details see: www.fao.org/hand-in-hand/en

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The follow-up provided by colleagues from the Office of FAO in Uganda, including Antonio Querido (FAO Representative in Uganda), Priya Gujadhur (Deputy Representative), Jean Marie Byakweli (Policy Officer), Leila Shamsaifar (Resource Mobilization and Partnerships Specialist) and Dominique Reumkens (Associate Professional Officer), was instrumental in coordinating comments and suggestions from MAAIF and NPA officials. This information was provided in writing and through various virtual technical discussion and consultation meetings. These colleagues also provided valuable technical feedback and comments, which helped the authors to adapt this study to the Ugandan context and to align it to FAO's programme of work in the country.

The support of Ruth Raymond, in editing the final draft of this study, and of Daniela Verona, in adapting it to the series' format, is also appreciated.

The study was made possible through funding from the Regular Programme and the Technical Cooperation Programme of FAO; specifically and respectively, the Multidisciplinary Fund Project "Strengthening governments' capacity for enabling an economic and social recovery post-COVID-19 though investments in agrifood sectors" and the Monitoring and Analysing Food and Agricultural Policies (MAFAP) programme.

Acronyms

CET	constant elasticity of transformation
CGE	computable general equilibrium
FAO	Food and Agriculture Organization of the United Nations
GDP	gross domestic product
GFCF	gross fixed capital formation
IMF	International Monetary Fund
MAAIP	Ministry of Agriculture, Animal Industry and Fisheries
MAFAP	Monitoring and Analysing Food and Agriculture Policies (FAO)
MTEF	Medium-Term Expenditure Framework
MTFF	Medium-Term Fiscal Framework
NPA	National Planning Authority
NDP	National Development Plan
NPV	net present value
RESAKSS	Regional Strategic Analysis and Knowledge Support System
SAM	social accounting matrix
TFP	total factor productivity
UBOS	Uganda Bureau of Statistics
UNHS	Uganda National Household Survey
USD	United States dollar

Executive summary

Economic and social reasoning suggests that agriculture can play a very important role in Uganda's economic recovery and in improving people's well-being in the post-COVID-19 era, with policies and investments that are coherent with the country's national development plans. As part of FAO's multidisciplinary fund project "Strengthening governments' capacity for enabling an economic and social recovery post-COVID-19 though investments in agrifood sectors," and in collaboration with FAO's Monitoring and Analysing Food and Agriculture Policies (MAFAP) programme and the Hand in Hand Initiative in Uganda, the FAO Agrifood Economics Division and Country Office in Uganda have worked with Ugandan Government authorities, in particular the National Planning Authority (NPA) and the Ministry of Agriculture, Animal Industry and Fisheries (MAAIF), among others, to develop this technical study.

The study addresses the following questions:

- Can public investment that promotes productivity in agriculture drive growth in agrifood production, with positive impacts on the economy as a whole and on rural poverty reduction, helping to achieve the objectives of national development plans?
- Which sectors or branches of agriculture will generate the most significant socio-economic payoffs from this public investment, thus maximizing its cost-effectiveness?

To answer these questions, the study used an economy-wide model of the Ugandan economy, including its multisectoral diversity and current fiscal constraints, to develop scenarios designed to assess the potential effects of government investment to increase productivity in selected agricultural sectors. The scenarios focused on public investment because, in a context characterized by recession, private investors are more risk-averse and the government must intervene through public policy to create an environment that is conducive to private investment.

The study found that new public investment in productive agriculture representing 0.25 percent of GDP (on average, about 373 billion in 2017 Uganda shillings) during 2023–2025 will generate positive impacts. In general, economic growth and the welfare of households – as measured by consumption – will be positively impacted to different degrees depending on the sector receiving the investment. The agricultural sectors targeted by government investment will increase their output (and food prices will fall), and this will stimulate growth in non-agricultural sectors, both by increasing demand for non-agricultural products and by lowering input prices and fostering upstream processing. Lower food prices will have a significant impact, since food represents a relatively large proportion of the consumption basket of the poorest households. Furthermore, labour income for rural households will increase with productivity growth, and this will reduce the rural poverty rate in 2030 by 0.02 to 0.18 percentage points. The option of foreign borrowing, when used alone, will allow the new investment to generate the greatest short-term economic recovery (versus domestic borrowing and direct taxation), but using a mix of funding sources will be more realistic in the context of Uganda.

A heterogeneous picture emerges if sectors are ranked according to the impact of investing the same amount of resources in each case: the sugar cane sector leads in three out of five variables (private consumption, total gross domestic product [GDP] and agrifood GDP), but in terms of impact on rural poverty reduction (the fourth variable), the cassava and potato sectors take the lead and, in terms of exports (the fifth variable), the tea, coffee, cocoa and vanilla sectors are out in front. Sectors such as cattle, bananas and goats also receive high scores for their impacts on private consumption and GDP and are potential recipients of investments that promote economic recovery, but only investment in the banana sector has the potential to significantly reduce poverty.

These findings provide important information about Ugandan priorities under the NDP III and the government's vision for agriculture, as well as for economic recovery and increased well-being post-COVID-19. To foster agro-industrialization, the government has selected ten priority commodities (coffee, tea, fisheries, cocoa, cotton, vegetable oil, beef, maize, dairy and cassava). The findings from our study validate the importance of prioritizing certain sectors (i.e., cattle, coffee, maize, tea, cotton, cocoa and cassava), because investing in them is expected to have significant effects on at least one of the five variables used to establish rankings. However, our results also highlight other sectors (i.e., sugar cane, bananas and goats), which do not currently figure on the government's priority list, despite our analysis showing that they would be very cost-effective recipients of public investment.

The ranking of sectors presented in the study is just a starting point – albeit a key one – for more focused analysis. As a next step, it will be important to identify the geographical areas where investment in priority sectors could have the greatest socio-economic and environmentally-friendly impact, due to high production and poverty reduction potential (**where to invest**). Having identified priority sectors and priority areas with great potential, it will be critical to identify the specific investments that are needed. In this respect, it will be necessary to identify the component of primary production that should be promoted (**what to invest in**) and the amount of resources that are needed (**how much to invest**) to justify the budgets.

1 Introduction

Almost two years since the outbreak of COVID-19, the pandemic continues to pose challenges for many countries. Decision-makers are still addressing the health emergency that the pandemic has precipitated, particularly in parts of the developing world where it came a bit late but with force. There is growing awareness that, while health must remain the main priority, guaranteeing access to sufficient and nutritious food must be an integral part of the health response to the pandemic. This has prompted FAO to work with governments to ensure that pandemic response efforts keep food supply chains active and facilitate access to safe and nutritious foods.

At the same time, it is clear that economies must recover from the unprecedented economic recession caused by the measures put in place to contain COVID-19. The economic recession is impacting livelihoods, food security, nutrition and poverty, particularly for the most vulnerable people. *The State of Food Security and Nutrition in the World 2021* estimates that somewhere between 720 and 811 million people faced hunger in 2020 – up by as many as 161 million in a single year. Nearly one in three people in the world did not have regular access to adequate food in 2020. The increase in the level of food insecurity from 2019 to 2020 equalled that in the previous five years combined. Although it is not yet possible to account for the full impact of the pandemic due to data limitations, it is estimated that 22.0 percent (149.2 million) of children under five years of age were affected by stunting globally, 6.7 percent (45.4 million) by wasting, and 5.7 percent (38.9 million) by overweight in 2020. Africa and Asia accounted for more than nine out of ten of all children with stunting, more than nine out of ten children with wasting and more than seven out of ten children affected by overweight worldwide. The actual figures for malnutrition, particularly for stunting and wasting, are expected to be higher due to the COVID-19 pandemic (FAO, IFAD, WHO, WFP and UNICEF, 2021). In July 2021, the World Bank announced that, while the global economy is set to expand by 5.6 percent in 2021, the recovery will be uneven, largely reflecting sharp rebounds in some major economies, whereas in many emerging market and developing economies, obstacles to vaccination will continue to hinder economic activity. Sub-Saharan Africa, for example, is expected to grow by 2.8 percent in 2021, but this average hides the difficulties that some countries will face in kick-starting their economies (World Bank, 2021).

Uganda has managed to navigate the global economic recession relatively well for now, although it has undoubtedly experienced an unwelcome economic slowdown and socio-economic impacts. According to a 27 July 2021 update from the Uganda Bureau of Statistics (UBOS), at constant prices of 2016, GDP had grown an average of more than 9 percent between 2016 and 2019. Growth in agriculture, forestry and fishing – key sectors for Uganda's economy representing altogether almost 24 percent of GDP – outstripped overall output growth in 2016–2019 (UBOS, 2021a).

The most recent International Monetary Fund (IMF) forecast on Uganda (October 2021) available at this writing is not optimistic, projected a GDP contraction of -2.1 percent for 2020, although this is optimistically expected to be followed by a rebound that will grow the economy by around 4.7 percent in 2021. This raises questions about what the drivers for such a strong economic recovery might be and how these drivers could be aligned with (or *de facto* be) the country's development plans and investments – for which this study provides some answers. Broadly speaking, governments around the world are opting for unprecedented fiscal and monetary stimulus measures, but they all face the same question: What are the most cost-effective ways to invest scarce resources that will accelerate growth

for the well-being of the entire population in alignment with existing policies and plans? Certainly, the international community must support the response capacity of lower-income countries. At the same time, these countries must exercise considerable fiscal responsibility and objectivity in reallocating their public resources to meet the most urgent needs arising from the pandemic.

FAO is assisting governments to consider the options available to revive their national economies, reduce rural poverty and avoid further deterioration of food security and nutrition, making the best possible use of the limited resources available in their fiscal purse. Economic stimulus measures should focus on the sectors that are most important to the economy and/or that generate employment and better living conditions for large segments of the population. It will be essential to explore options to reactivate agriculture (including crops, livestock, forestry and fisheries) to ensure Uganda's economic recovery and improved well-being post-COVID-19, given the importance of this sector. Considering the current serious fiscal constraints, it is necessary to generate evidence around the range of options for economic recovery, so that the Ugandan Government can determine which sectors will generate clear socio-economic benefits, particularly in rural areas where rates of extreme poverty and food insecurity are the highest. This evidence can also facilitate the process of accessing international financing to support the necessary investments. In Uganda, it makes sense to focus on the agriculture, forestry and fishing sector, which represents about 24 percent of GDP and, according to the Uganda National Household Survey (UNHS) 2016–2017, employs more than 64 percent of the working population (14–64 years) (UBOS, 2018). This and the heavy reliance of the population on informal economic activities are clear indications that agriculture provides livelihoods for a large part of the population.

This study, which results from a collaboration and policy support engagement with Ugandan Government authorities, in particular the National Planning Authority (NPA) and the Ministry of Agriculture, Animal Industry and Fisheries (MAAIF), analyses several scenarios to answer the following questions:

- Can public investment that promotes productivity in agriculture drive growth in agrifood production with positive impacts on the economy as a whole and on rural poverty reduction, helping to achieve the objectives of national development plans?
- Which sectors or branches of agriculture will generate the greatest socio-economic payoffs from public investment to boost productivity, thus maximizing the cost-effectiveness of the investment?

To generate the prospective scenarios for analysis, a multisectoral computable general equilibrium (CGE) model for Uganda was used, which captures, over time, the macroeconomic, sectoral and distributional effects of new public investments in productivity in the short, medium and long term. The CGE model can accommodate the fiscal and public financing restrictions (and the relevant policies) in effect during the current restrictive context of the Ugandan economy under the pandemic and further down the road towards recovery.

The CGE model has been used to simulate two types of scenarios. The first is a base or reference scenario, which reproduces the Ugandan economy's past and current behaviour, including its sectoral structure, and predicts its future using a projected economic growth rate. This base scenario is then compared with scenarios that are designed to assess the potential effects of government investment to increase productivity in selected agricultural sectors, for example, investments to improve rural roads, irrigation systems, storage infrastructure, etc., which have been empirically proven to boost productivity. The scenarios focus on public investment because, in a context characterized by recession such as at present, private investors are more risk-averse and the government must intervene through public policy to create an environment more conducive for private investment.

The scenario analysis described above makes it possible to determine which agricultural subsectors will have the most significant effects on sectoral and national economic growth and rural poverty reduction as a result of public investment. The study will thus be able to identify the sectors where public investment is most cost-effective. Different sources of financing for productive public investment were considered when designing the scenarios to determine their macroeconomic feasibility, ultimately opting for the source of financing considered most appropriate by the Government of Uganda in line with budget frameworks and development plans.

Following this introduction, the remainder of the study is organized into five sections. Section 2 describes the recent context of Uganda in terms of economic and social performance, development plans and the role and financing of agriculture. Section 3 summarizes the modelling approach to generating scenarios. Section 4 describes the potential public investment scenarios and analyses their macroeconomic, sectoral and distributional results. Finally, Section 5 presents conclusions and policy recommendations. Supplementary material is presented in three annexes.

2 Context: economic and social performance and development plans

KEY MESSAGES

- The impressive progress made in Uganda over the last 20 years has brought the country ever closer to achieving middle-income country status. The National Development Plan (NDP) III is expected to provide the impetus needed to achieve this status.
- The expected cost of the NDP III over a five-year period amounts to 411.7 trillion Ugandan shillings, 276.9 trillion of which come from public investment. Agro-industrialization is one of the NDP III's key strategic programmes.
- While still falling short of Uganda's Malabo Declaration commitment, the allocated share to agriculture under the NDP III is higher than in previous years and there is a strong focus on capital expenditures, which could also be a catalyst for post-COVID-19 recovery.
- Using planned investments, the government aims to create 800 000 jobs in the agrifood sector, achieve an annual agricultural GDP growth rate of 6 percent and triple the value of exports.

Uganda has achieved a great deal over the past few decades in terms of several key development indicators. The percentage of the population with access to electricity has increased almost six-fold over the last twenty years (from 7 to 41.3 percent), life expectancy has expanded by 17 years (from 46 to 63 years) and adult literacy rates have gone up by almost 10 percentage points (from 68.1 to 76.5 percent) (World Bank, 2020). These indications of social development have been accompanied by impressive economic developments, epitomized by a three-fold increase in real GDP (in constant USD), a 74 percent increase in real GDP per capita (from 551 constant USD in 2000 to 958.2 in 2020), and a 24 percentage point decrease in poverty rates (from 65.6 to 41.3 percent)[2] (World Bank, 2020). According to a poverty assessment by the World Bank, agricultural growth has been a key driver of overall poverty reduction, particularly in rural areas (World Bank, 2016). Despite this, the most recent data from the Ugandan Bureau of Statistics (UBOS) available at the time of writing suggests that poverty remains primarily rural, with approximately seven out of eight poor family living in rural areas.[3]

[2] The poverty headcount ratio at USD 1.90 a day (2011 PPP) is used. If the national poverty line was instead used, the poverty headcount would have decreased from 37.7 percent to 20.3 percent in 2019/20 according to data from UBOS.

[3] Update from August 2021 (UBOS, 2021b).

The impressive accomplishments over the past 20 years throughout the implementation of the NDP I and NDP II means that Uganda is now very close to becoming a middle-income country. The NDP III is a flagship policy document detailing how, for the period 2020/21 to 2024/25, the country aims to overcome the remaining bottlenecks to middle-income status through sustainable industrialization for inclusive growth employment and wealth creation (NPA, 2020).

As acknowledged by the Government of Uganda, achieving the goals of the NDP III will not be easy and important challenges remain. Concerns remain over the dominance of the subsistence economy, the high rates of undernutrition, and regional disparities in terms of poverty reduction. The current population growth rate makes the need for structural changes in the economy more urgent and adds additional pressure on the labour market, highlighting the importance of job creation in the Ugandan context (NPA, 2020).

Under the NDP III, the government seeks to overcome the above-mentioned challenges by leveraging private and public investments to finance its strategy of industrialization for sustainable growth. The aim of the NDP III is to invest 411.681 trillion Ugandan shillings (276.878 trillion of which is public financing) over a five-year period across 18 strategic programmes. To put this into perspective, the projected yearly disbursements of the NDP III represent approximately 40 percent of GDP during each year of its lifetime (NPA, 2020). Given these investments, the government expected to reach several targets, including annual GDP and agricultural GDP growth of 7 percent per year, a reduction in poverty rates and inequality, and the creation of 520 000 jobs a year (NPA, 2020). This expectation seems less attainable due to the global economic recession brought about by COVID-19.

2.1 Expected role of agriculture in the development planning

The agriculture sector is expected to play a central role in the NDP III, with a programme focused on agro-industrialization. This programme aims to boost agricultural GDP and to create jobs in agriculture and agro-industry by increasing the commercialization and competitiveness of agricultural production and agroprocessing. To foster agro-industrialization, the government has selected ten priority commodities (coffee, tea, fisheries, cocoa, cotton, vegetable oil, beef, maize, dairy and cassava). Together, these commodities account for more than 38 percent of area under crop cultivation (FAO, 2021), 30 percent of total exports (NPA, 2020), 3 percent of total imports[4] (UN, 2021) and 80 percent of the country's tropical livestock units (TLUs).[5] Under the NDP III, the Government of Uganda is expected to invest 18.656 trillion Ugandan shillings (of which 9.187 trillion Ugandan shillings will be funded with public resources) over the five-year period. With this investment, the government expects to:

- achieve a growth rate in agricultural GDP of 6 percent, from the rate of 3.8 percent achieved between 2019/20 and 2020/21;
- triple the value of exported processed agricultural commodities from 0.9 to 2.7 billion;
- increase labour productivity in the agrifood sector by almost 50 percent, from USD 2 212 to USD 3 114 per worker;

[4] The 3 percent figure represents the average share of the value of vegetable oil imports (soy, palm, etc.) expressed as a share of total value of imports reported in UN Comtrade Database for the years 2018, 2019 and 2020 (UN, 2021).

[5] The share of TLUs is based on the calculation from the authors based on data from FAOSTAT (FAO, 2021). In order to obtain the values, the total number of heads of livestock (by type of livestock) was multiplied by a TLU conversion factor. The conversion factors used were the following: 0.7 (every type of cattle), 0.5 (asses and mules), 0.2 (pigs), 0.1 (sheep), 0.08 (goats) and 0.01 (chicken) based on FAO and IIASA (1991) and Otta and Chilonda (2002).

- reduce the total value of imported cereals, cereal preparations, vegetable fats and oils from USD 931 to USD 500 million;
- create almost 800 000 jobs in the agrifood sector over a five-year period starting from 2020/21;
- increase the proportion of households that are food secure from 60 to 90 percent; and
- reduce the percentage of households whose main source of livelihood is subsistence agriculture from 68.9 to 55 percent.

The NDP III was developed prior to the outbreak of the unprecedented COVID-19 pandemic with all of its health, economic and social repercussions. It will undoubtedly be more challenging to achieve the objectives of the plan, considering the economic deceleration in 2020 and the more meagre growth expected in 2021, the recessionary global economy, and the limited fiscal resources, some of which have been directed to the health emergency. The challenge is to exercise considerable fiscal responsibility and objectivity in allocating public resources to meet the most urgent needs arising from the pandemic while enabling an economic recovery that continues to align with the objectives of the NDP III.

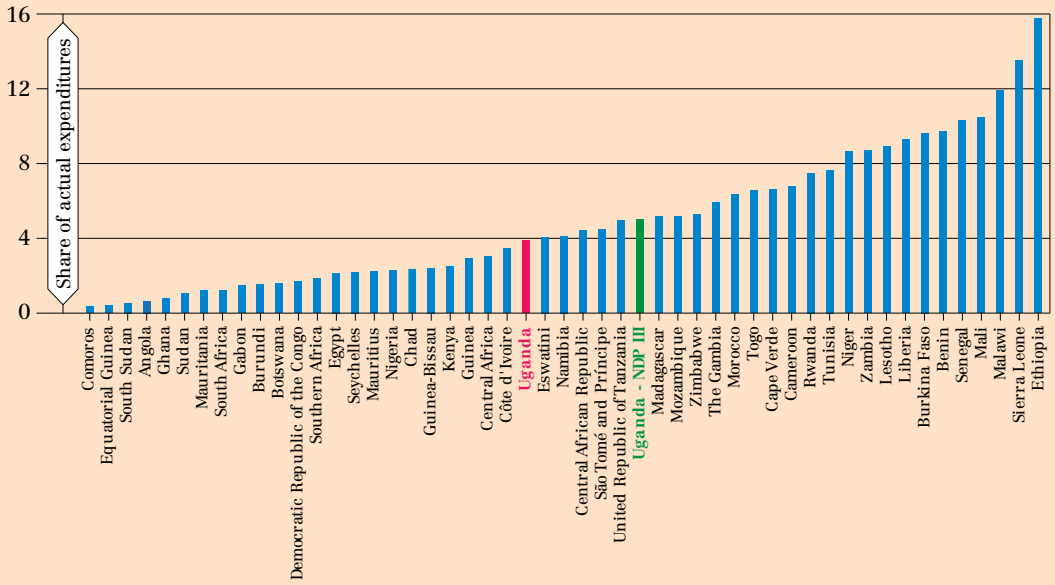
2.2 Planned expenditure in agriculture and sources of financing

To achieve the goals of the NDP III, the government has set out to spend 9.187 trillion Ugandan shillings on agriculture over a five-year period. Given current expenditure projections in the Medium-Term Fiscal Framework (Ministry of Finance, Planning and Economic Development, 2020), this spending amount, planned before the COVID-19 pandemic, would be insufficient to reach the Malabo target of allocating 10 percent of the total budget to agriculture. Still, it represents a substantial increase over the shares allocated to agriculture during the 2015–2019 period (Regional Strategic Analysis and Knowledge Support System or RESAKSS).

As shown in Figure 1, Uganda spent approximately 4 percent of its budget on agriculture from 2015 to 2019, making the country 27th – in terms of percentage of the budget spent in agriculture – out of 50 countries that have reported their expenditures to RESAKSS. Under the NDP III, the Government of Uganda plans to spend approximately 5 percent of its budget on agriculture, which would bring Uganda above the average share allocated to agriculture in the median African country over the 2015–2019 period. With lower economic growth during the pandemic, however, the allocation of fiscal resources to agriculture will be more challenging.

A key challenge associated with increasing the expenditure on agriculture relates to the financing of these expenditures. This is especially challenging in the Ugandan context as the government aims to increase expenditures in agriculture over the 2020/21–2024/25 period while simultaneously stimulating private investment and pursuing a fiscal policy that ensures that debt remains at a sustainable level. On top of that, the projected negative GDP growth for 2021 (i.e., -2.1 percent according to the IMF's forecast in October 2021, the most up-to-date information available at the time of writing) presents adverse conditions for moving forward. Inevitably, attaining Uganda's multiple goals will require careful choices around financing instruments since different funding modalities lead to different outcomes. For example, funding public investments through increased taxes or domestic loans may stifle domestic economic activity and/or private sector investments. On the other hand, an overreliance on foreign borrowing could jeopardize the long-term sustainability of the Ugandan debt and may penalize the export sector through real exchange rate appreciation. For this reason, it is critical to analyse various scenarios with an economy-wide perspective – as is done in this study.

FIGURE 1 **Share of actual expenditures allocated to agriculture in selected African countries (average 2015–2019)**



Source: RESAKSS (Regional Strategic Analysis and Knowledge Support System). 2021. Government agriculture expenditure (% of total expenditure). In: *RESAKSS* [online]. [Cited 1 October 2021]. www.resakss.org/node/11

Given that projected revenues will not be sufficient to cover its planned investments, Uganda has decided to finance the NDP III through a mix of financing sources, consisting of government revenues and grants, as well as different financing sources, as can be seen in Table 1. This table presents a summary of the medium-term framework from the National Framework Budget paper for the 2021/22–2025/26 fiscal years, which provides information on how the government envisages to finance the NDP III. A key challenge will be to prioritize the investments that are most cost-effective in order to spur economic recovery with social payoffs and provide the momentum needed to achieve NDP III objectives.

TABLE 1 **Summary of Medium-Term Fiscal Framework (MTFF)**

	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26
	Billion Ugandan shillings						
Total revenues and grants	18 073	21 077	23 600	26 094	31 491	37 256	44 584
Tax revenues	15 912	18 063	20 131	22 754	26 323	30 678	35 673
Non-tax revenue	1 374	1 240	1 562	1 734	1 903	2 135	2 427
Oil revenues	–	56	–	–	–	1 385	3 846
Grants	787	1 718	1 907	1 606	3 265	3 058	2 638
Total expenditures	28 123	37 252	35 070	37 858	41 331	43 760	49 149
Recurrent	14 823	19 052	18 576	19 590	20 980	24 013	26 721
Capital	12 064	15 371	15 499	17 868	20 151	19 747	22 428
Other	1 236	2 829	995	400	200	–	–

TABLE 1 (cont.) Summary of Medium-Term Fiscal Framework (MTFF)

	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26
	Billion Ugandan shillings						
Overall financing	-10 050	-16 175	-11 470	-11 764	-9 840	-6 504	-4 565
Domestic financing	3 878	6 318	2 965	2 403	2 230	2 144	391
External financing	6 293	9 858	8 504	9 361	7 610	4 361	4 173
	Percentage						
Deficit (% overall expenditures)	-36	-43	-33	-31	-24	-15	-9

Source: Ministry of Finance, Planning, and Economic Development. 2020. *National Budget Framework Paper FY 2021/22 – FY 2025/26*. Kampala.

Table 1 highlights three important points, given that the medium-term fiscal vision did not anticipate the outbreak of an unprecedented pandemic. First, government revenues (and tax revenues in particular) are projected to increase substantially and are likely to remain the main source of financing for the NDP III. The projected increase in government revenues during the implementation period is expected to come from four sources: 1) a growing tax base; 2) reductions in non-payment of taxes, specifically through a comprehensive compliance plan targeting tax evasion and avoidance; 3) changes in tax policies; and 4) oil revenues towards the end of the period. To mobilize domestic revenue, the government will review its tax policy (value-added tax, corporate income tax and personal income tax), improve the targeting of audit activities and scale-up its tax education activities. Second, despite the fast revenue growth (including grants) before the pandemic, government revenues will not be sufficient to cover the planned increase in expenditures and the deficit will be larger in the initial periods (i.e., frontloading). It is expected that government revenues (including grants) will be unable to finance approximately 25 percent of the expenditures during the NDP III implementation period. Third, foreign borrowing will be the main source of deficit financing, with approximately 75 percent of the total deficit financed through foreign borrowing. While this will put additional stress on Uganda's debt situation, it will reduce the pressure on domestic credit supply, which is critical to support the growth of small and medium-sized enterprises (SMEs).

Turning to expenditures in the agriculture sector, as summarized in Table 2, we can see that, beyond planned increases in the levels of expenditure, the composition of public expenditures is expected to change during the NDP III implementation period. The first aspect of note is that the government plans to keep the share allocated to wages relatively low, at just under 10 percent of total expenditures. The second is that the share allocated to capital expenditures (between 65.7 and 77.3 percent) is high enough to support economic recovery. In fact, as shown in Table 3, if realized, Uganda's planned share of capital expenditures in agriculture would be the third highest share among countries reporting to FAOSTAT (FAO, 2021). It would also make Uganda the country with the highest share of capital expenditures in agriculture across all African countries included in Mink's review of the Agricultural Public Expenditure Reviews carried out by the World Bank (2016). Providing recommendations on how to make the most cost-effective use of such planned expenditures is a key objective this study. Finally, the third notable aspect is the share of agricultural expenditures funded by external financing sources. About 36 percent of Uganda's total agriculture expenditures are expected to be financed by external sources. The risk for the

implementation of the NDP III is that the execution of donor-funded agriculture expenditures tends to be substantially lower than the execution of nationally-funded expenditures (Pernechele *et al.*, 2021). If donor-funded agricultural expenditures were perfectly executed, however, they could be an ideal source of rapid economic recovery compared to agricultural expenditures that are funded differently, as will be further explained in the analysis below.

TABLE 2 Levels and economic composition of public expenditures for agriculture

	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26
	Billion Ugandan shillings					
Total expenditure	1 534.62	1 509.26	1 523.50	1 523.50	1 523.50	1 523.50
Recurrent – wage	142.32	142.32	142.32	142.32	142.32	142.32
Recurrent – non-wage	206.23	374.65	374.65	374.65	374.65	374.65
Development – Government of Uganda	521.34	472.03	472.03	472.03	472.03	472.03
Development – external	664.73	520.27	534.51	534.51	534.51	534.51
	Share of agriculture expenditure					
National expenditure	0.57	0.66	0.65	0.65	0.65	0.65
External financing	0.43	0.34	0.35	0.35	0.35	0.35

Source: Ministry of Finance, Planning, and Economic Development. 2020. *National Budget Framework Paper FY 2021/22 – FY 2025/26*. Kampala.

TABLE 3 Public sector financial situation, 2010–2020

Country	Average share of capital expenditures (2001–2020) – all years reported (%)
Angola	52
Botswana	38
Burkina Faso	73
Guinea-Bissau	20
Kenya	44
Lesotho	8
Mauritius	4
Morocco	35
South Africa	30
Togo	76
Zimbabwe	35
Uganda NDP III (planned)	68

Source: FAO. 2021. FAOSTAT. In: *FAO* [online]. Rome. [Cited 1 October 2021]. www.fao.org/faostat

3 Data and methods

KEY MESSAGES

- Policy decisions on public investment in productive infrastructure for agriculture – including those foreseen as part of the NDP III – should be informed by prospective scenarios.
- An economy-wide modelling tool that considers the multisectoral diversity and fiscal constraints of Uganda's economy is fundamental to developing prospective scenarios in support of the NDP III.
- A computable general equilibrium model that records macroeconomic balances and constraints, sectoral supply and demand, and the income-expenditure balances of institutions using information from a social accounting matrix, is such tool.
- In the case of Uganda, multisectoral diversity is captured by a model that represents the interrelationships among 68 production sectors, two types of households (rural and urban), the government (both its fiscal policies and its budget) and the rest of the world (represented through the balance of payments).
- A computable general equilibrium model, such as is used here, needs to be combined with a microsimulation model to more accurately estimate distributional and poverty effects.

3.1 Prospective scenarios with a computable general equilibrium model

Increasing government investment to promote agriculture will have effects on agricultural output both directly and indirectly (for example, through input-output relationships between agriculture and other sectors of the economy, such as the food industry). In the case of Uganda, the effects could be significant if one considers that agriculture accounts for 33.7 and 31.5 percent of GDP and private consumption, respectively, and that agrifood commodities account for a large share of total exports (35.5 percent) and imports (12.8 percent).[6] As a result, analysing the policy shocks that affect agriculture, including increased government investment in its agricultural subsectors, requires capturing the interrelationships among economic agents, such as producers and consumers, while considering the direct and indirect effects that these relationships may generate. In other words, an analysis of alternative scenarios around agriculture should take a multisectoral approach that considers both the economy as a whole and fiscal constraints, particularly if the effects of public investment are to be considered. A computable general equilibrium (CGE) model is fit for purpose when it comes to capturing the range of potential effects.

An analysis of scenarios derived from a CGE model can help evaluate the short- and long-term macroeconomic, sectoral and distributive effects of different shocks in a framework

[6] Figures are based on the main data source introduced in Section 3.2.

of analytical consistency that alternative methods do not permit. In fact, consistency is ensured by simultaneous consideration of macroeconomic equilibrium, sectoral supply and demand balances, and the equalization of income and expenditure for each institutional sector (households, enterprises, government, and the rest of the world being among the most important). Recently, FAO has applied models, such as the one used in this study, to evaluate different public investment scenarios (see, e.g., Sánchez, Cicowiez and Ramírez, 2020; Sánchez, Cicowiez and Ortega, 2021). For the purposes of our analysis, the CGE model is complemented by a microsimulation model to estimate the effects on poverty, which is necessary for the reasons explained below.

This study uses a 'recursive-dynamic' CGE model, which was initially developed as a generic model that can be applied in different contexts (Cicowiez and Lofgren, 2017). This CGE model has some relatively standard characteristics (see, for example, Lofgren, Lee Harris and Robinson, 2002; Robinson, 1989), as well as others that make it particularly well-suited for assessing the effects of increased public investment in Ugandan agricultural subsectors. The remainder of this section discusses the general structure of the CGE model used in the study, which is key to understanding the scenario results.[7]

Technically, a CGE model is a system of simultaneous (linear and nonlinear) equations. The CGE approach encompasses an entire economy, ensuring consistency among its components. It encompasses relationships among production sectors (and the income they generate), households, enterprises, government (including policies and budget) and the rest of the world (represented through the balance of payments). It is an appropriate tool for analysing increases in government investment because it captures differences between production sectors in terms of the household preferences that influence what they produce, as well as variations in labour intensity, capital accumulation and technological change. A CGE model also considers the links with domestic and external markets (exports and imports).

In each period (or year) for which the model is solved, the different economic agents (producers, households, government, and the rest of the world) must respect their budget constraints: income and expenditure are captured in full and balanced by design, as in reality. For example, households spend a share of their income on direct taxes and savings; another part is spent on their consumption basket.[8] The rest of the world, seen as an institution, also has a budget constraint: foreign exchange inflows and outflows are equalized by endogenous adjustments of the real exchange rate.[9] In general, wages, rents and prices play a crucial role in balancing market supply and demand for factors of production and products (goods and services). World prices are taken as given for internationally-traded products, whether exported or imported (the assumption being that a small country like Uganda accepts world prices and does not affect them). Domestically, however, the price for those products can be influenced by taxes, subsidies, and the exchange rate.

As noted, the CGE model is recursive-dynamic; that is to say, the dynamic in the model is recursive because solutions for each year are linked to what happened in previous years only.[10] Over time, production is determined by the increase in the use of production factors (labour, capital, land and other natural resources) and the productivity of these factors. On the one hand, capital stock growth is endogenous and depends on investment and depreciation.[11]

7 Because of its detailed technical content, a supplementary document containing the model's mathematical statement is available upon request from the authors.

8 Households determine the composition of this consumption basket by maximizing their household utility.

9 The real exchange rate is the variable that adjusts transactions between Uganda and the rest of the world.

10 In other words, producers and consumers are myopic and make decisions year-to-year under the assumption that the conditions of each year will hold in future years.

11 The values of endogenous variables are calculated by solving the model's system of simultaneous equations. By contrast, the values of exogenous variables are imputed and determined outside the CGE model.

On the other hand, the projected supply levels for labour and natural resources (land for crops and livestock, fish stock for fishing, and extractive resources for mining) are exogenous. In the case of labour, the projections reflect the evolution of the working-age population and labour participation rates. The unemployment rate is endogenous. The growth of total factor productivity (TFP) in agriculture depends on the volume of public investment in agriculture.

3.2 Social accounting matrix

The main source of information for applying (or calibrating) a CGE model is a social accounting matrix (SAM) – a double entry table with the same number of rows and columns that records the value of transactions around activities, products, households, enterprises, government, and the rest of the world. For example, for a given year, a SAM shows the amount that each productive activity has allocated to purchasing intermediate inputs from other productive activities and to paying for production factors (labour, capital, land, and/or other natural resources).

This study uses a SAM for Uganda that was built by combining the following sources of official information for the fiscal year 2016/17: supply and use tables (SUTs), prepared by UBOS; balance of payments, prepared by Bank of Uganda; and information on government financing also prepared by UBOS. In addition, using the UNHS 2016/17, payments to the labour factor (i.e., remuneration to workers) were disaggregated according to the highest level of education achieved by workers and households were disaggregated by rural and urban areas. To simplify, in what follows we refer to the SAM base-year as 2017.

Table 4 shows the dimensions of the SAM that were used to calibrate the CGE model for Uganda, which in turn defined key dimensions of the model in terms of its disaggregation of production activities, commodities produced and exchange with the rest of the world, factors of production and institutions. In general, agricultural subsectors are identified individually, to the extent that data permit. The disaggregation of the SAM – and thus of the model – also focuses on sectors of the food industry that use agricultural products as intermediate inputs. For example, the meat and dairy sectors are singled out as they are closely linked to livestock farming. In addition, key inputs to production, such as energy, trade and transport services, are treated individually to capture productive linkages beyond the agrifood sectors.

In the remainder of this section, we will show how select information may be extracted from the SAM and to be presented in a set of figures that describe the structure of Uganda's economy in 2017 and become a critical input to understanding both the base-year situation and the results of the CGE model. To facilitate the description, the 68 production sectors included in the SAM were aggregated into 17. However, the scenarios described and analysed in Section 4 were conducted at the level of sectoral disaggregation showed in Table 4.

Figure 2 shows that agriculture accounts for 25.7 and 46.5 percent of value added and employment, respectively. In addition, it shows that agriculture features relatively low values in the ratio of value added to employment. Specifically, the value added per worker in agriculture and the other sectors is 0.6 and 1.4, respectively. It is thus expected that labour productivity increases in agriculture would allow for an expansion of employment in non-agricultural sectors, which must be kept in mind to understand simulation results. On the import side, agriculture and manufacturing represent 4.0 and 82.9 percent of total imports respectively. However, 94.0 and 46.7 percent of wheat and rice demands are covered by imports. The food industry is important both in terms of value added and foreign trade. Moreover, the production share that is exported and the consumption share that is imported amount to 14.2 and 13.1 percent, respectively (see Figure 3). Cotton, flowers, cocoa and coffee are the most export-oriented agricultural products.

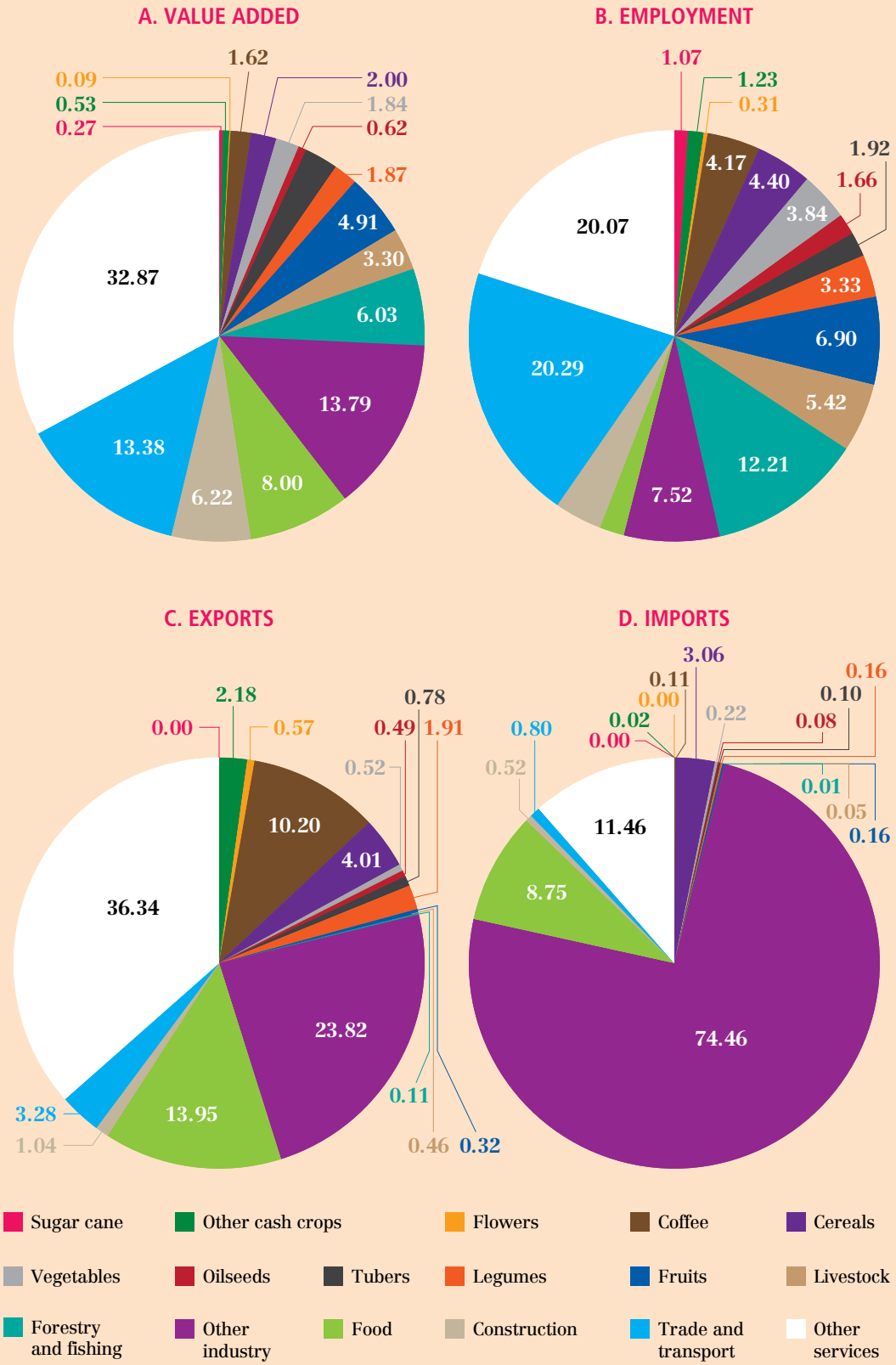
TABLE 4 Accounts in Uganda's social accounting matrix

Category	Item
Sectors (activities and commodities)	Agriculture, forestry and fishing (36): sugar cane, tobacco, cotton, flowers, cocoa, coffee, tea, vanilla, other cash crops, wheat, maize, rice, sorghum, millet, vegetables, soybeans, groundnuts, sesame, sunflower, potatoes, cassava, other root crops, beans, other legumes, banana, other fruits, cattle, camels and horses, goats, sheep, pigs, rabbits, poultry, other agriculture, forestry, and fishing
	Mining (2): oil and gas, other mining
	Manufacturing (19): meat, processed fish, oils and fats, dairy, milling, bakery, sugar, coffee products, tea products, other food, beverages and tobacco products, textiles, wood and paper, petrochemical, rubber and plastic, non-metallic mineral products, metals, machinery and equipment, other manufacturing
	Other industry (2): electricity, gas and water, construction
	Services (9): trade, transport, hotels and restaurants, financial services, professional services, public administration, education, health, other services.
Factors (8)	Labour, unskilled
	Labour, skilled
	Capital, private
	Capital, government
	Land
	Natural resource, forestry
	Natural resource, fishing
	Natural resource, mining
Institutions (4)*	Households (2): rural, urban
	Government
	Rest of the world
Taxes (5)	Tax, activities
	Tax, imports
	Tax, value-added tax
	Tax, commodities
	Tax, income
Distribution margins (3)	Trade and transport margins, domestic
	Trade and transport margins, imports
	Trade and transport margins, exports
Investment (3)	Investment, private
	Investment, government
	Investment, change in inventories

Notes: * The institutional capital accounts are for domestic non-government (aggregate of households), government, and rest of the world.

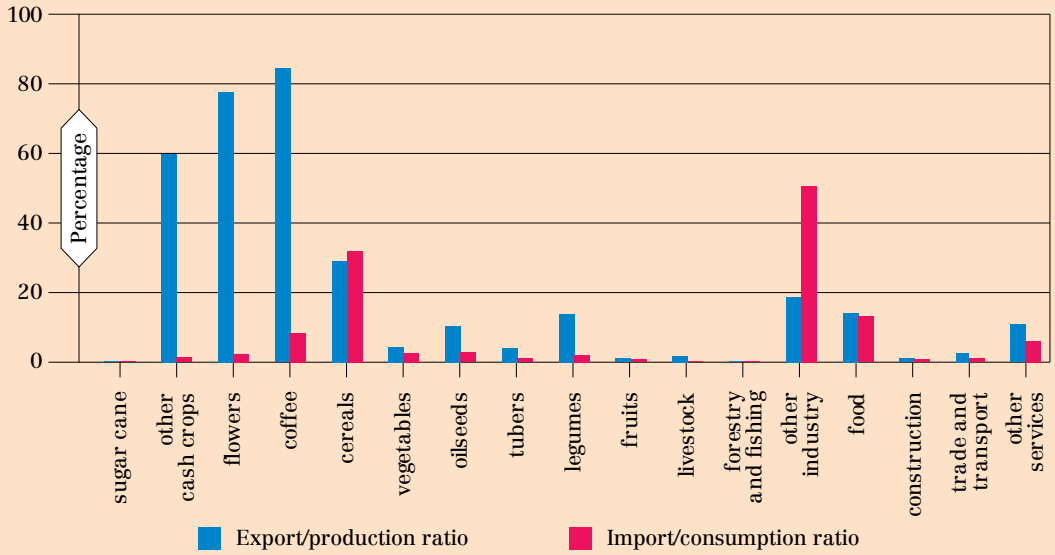
Source: Authors' own elaboration.

FIGURE 2 Subsector structure for selected indicators, 2017 (%)



Source: Authors' own elaboration based on the 2017 Ugandan social accounting matrix.

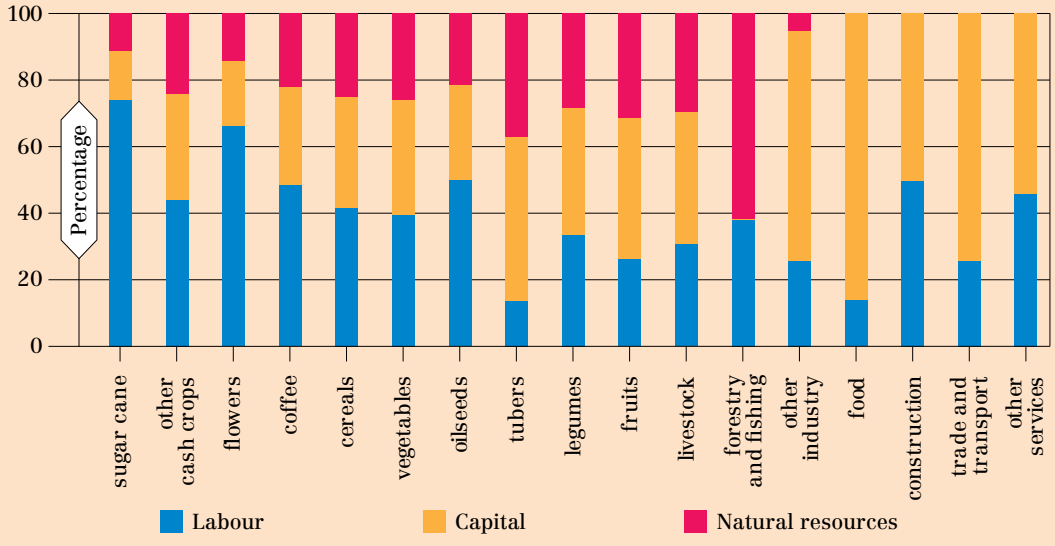
FIGURE 3 Export orientation of production by sector and import orientation of consumption by commodity, 2017



Source: Authors' own elaboration based on the 2017 Ugandan social accounting matrix.

Figure 4 shows factor shares in the sectoral value added. It is indicative that agriculture, construction, and transport all require a relatively intensive use of unskilled labour. Any increase in the productivity in these sectors would imply movement of some workers out of them because increased productivity means the same output can be produced by fewer workers. On the other hand, the manufacturing sector is fairly demanding in its use of capital. The labour/capital ratios of the production sectors have a major impact on the results obtained from policy simulations using a CGE model. Hence, this information is useful when we analyse the results from the simulated public investment scenarios.

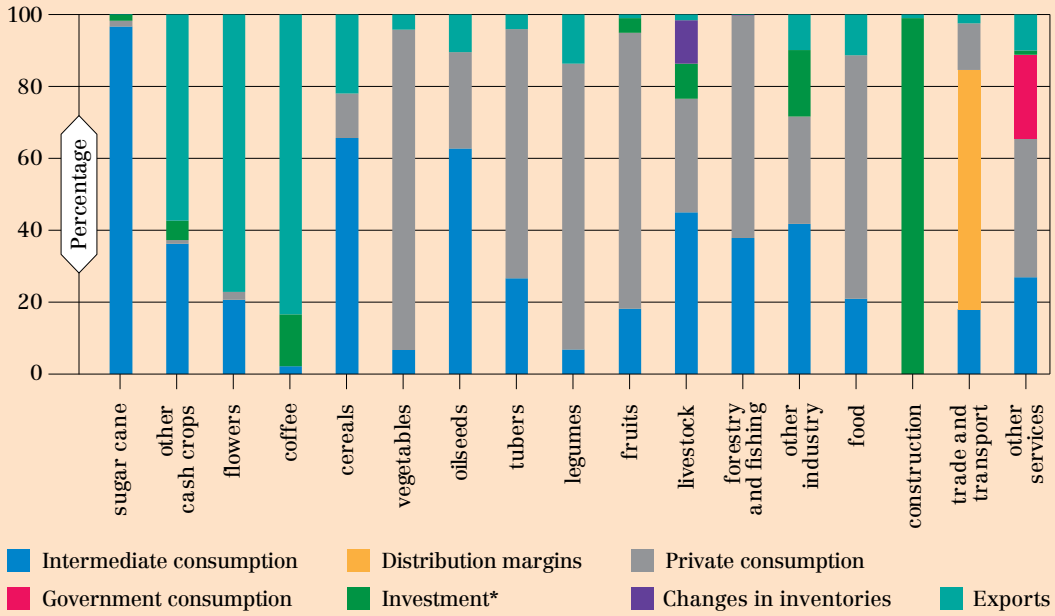
FIGURE 4 Sector factor intensity, 2017



Source: Authors' own elaboration based on the 2017 Ugandan social accounting matrix.

Finally, Figure 5 shows the demand structure for each commodity in the SAM. For example, 34.5 percent of the cassava output – which falls within the 'tubers' group in the figure – is used as an intermediate input by the manufacturing sector, while 64.7 percent is consumed by households. Figure 5 also shows that capital goods (i.e., gross fixed capital formation or GFCF) are mostly produced through manufacturing (including machinery and equipment) and construction.

FIGURE 5 Sector demand structure, 2017



Note: * Investment refers to gross fixed capital formation.

Source: Authors' own elaboration based on the 2017 Ugandan social accounting matrix.

3.3 Additional data

Beyond the SAM, the calibration of the CGE model needs data related to factor stocks and various elasticities. For capital depreciation rates, we followed Agénor, Bayraktar and El Aynaoui (2005) and assume rates of 5 percent and 2.5 percent for private and public capital, respectively. For unemployment and underemployment rates, we used the estimates from the UNHS 2016–2017, that is, 9.8 percent and 6.1 percent, respectively. For projections of the Ugandan population, disaggregated into multiple age groups and two locations (rural and urban), we used the 2019 UN World Population Prospects dataset and the 2018 UN World Urbanization Prospects (UN, 2019).

The CGE model also uses several (exogenous) elasticities that define how producers and consumers respond to price and income changes, among others. These elasticities apply to production trade, and consumption. The values for the sectoral elasticities of factor substitution, the so-called Armington elasticities (i.e., the elasticities of substitution between imports and domestically-produced output by commodity), the constant elasticity of transformation (CET) elasticities (i.e., the elasticities of transformation between exports and domestic sales), and the income elasticities of household demand are informed by econometric evidence from secondary sources as presented in Sadoulet and de Janvry (1995), Aguiar *et al.* (2019), and Muhammad *et al.* (2011). In sum, the elasticities of factor

substitution are in the range of 0.20–0.95, the Armington and CET elasticities are both in the range of 0.9–2.0, and the income elasticities of household demand are in the range of 0.77–1.55. In any event, given the uncertainty of supply and demand elasticities in this – and any – CGE model, we will assess the sensitivity of the CGE model results to changes in their values in Annex C.

3.4 Microsimulation model

The CGE model is combined with a microsimulation model to estimate the distributional effects of the different scenarios considered. The CGE model and the SAM for Uganda identify two representative households according to their urban or rural origin. Therefore, a part of the distributional effects generated by changes in factor remuneration is captured in the CGE model. In particular, changes in income/consumption distribution among those two representative households are determined by the model. However, income distribution in each of these representative households is assumed to be constant. In a second stage, therefore, the microsimulation model distributes, among individual households identified in the UNHS 2016–2017, the changes in income/consumption in each representative household. To do so, each household in the UNHS 2016–2017 is linked to a representative household in the CGE model. For example, if the CGE model results show that income from unskilled labour increases, all things being equal, the households earning part of their income from unskilled work will experience an increase in income/consumption. The microsimulation model reports standard indicators of monetary poverty.

4 Investment scenarios: definition and analysis of results

KEY MESSAGES

- A reasonable amount of public investment in productive infrastructure in Uganda's agriculture (i.e., 0.25 percent of GDP during the years 2023–2025) will positively affect economic growth and household welfare, although to different degrees depending on the sector.
- Lower food prices and increased labour income for rural households will lead to reductions in the rural poverty rate by 2030, ranging from 0.02 to 0.18 percentage points.
- Used alone, foreign borrowing would allow new investment to generate the greatest short-term economic recovery (as opposed to domestic borrowing and direct taxation); but using a mix of funding sources will be more realistic for Uganda.
- The sugar cane sector takes the lead in terms of supporting private consumption, total GDP and agrifood GDP, while the cassava and potato sectors lead in rural poverty reduction, and the tea, coffee, cocoa and vanilla sectors have the greatest impact on exports.
- Sectors such as cattle, bananas and goats also score high for their impacts on private consumption and GDP, making them potentially valuable recipients of investment to promote economic recovery. However, only investment in the banana sector would enable a significant reduction in poverty.

4.1 Base scenario: the point of departure

To investigate scenarios for new public investment in Uganda's agricultural infrastructure, we must first explore the base or reference scenario. The base scenario is designed to provide a business-as-usual projection into the future, informed by data on estimated GDP growth (which is exogenously imposed – that is, it is not an outcome of the model – exclusively in this base scenario) and other relevant information. In the case of Uganda, the base scenario starts in 2017 and extends until 2030. For each year during this period, equilibrium solutions are generated using the CGE model. The solution for 2017 replicates the information in the SAM – which ensures consistency – while the solutions from 2018 to 2020 reflect major macroeconomic developments, mostly a reproduction of actual GDP growth. To facilitate the presentation and the analysis, the base scenario assumptions are kept as simple and transparent as possible. Most importantly, it is assumed that: i) the GDP growth rate is exogenous, drawing on recent IMF data (IMF, 2021); ii) all international (export and import) prices are constant in real terms; and iii) drawing on the SAM data, GDP shares for most

institutional payments, including all receipt and spending items in the government budget, are determined exogenously and maintained as fixed. In addition, for non-capital factors, the base scenario assumes that: i) the economically-active population grows at the same rate as the working-age population; ii) the supply of agricultural land remains constant; and iii) fishing and the extraction of mining resources grow at the GDP growth rate.

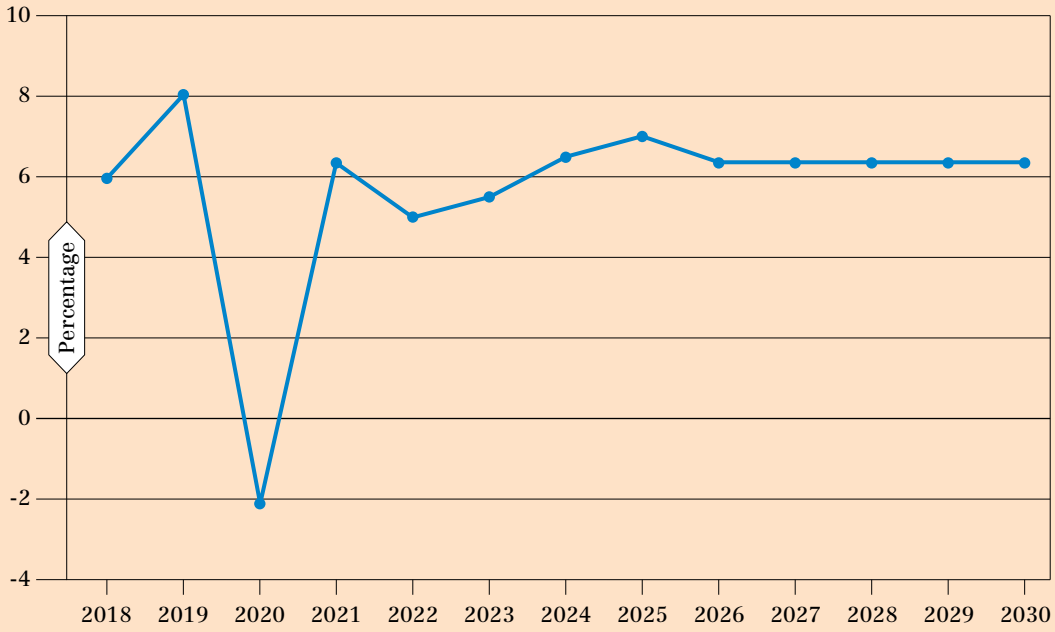
To generate a base scenario that replicates what was observed in 2018–2020 and subsequently converges to stable growth rate, the following assumptions are made: tax rates remain unchanged; other government revenues (such as domestic and foreign borrowing) as well as all government spending evolve proportionally to the GDP, which is observed and kept constant; and, except for exports and imports, balance-of-payment components also evolve as an exogenous proportion of GDP.

Figures 6 to 9 summarize results from the base scenario covering macroeconomic aggregates, sectoral value added, per capita household consumption and poverty. To facilitate comparisons with the non-base scenarios presented below, the picture is one of stable growth, the main deviation being the COVID-19-related economic contraction. Specifically, after a 2.1 percent decline in 2020, GDP grows at an average annual rate of 6.2 percent until 2030 (see Figure 6).[12] Among domestic demands, private consumption dominates (see the left-hand axis on Figure 8), followed by private investment, government consumption and government investment (see the right-hand axis on Figure 8). The macroeconomic aggregates shown in Figures 6 to 8 grow, on average, at annual rates of 5.6–5.9 percent during 2017–2030. At the sectoral level, the growth rates are in the range 3.2–6.0 percent (see Figure 9). For agriculture, growth is lower due to the slow growth in land supplies and low-income elasticities of demand. Moreover, Figure 9 also points to a slow process of structural transformation in the absence of new investments, for example, of course, those associated with the implementation of the NDP III, which are not captured by the base scenario. Finally, given that private consumption growth exceeds population growth, which for 2021–2030 is projected at 2.9 percent, aggregate household welfare is increasing. In per capita terms, household consumption grows at a rate of 2.5 percent per year, leading to a decrease in the poverty rate, from 22.0 percent in 2017 to 12.0 percent in 2030 – with most poverty reduction seen in rural areas (see Figure 10).

It should be noted that the base scenario, as described here, is not a forecast of how we expect Uganda's economy to evolve until 2030. Instead, it is based on the assumption that external conditions (mainly international prices) and domestic conditions (mainly economic policies) do not change during the 2022–2030 period and, as noted, investment planned under the NDP III is not simulated.

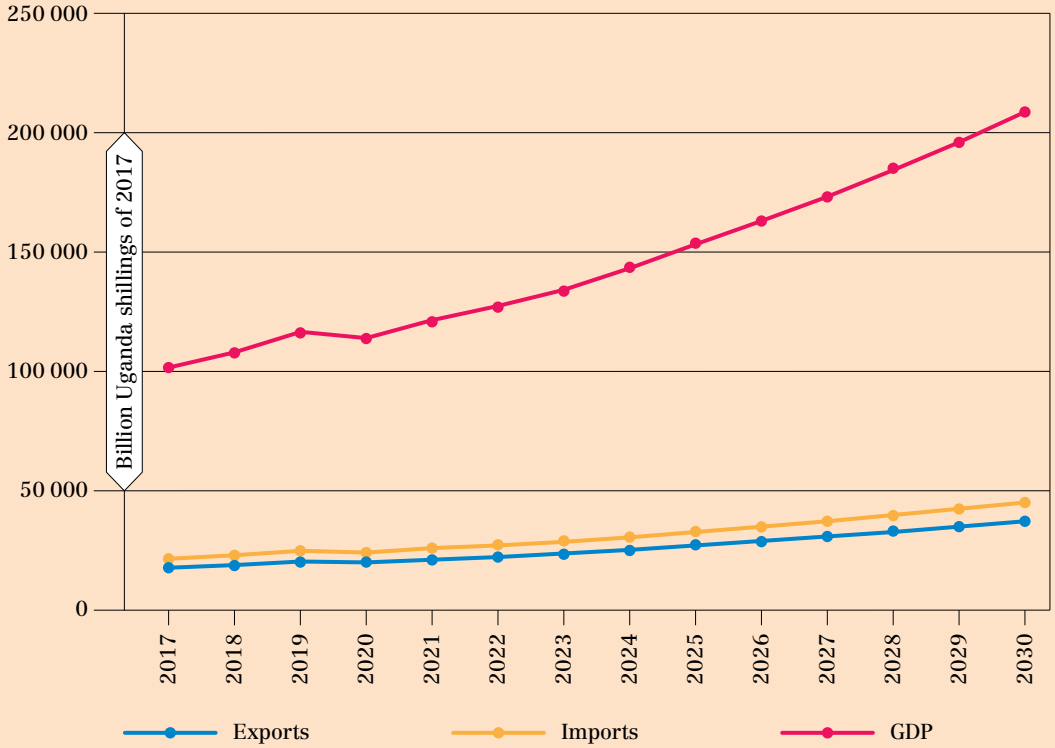
[12] These figures are based on the IMF World Economic Outlook published in April 2021, the latest available at the time of writing (IMF, 2021).

FIGURE 6 GDP growth rate in the base scenario



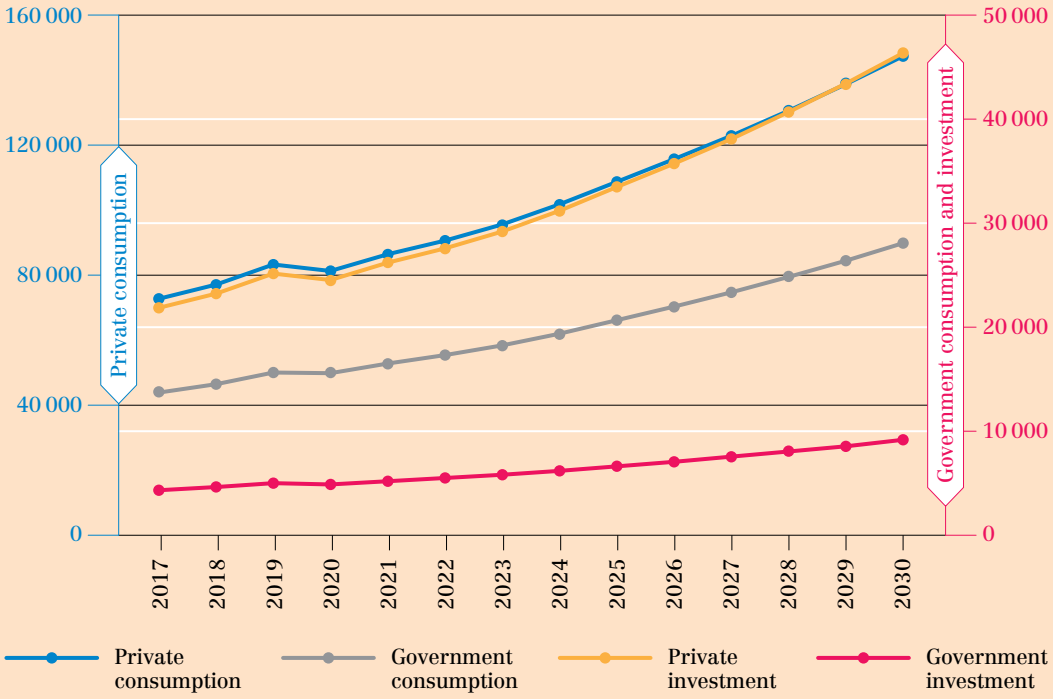
Source: Authors' calculations based on IMF (International Monetary Fund). 2021. World Economic Outlook Database. April 2021 edition. In: *IMF* [online]. Washington, DC. [Cited 28 June 2021]. www.imf.org/en/Publications/WEO/weo-database/2021/April

FIGURE 7 Exports, imports and GDP in the base scenario



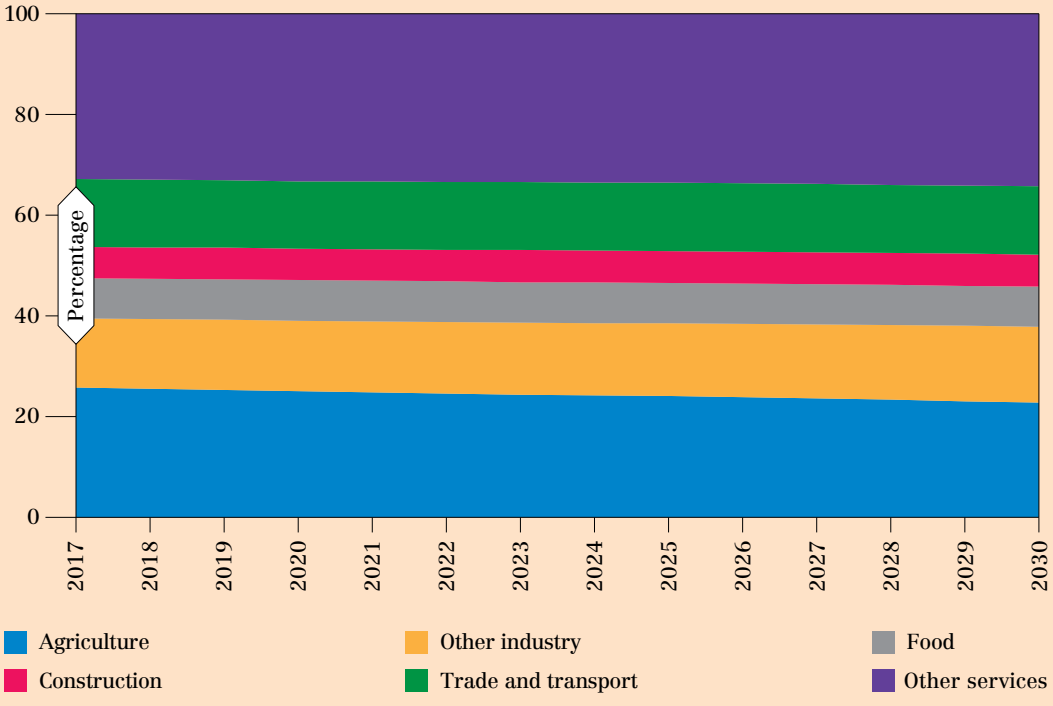
Source: Authors' calculations based on simulation results.

FIGURE 8 Domestic final demands in the base scenario (in billion 2017 Uganda shillings)



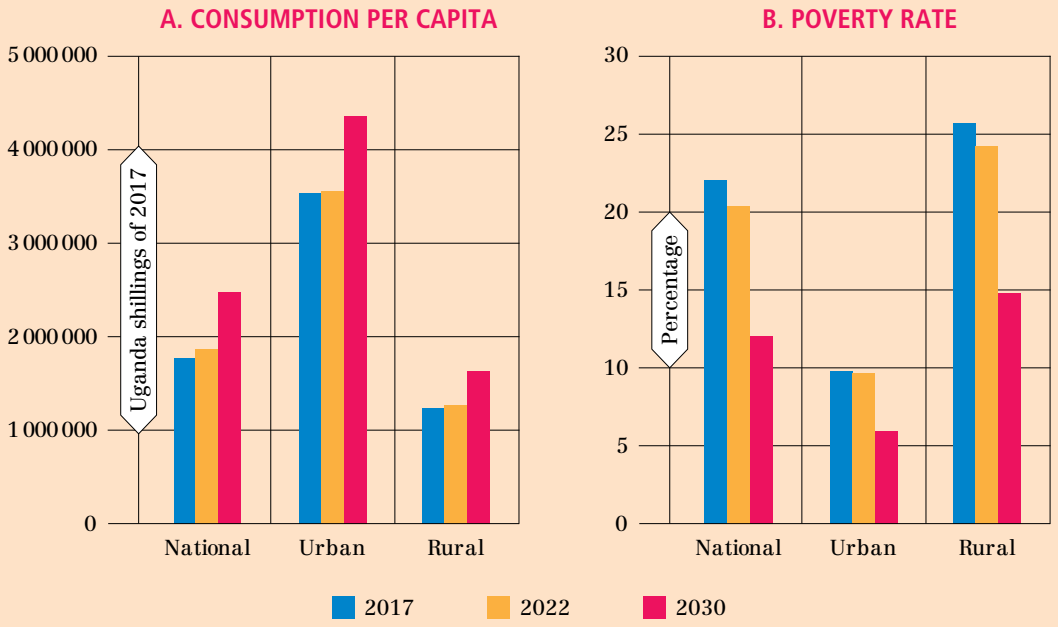
Source: Authors' calculations based on simulation results.

FIGURE 9 Real sectoral GDP structure in the base scenario



Source: Authors' calculations based on simulation results.

FIGURE 10 Real household consumption per capita and poverty rate



Source: Authors' calculations based on simulation results.

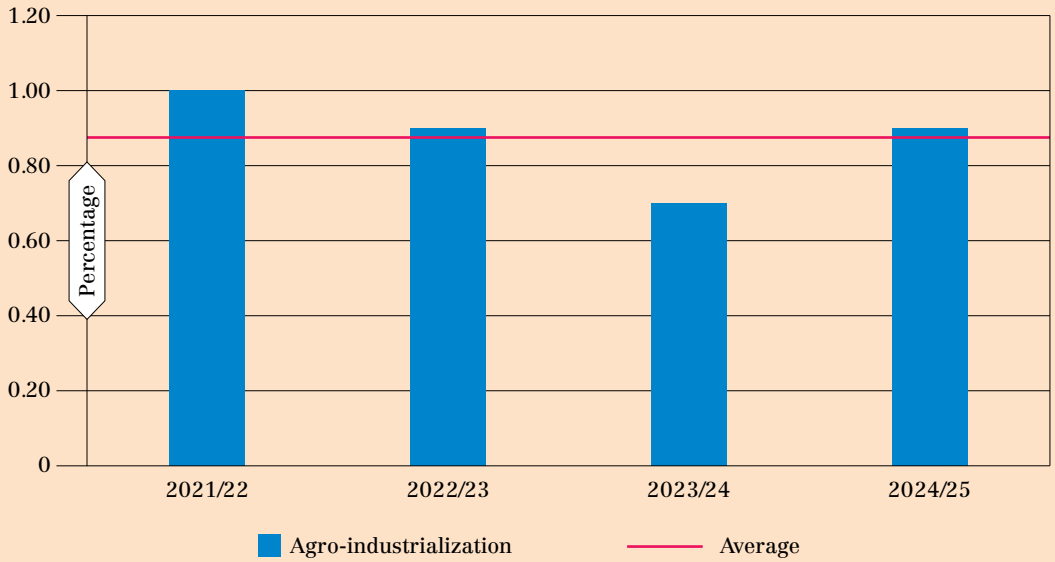
4.2 Scenarios of public investment in productive infrastructure

Definition of the scenarios

In this section, a total of 28 scenarios on government investment in productive agricultural infrastructure are analysed and compared to the base scenario. To define a realistic amount of government investment for simulation purposes, we scrutinized potential investment in agro-industrialization based a reading of the NDP III and 2021/22 Budget Framework's Medium-Term Expenditure Framework (MTEF) (Ministry of Finance, Planning and Economic Development, 2020), in close consultation with the Uganda's National Planning Authority (NPA). This exercise indicated that, on average, the Government of Uganda's planned investment in agro-industry represents about 0.88 percent of GDP per year from 2021/22 to 2024/25 (see Figure 11).

We considered 0.88 percent of GDP as a ceiling and arbitrarily – but realistically – made the choice to simulate around a quarter of that planned investment. That is, in all 28 non-base scenarios government investment is increased by 0.25 percent of GDP (on average, about 373 billion 2017 Uganda shillings) during the years 2023–2025 relative to the base scenario; this new investment targets one or more agricultural sectors at a time. In addition, all 28 scenarios assume that TFP in the targeted agricultural sectors increases by the equivalent of 30 Uganda shillings for each additional 100 shillings invested. In other words, it is assumed that the marginal product of government capital is 0.3. In the literature, estimates for the marginal product of government capital vary widely but values in the range of 0.15–0.60 were estimated for a wide range of country categories (see Gupta *et al.*, 2014; Dessus and Herrera, 2000; Lowe, Papageorgiou and Perez-Sebastian, 2019). Our assumption for the impact of the increase in government capital stocks on sector-specific TFP levels is based on plausible mid-range parameters taken from the literature. In Annex B, we consider the impact of varying the marginal product of government capital and the amount of government investment.

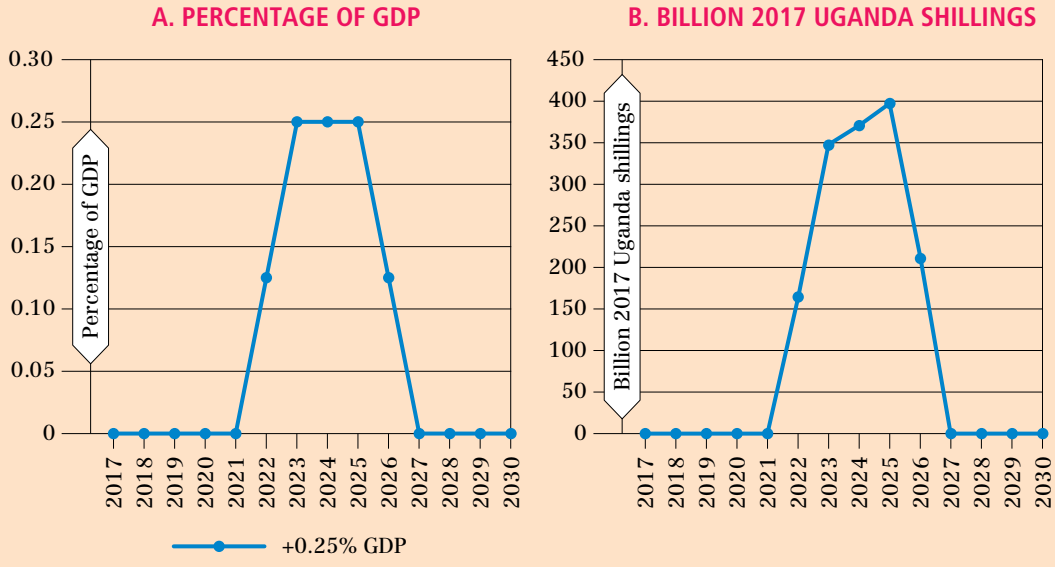
FIGURE 11 Planned public investment in agro-industrialization as a percentage of GDP, 2021/22–2024/25



Source: Authors' calculation based on NPA (National Planning Authority). 2020. *Third National Development Plan (NDP III) 2020/21 – 2024/25*. Kampala; and Ministry of Finance, Planning, and Economic Development. 2020. *National Budget Framework Paper FY 2021/22 – FY 2025/26*. Kampala.

In all non-base scenarios, changes in government investment are imposed in multiple steps – and in alignment with the NPA, as shown in Figure 12. In 2022, government investment will exceed the base level by 0.125 percent. In the years 2023–2025, it will exceed the base level by 0.25 percent. In 2026, investment declines, exceeding the base level by 0.125 percent and finally, in 2027–2030, it returns to base level.

FIGURE 12 Increased government investment relative to the base scenario



Source: Authors' own elaboration.

The investment scenarios are defined in Table 5. Each scenario is named by the agricultural sector targeted by government investment. The first four scenarios cover all crops; their names include a reference to the source of financing: foreign borrowing (crops-fbor), domestic borrowing (crops-dbor), income tax (crops-tdir),[13] and mixed financing (crops-mix).

TABLE 5 Definition of non-base scenarios

#	Name	Sectoral focus	Source of funding
1	crops-fbor	crops	foreign debt
2	crops-dbor	crops	**domestic debt**
3	crops-tdir	crops	**income tax**
4	crops-mix	crops	**mixed**
5	Sugar cane	**crops**	mixed
6	cotton	**cotton**	mixed
7	flowers	**flowers**	mixed
8	cocoa	**cocoa**	mixed
9	coffee	**coffee**	mixed
10	tea	**tea**	mixed
11	vanilla	**vanilla**	mixed
12	wheat	**wheat**	mixed
13	maize	**maize**	mixed
14	rice	**rice**	mixed
15	sorghum	**sorghum**	mixed
16	millet	**millet**	mixed
17	vegetables	**vegetables**	mixed
18	soybeans	**soybeans**	mixed
19	groundnuts	**groundnuts**	mixed
20	simsim	**sesame**	mixed
21	potatoes	**potatoes**	mixed
22	cassava	**cassava**	mixed
23	beans	**beans**	mixed
24	bananas	**banana**	mixed
25	cattle	**cattle**	mixed
26	goats	**goats**	mixed
27	pigs	**pigs**	mixed
28	poultry	**poultry**	mixed

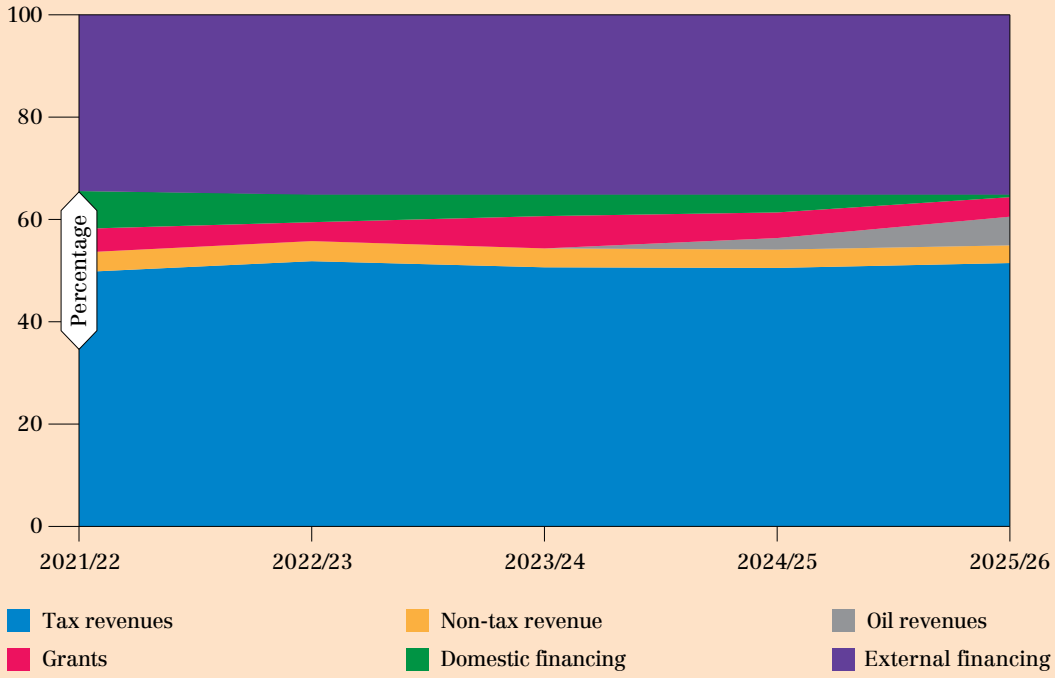
Notes: The differences between scenarios 2 through 28 and the fourth scenario are indicated in blue.

Source: Authors' own elaboration.

[13] This option refers to an increase of tax revenues – through increased effective tax rates, presumably as a result of improved tax administration. The effective tax rate is defined as the ratio between collection and the taxable base. Consequently, that rate could increase, even if the legal rate does not change.

The mixed financing scenario is based on our reading of the NDP III and the 2021/22 Budget Framework's MTEF, which assume a combination of tax and non-tax revenue, oil revenue, grants, domestic and foreign borrowing (see Section 2, Figure 13 and Annex A). Under the crops-mix scenario, which the NPA has identified as the most feasible and realistic scenario for Uganda, tax revenues and external borrowing take the lion's share of all financing. Scenarios 1–3 also help us to understand the pros and cons of a mixed financing scenario, particularly in terms of enabling a faster economic recovery, as explained below.

FIGURE 13 Financing sources under mixed-financing scenarios



Source: Authors' calculation based on NPA (National Planning Authority). 2020. *Third National Development Plan (NDP III) 2020/21 – 2024/25*. Kampala; and Ministry of Finance, Planning, and Economic Development. 2020. *National Budget Framework Paper FY 2021/22 – FY 2025/26*. Kampala.

In scenarios 5 through 28, we vary the agricultural sectors that benefit from new government investment. For example, in scenario 5 (sugar cane), the sugar cane production sector experiences a TFP boost from new government investment financed through a combination of sources. The use of mixed financing for these scenarios facilitates comparison and helps us to rank agricultural sectors according to the cost-effectiveness of investment to boost their productivity. This cost-effectiveness is reflected in changes to indicators such as GDP, private consumption, private investment, exports and the net present value of investment, among others.

The simulated investment scenarios differ from the base scenario for the 2022–2030 period, while they are identical from 2017 to 2026. Increases in public investment are introduced during the 2022–2026 period, and government investment returns to the levels of the base scenario from 2027 to 2030 (see Figure 12). As a result, the last years of simulation portray the medium- to long-term effects increased government investment in agriculture.

It should be stressed that the non-base scenarios are not forecasts (that is, they do not tell us what is expected to happen). Instead, they focus on how the future may differ depending on the presence or absence of an increased government investment in agriculture.

Transmission channels

Panels a through c in Figure 14 summarize the main transmission channels that explain the results of simulating public investment increase under the 28 scenarios. Panel a portrays the direct effects of increased public investment itself. Under all scenarios, growth in public investment builds the stock of public (infrastructure) capital, which increases the TFP of the beneficiary sector, depending on the value of the marginal product of public capital. Increased TFP in agricultural sectors will have a positive impact on GDP depending on a number of factors, particularly backward and forward production linkages (i.e., input–output relationships among sectors), the share of value added in gross production value and the export-orientation of the sector. In all cases, increased productivity is expected to positively impact household incomes, which will have positive effects on consumption, savings and private investment.

Panels b–d in Figure 14 refer to the effects that are directly linked to the source of investment funding. In panel b, foreign borrowing finances public investment without directly affecting domestic demand. However, foreign borrowing can lead to an inflow of foreign exchange, which pushes the real exchange rate down, negatively impacting the tradable sectors of the economy. In panel c, financing through domestic borrowing reduces the savings of households and enterprises, which would have otherwise been available to finance private investment. Therefore, the expected net effect of public investment on GDP is, *a priori*, indeterminate. Of course, public debt stocks increase under both the foreign and domestic borrowing scenarios.

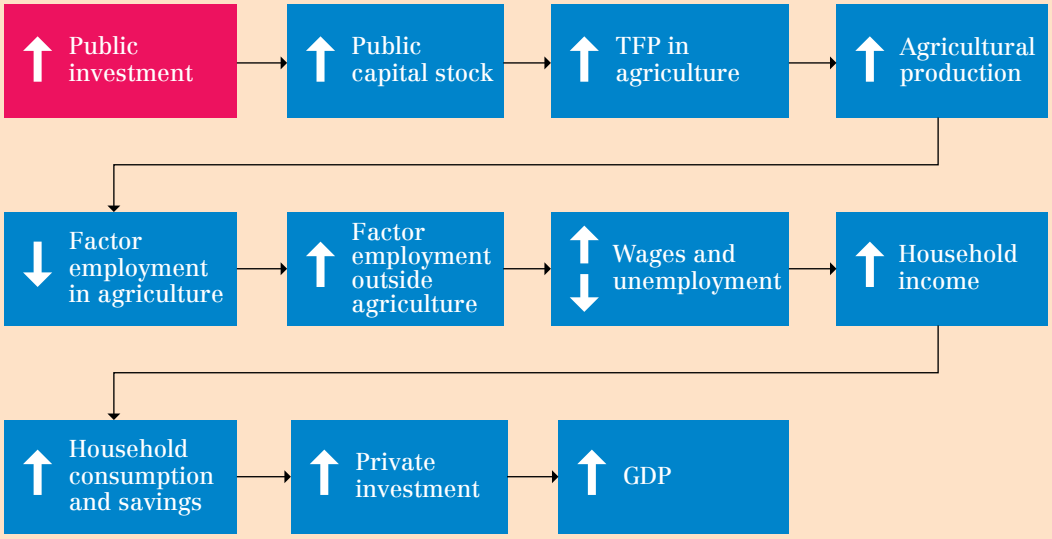
In panel d, the growth in public investment is financed by increasing income tax rates for households and enterprises. As a result, at least in the short term, there is a reduction in disposable income, which results in a drop in private consumption and savings.

Discussion of the various transmission channels shows that the results of the public investment scenarios cannot be established *a priori*. In other words, the net effect of each scenario on agricultural productivity should be determined empirically. This is particularly the case for scenarios that make simultaneous use of more than one financing source.[14]

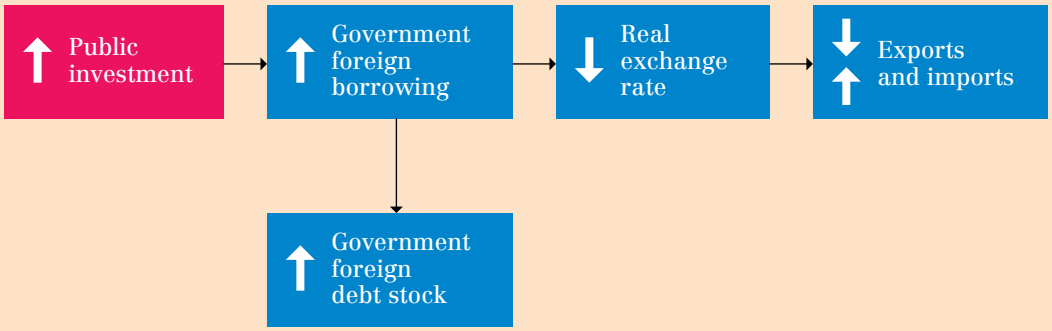
[14] Under this particular scenario, all the transmission channels associated with the other individual financing sources are present simultaneously; therefore, the outcome of using such a mix can only be empirically determined, and not ex ante by a theoretical figure such as in Figure 14b, c, d and e.

FIGURE 14 Transmission channels for increased public investment in production infrastructure using different sources of financing

A. TRANSMISSION CHANNELS OF INCREASED PUBLIC INVESTMENT IN PRODUCTION INFRASTRUCTURE



B. TRANSMISSION CHANNELS IF FINANCING IS THROUGH FOREIGN BORROWING



C. TRANSMISSION CHANNELS IF FINANCING IS THROUGH DOMESTIC BORROWING

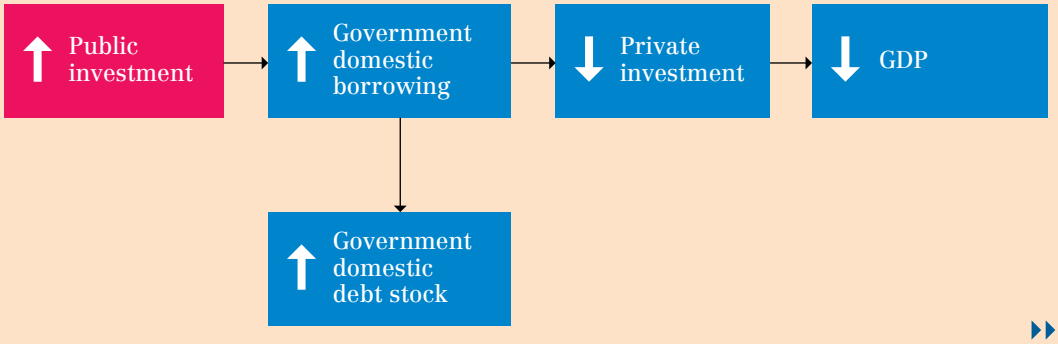
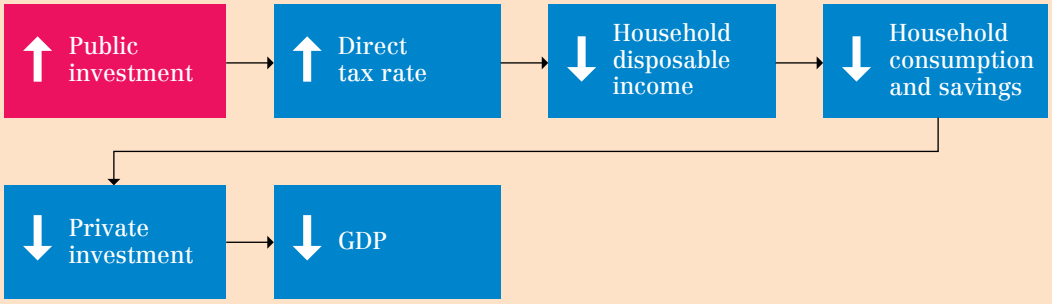


FIGURE 14 (cont.) Transmission channels for increased public investment in production infrastructure using different sources of financing

D. TRANSMISSION CHANNELS IF FINANCING IS THROUGH DIRECT TAXES



Source: Authors' own elaboration.

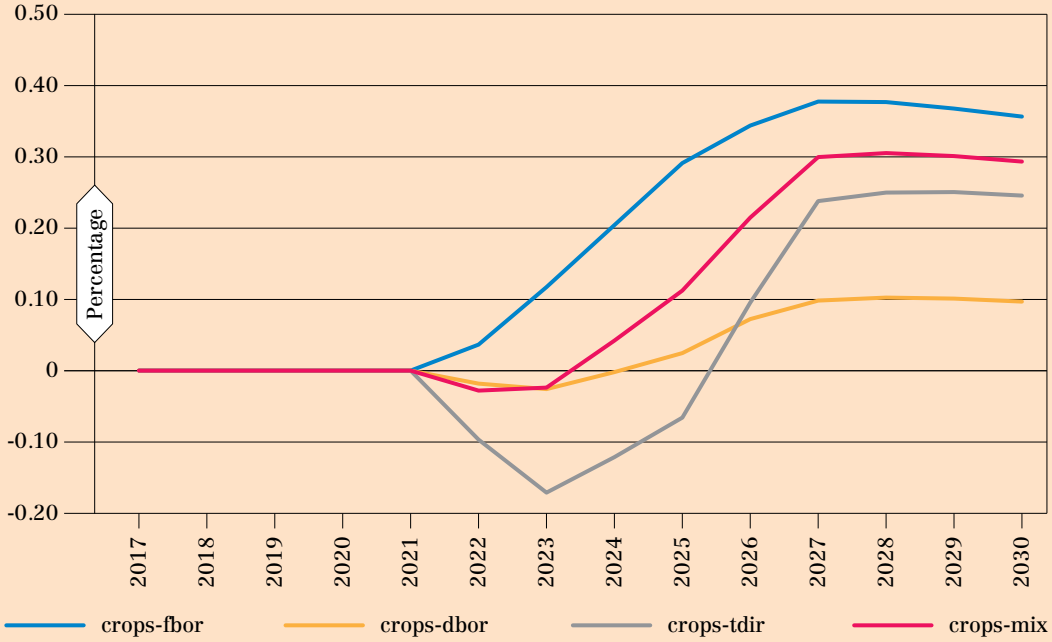
4.3 Analysis of results

A detailed analysis of all 28 funding scenarios is obviously not feasible in a limited amount of space. At any rate, our chief interest is to answer the questions raised in the introduction to this paper: Can government investment to promote agricultural have a positive economic impact on the economy and promote rural poverty reduction? Where will this government investment result in the most significant socio-economic payoffs, thus maximizing its cost-effectiveness? The following sections focus on the macroeconomic, sectoral, and distributive results needed to answer these questions. The results for key indicators in the CGE model are presented as percentage deviations from their values in the base scenario. In addition, Annex C analyses the sensitivity of the results to the value assigned to the different elasticities of the model that were described in Section 3. Overall, the qualitative results presented in this section do not change when the values of the elasticities of the model are modified.

Macroeconomic results

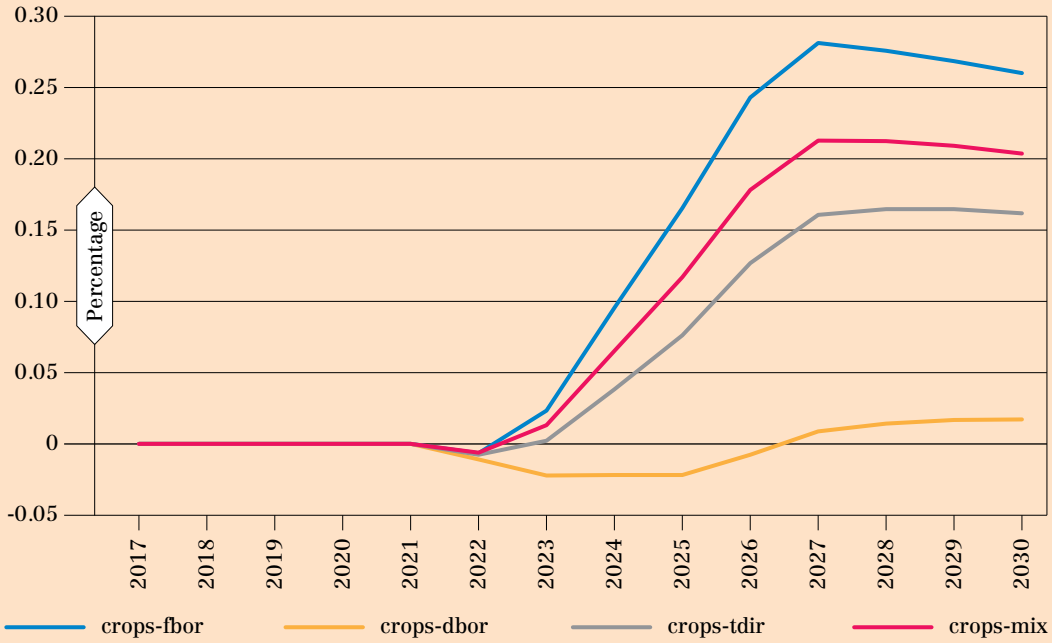
We first turn to scenarios 1 through 4, as described in Table 5, focusing on the macro results presented in Figures 15 and 16. Under these scenarios, the government targets new investment to all crops using different financing mechanisms. In each case, we find positive macroeconomic effects in the medium- to long-term whereby indicators, such as GDP, employment, and private consumption grow, on average, at rates higher than recorded in the base scenario. For example, by 2030 the level of GDP is up to 0.25 percent higher than in the base scenario. Indicators, such as private consumption and private investment, also show positive impacts in the medium to long run. Needless to say, a higher level of private investment is reflected in an increase in private capital stock, which, in turn, has a positive second-round effect on macroeconomic indicators.

FIGURE 15 Real private consumption under scenarios 1–4 covering all crop sectors with alternative financing sources, 2017–2030 (percentage deviation from the base scenario)



Source: Authors' calculations based on simulation results.

FIGURE 16 Real GDP under scenarios 1–4 covering all crop sectors with alternative financing sources, 2017–2030 (percentage deviation from the base scenario)



Source: Authors' calculations based on simulation results.

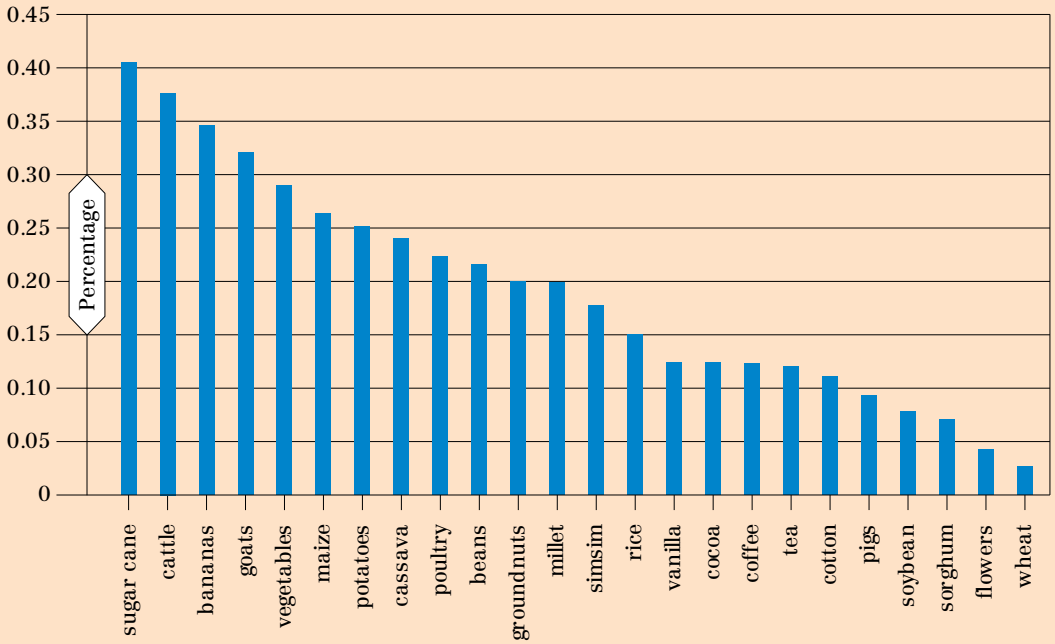
As indicated, the impact of increased government investment in agriculture depends on the funding mechanism. On the one hand, if funding comes from domestic borrowing, private investment growth declines strongly and GDP growth weakens (scenario 2: crops-dbor). On the other hand, if funding comes from foreign sources, there is no negative impact of increased domestic resource mobilization on private investment (scenario 1: crops-fbor). Moreover, the results show that government investment in agriculture funded by increased foreign financing allows households to increase their consumption levels at a higher growth rate (see Figure 15), even in the short run. This seems to suggest that increased foreign borrowing is a better alternative – particularly for a fast recovery – but, in reality, it simply reflects the fact that the effects of accumulating foreign debt are not felt during the period of analysis, while they still represent a future burden. In turn, financing through direct taxes (scenario 3: crops-tdir) generates a relatively large short-term drop in disposable income and therefore, in private consumption and private investment. However, in the medium- and long-term, financing through direct taxes results in a higher private consumption and GDP increase than financing through domestic borrowing – but this is not the case compared to financing through foreign borrowing. Lastly, as shown in Figure 13, scenario 4 (crop-mix) combines alternative sources of financing: tax revenue (51 percent), non-tax revenue (4 percent), oil revenue (2 percent), grants (5 percent), domestic borrowing (4 percent) and foreign borrowing (35 percent). Consequently, the results fall somewhere between those of the previous three scenarios.

As noted, scenarios 5 through 28 target individual agricultural sectors and assume that the increase in government investment is financed through the indicated mix of sources. Figures 17 and 18 compare the long-term impacts of investing in different sectors in terms of private consumption and GDP, respectively. In both cases, the sugar cane investment scenario exhibits the largest gains. Private consumption and GDP in 2030 are 0.41 and 0.38 percent higher respectively than under the base scenario. Alternatively, the cumulative increase in private consumption and GDP between 2022 and 2030 is equivalent to 3.2 percent and 3.6 percent, respectively, of the base-year private consumption (GDP). According to base-year data, sugar cane is the agricultural subsector with the lowest value added per worker. Therefore, an increase in sugar cane TFP will allow more workers to be reallocated to other production activities. Thus, economy-wide impacts are particularly strong when sugar cane is targeted by new government investment. Moreover, the production of sugar cane has strong forward linkages with the sugar industry since virtually all of its output is used as an intermediate input by the industry.

Investing in the cattle, banana, goat, vegetable, maize, potato and cassava sectors also results in important impacts on private consumption. In all cases, products from these sectors are – directly or indirectly – relatively important to the consumption basket of rural and urban rural households. Cattle, goats and maize are consumed by households as meat and milling products. Hence, any reduction in price brought about by an increase in supply will have a positive impact on private consumption. More precisely, increasing supply in these agricultural sectors due to higher TFP will lead to a decline in their relative price since demand increases (brought about by growth in household income and investment demand) are generally lower than supply increases.

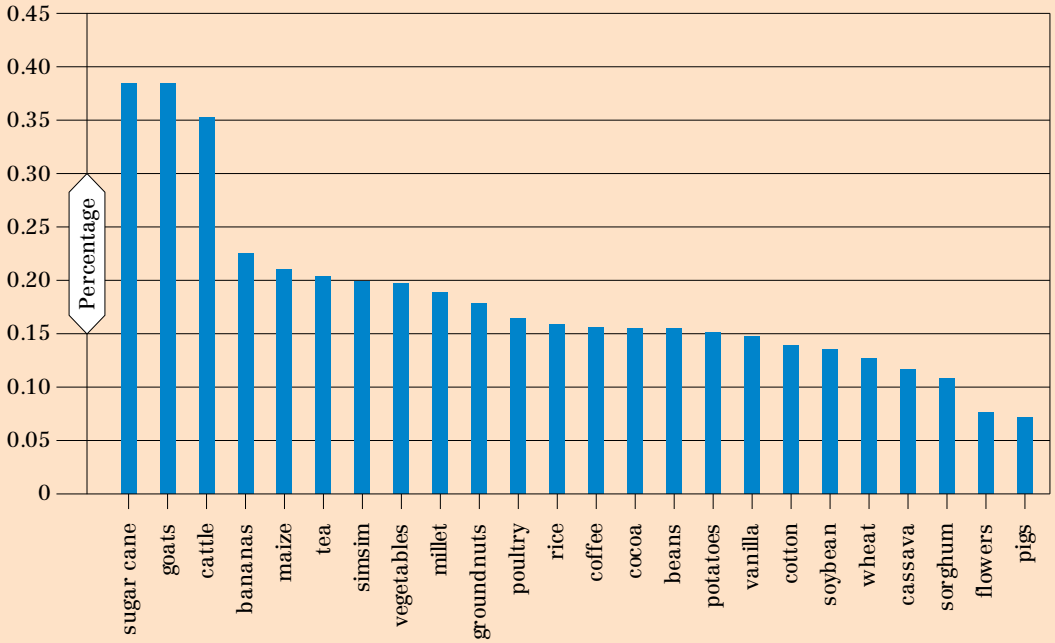
In the case of GDP, the ranking in terms of impacts is similar to that of private consumption. However, products, such as tea and sesame (which are included in the sectors ‘other cash crops’ and ‘oilseeds’ on Figures 17 and 18, respectively), also rank high. The production of tea products is relatively capital-intensive and its promotion has a relatively strong impact on private investment, which translates into a larger private capital stock with a positive second-round effect on GDP. For its part, sesame has strong forward linkages with the food industry and a sizeable share of its output is exported to the rest of the world (see Figure 5). These results show the importance of accounting for demand constraints and relative price changes.

FIGURE 17 Real private consumption in government investment scenarios involving individual agricultural sectors with mixed financing, 2030 (percentage deviation from the base scenario)



Source: Authors' calculations based on simulation results.

FIGURE 18 Real GDP in government investment scenarios for individual agricultural sectors with mixed financing, 2030 (percentage deviation from the base scenario)

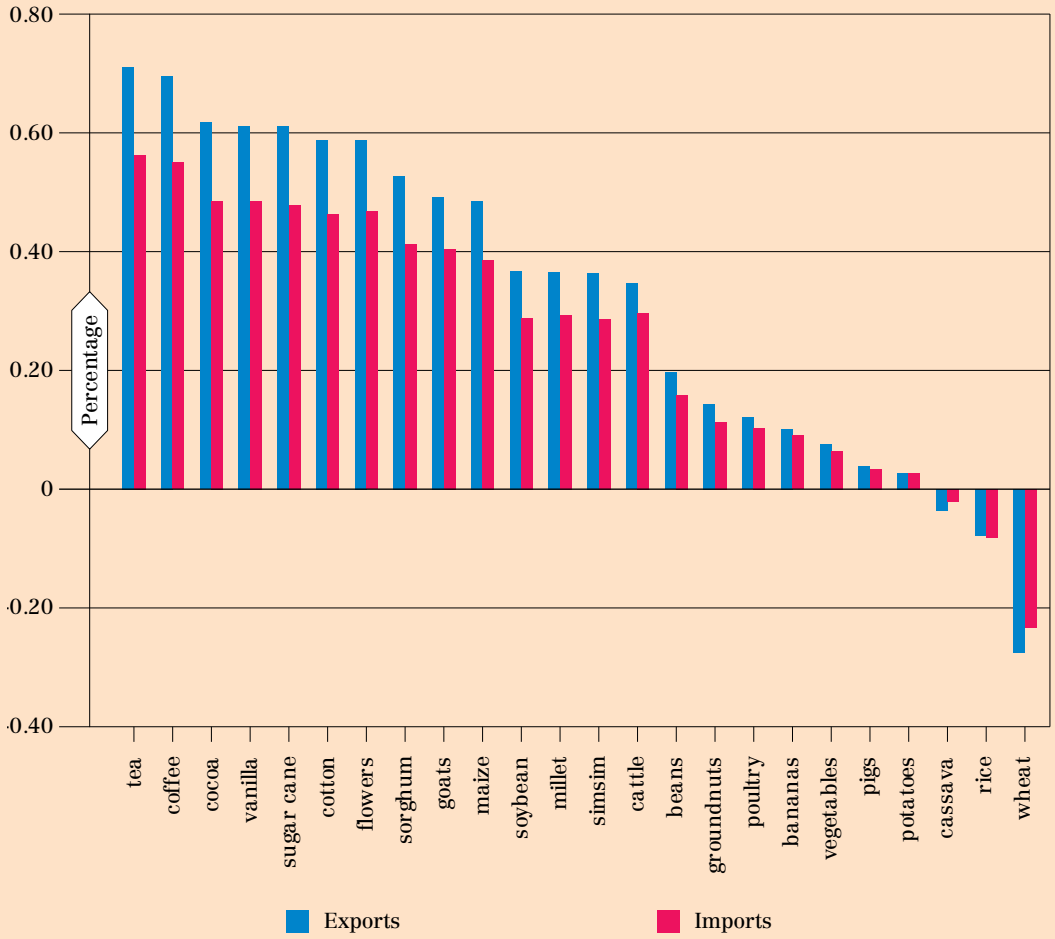


Source: Authors' calculations based on simulation results.

Figure 19 shows the impacts of investing in different agricultural sectors on exports and imports in 2030. As expected, the sectors generating the highest export increases are coffee, cocoa, vanilla, cotton and flowers. In Section 3, we found these to be the most export-oriented agricultural sectors. Tea – the first-ranked product – is not very export-oriented. However, it is indirectly exported as an input in the production of tea products; more than 71 percent of the output of tea products is exported. Sugar cane is high in the ranking because of its relatively large economy-wide impacts, as already discussed.

Interestingly, targeting the investments to increase the TFP of the wheat sector has a negative impact on both exports and imports, which is also the case for the rice and cassava sectors, although to a much lower extent. Under the base-year scenario, 94.0 percent of wheat demand comes from imports (see Figure 3, sector 'cereals,' which includes wheat). The decrease in total imports is explained by the reduction of wheat imports due to import substitution. In turn, to maintain a given level of foreign savings, exports also fall relative to the base scenario. In 2030, the ratio between wheat imports and consumption is projected to fall by more than 9 percentage points relative to the base scenario (that is, from 94.0 percent in the base year to 84.8 percent in 2030). For rice, the qualitative results are similar given that 46.7 percent of rice consumption is met with imports.

FIGURE 19 Exports and imports under government investment scenarios for individual agricultural sectors with mixed financing, 2030 (percentage deviation from the base scenario)



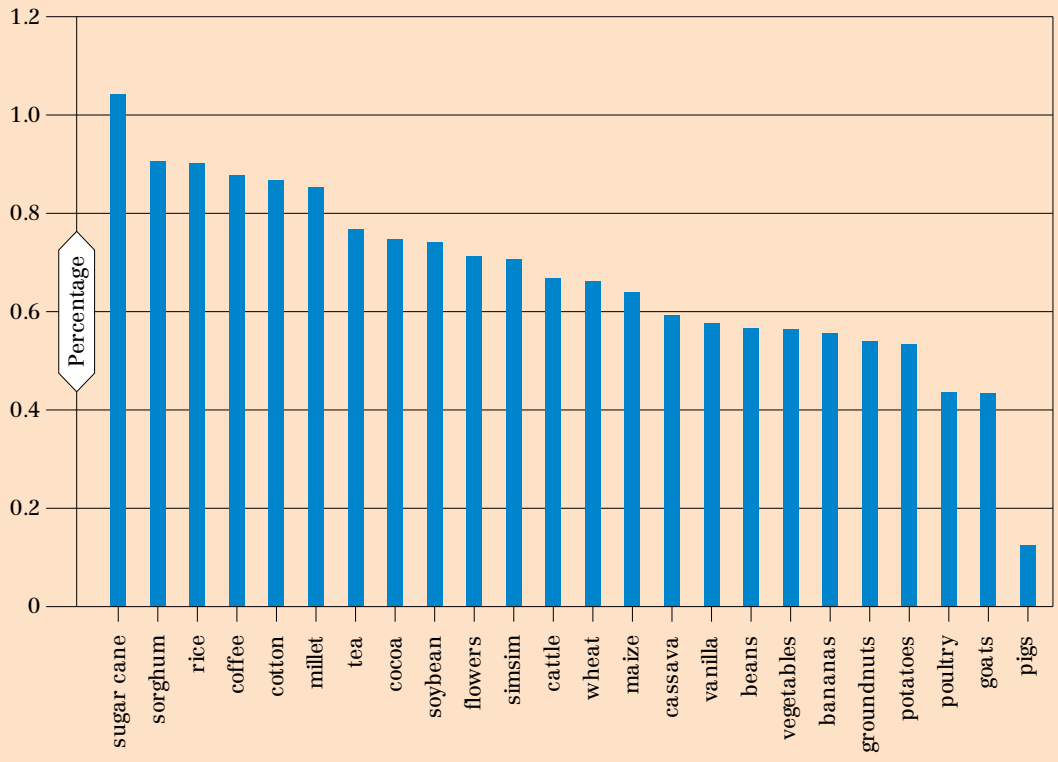
Source: Authors' calculations based on simulation results.

Sectoral production results

Naturally, targeted agricultural sectors experience increased output with increased government investment. Additionally, faster agricultural growth stimulates additional growth in non-agricultural sectors, both by increasing the final demand for non-agricultural products and by lowering input prices and fostering upstream processing. For example, under the cattle scenario, GDP for the meat sector increases 3.4 percent relative to the base scenario in 2030 (not shown here graphically). Increased agriculture production also generates additional demand for chemicals and transport services, which further stimulates growth in other manufacturing and service sectors.

In Figure 20, agricultural sectors (or their respective scenarios) are ranked according to their impact on agrifood GDP when they are specifically targeted for government investment. Here, agrifood GDP is defined as the sum of the value added generated by agriculture and the food industry. It thus captures the production linkages between agriculture and the food industry. The three agricultural sectors with the greatest effects on agrifood GDP are sugar cane, sorghum and rice. At the opposite end of the ranking, poultry, goats and pig farming have the smallest effect on agrifood GDP.

FIGURE 20 Agrifood GDP under government investment scenarios for individual agricultural sectors with mixed financing, 2030 (percentage deviation from the base scenario)



Source: Authors' calculations based on simulation results.

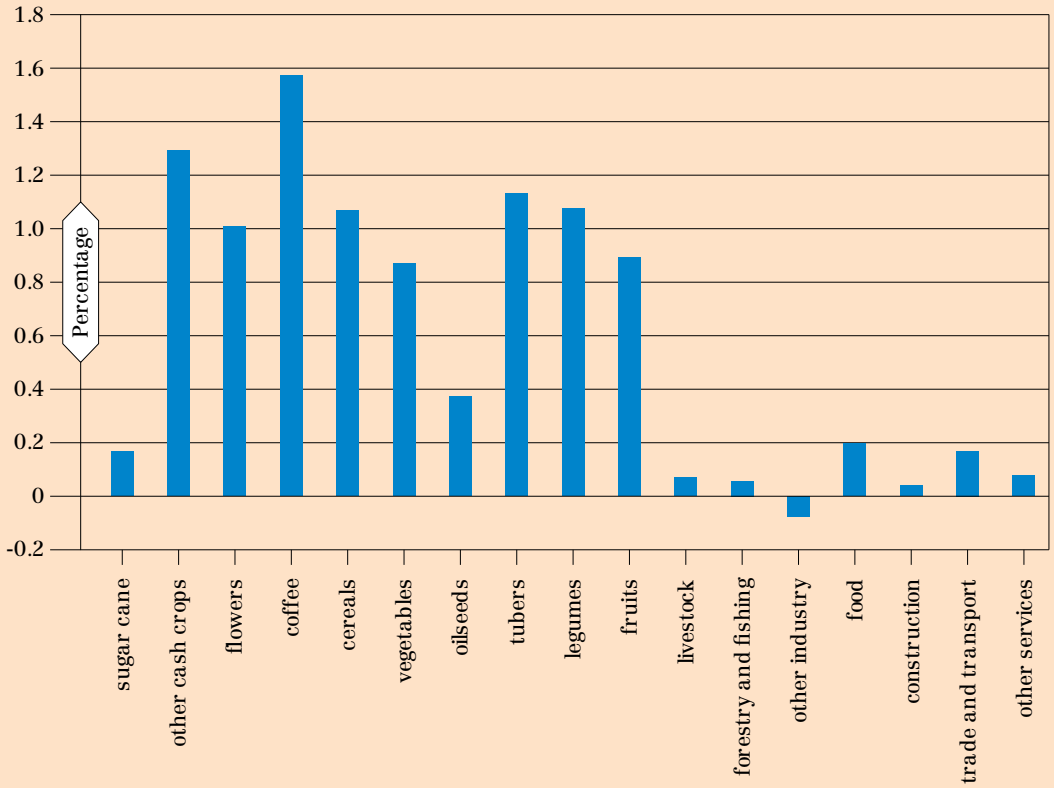
In general, crops have a more significant export and import orientation than livestock (see Figure 2). As a result, any negative effects on domestic prices caused by increases in crop production would be mitigated by increased exports and/or reduced imports. Thus agrifood GDP will increase further when promoting sectors that, directly or indirectly, are more export- or import-oriented.

As expected, production linkages with the food industry are less important when government investment targets crops that are consumed without processing, such as vegetables and potatoes. For example, the vegetables sector allocates most of its production to private consumption (89.1 percent) (see Figure 5). Therefore, increases in its output are relatively unimportant in terms of driving production in other sectors. Consequently, the scenario where vegetables production is targeted by government investment ranks in position 18, as can be seen in Figure 18.

The analysis looks beyond the linkages between agriculture and the food industry sector. Figure 21 shows the effects on the Ugandan economy under the scenario where government investment promotes all crops (crops-mix). The results show direct effects on the crop sectors, with backward linkages with public utilities such as electricity and water and transport, and forward linkages with the food industry, trade and other services. The crops that experience the greatest impact from exclusive government investment are highly export-oriented, such as vanilla, cocoa and tea – these results are not shown graphically.

If Uganda's objective is to maximize the effects of new government investment on growth, and thus to contribute to post-pandemic recovery, our results underscore the importance of investments that: i) promote sectors currently integrated into value chains, and/or ii) promote the entire value chain rather than just the primary stage for sectors that are not currently integrated into value chains. Moreover, as discussed above, sectors that are more active in world markets can increase their production and exports without being limited by the size of the domestic market.

FIGURE 21 Sectoral output in investment scenario including all crop sectors with mixed financing, 2030 (percentage deviation from the base scenario)

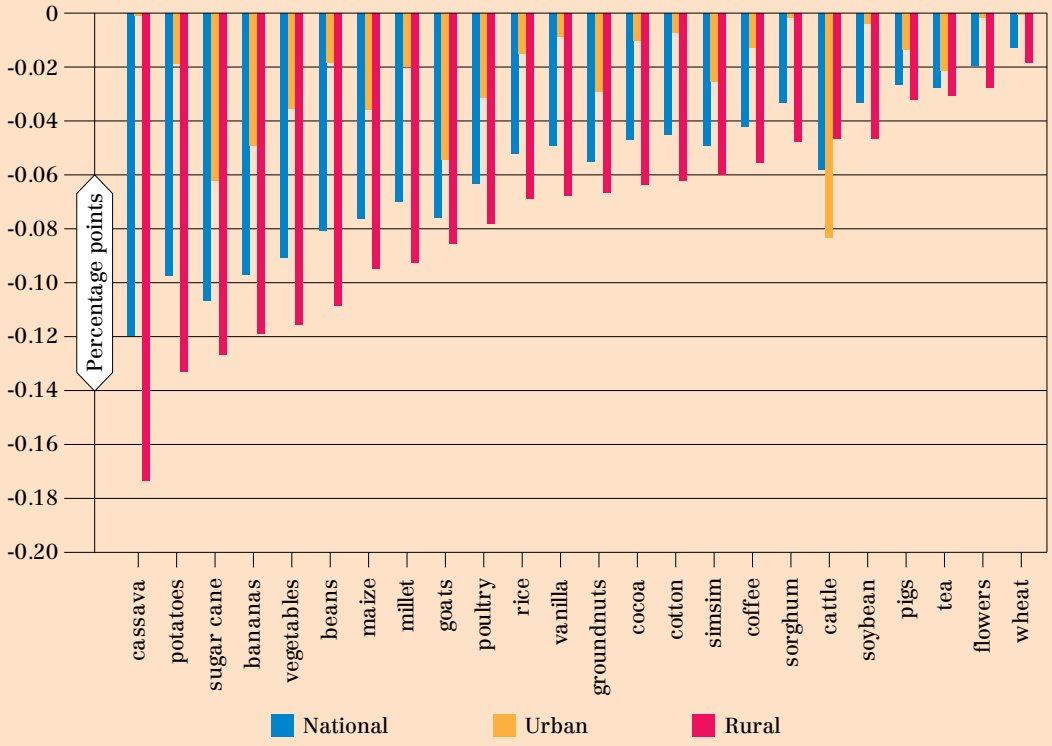


Source: Authors' calculations based on simulation results.

Poverty results

The effects of government investment in agriculture on poverty indicators are consistent with the performance of private consumption, since the poverty rate depends on changes in income and prices. Promoting agricultural sectors reduces, under all scenarios, the average price of food. This is not trivial, since food represents a relatively large proportion of the consumption basket in Uganda's poorest households. In addition, increased agricultural productivity has a positive impact on the labour income of rural households. In general, the scenarios will reduce rural poverty rates by 2030, ranging from 0.02 to 0.18 percentage points (see Figure 22). As expected, given its obvious links to the agricultural sectors and a higher initial poverty level, poverty reduction is stronger in rural areas. For example, rural and urban poverty are reduced by 0.12 and 0.05 respectively under the banana scenario. Interestingly, the cattle scenario shows a propensity to reduce poverty more in urban areas than in rural areas. This result is explained by higher meat consumption per capita in urban areas. Thus, a reduction in the price of meat has a stronger impact on urban consumption per capita (and consequently, on poverty) than in rural consumption per capita (and poverty).

FIGURE 22 Poverty rates under government investment scenarios for individual agricultural sectors with mixed financing, 2030 (percentage points deviation from the base scenario)



Source: Authors' calculations based on simulation results.

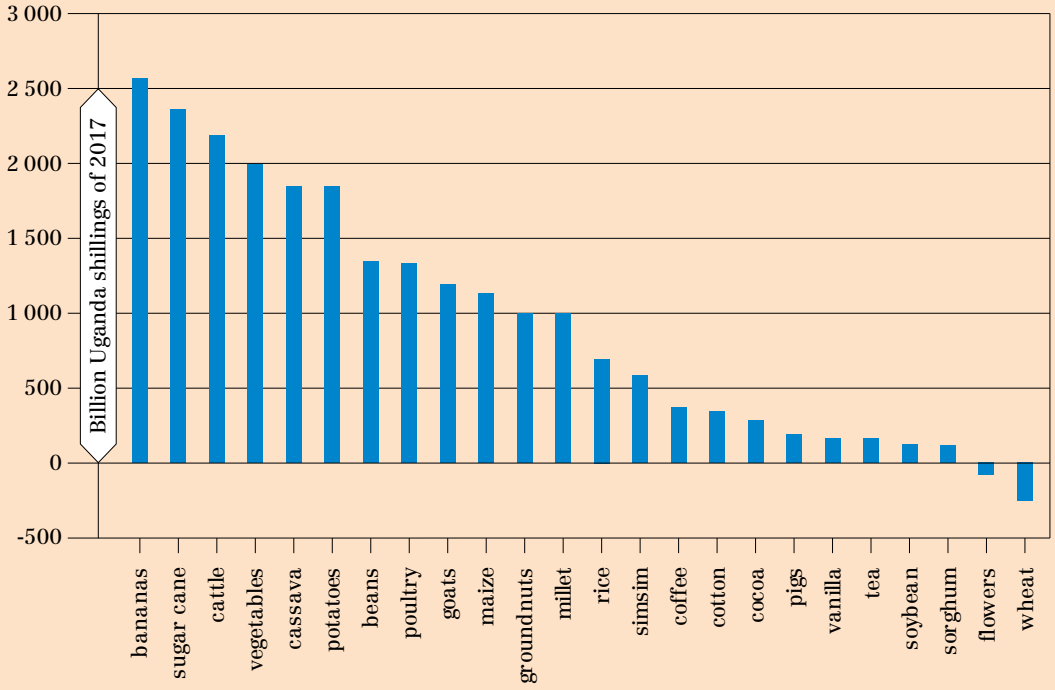
Net present value of government investment

Finally, we examined the net present value (NPV) of the simulated public investments in agricultural sectors. The NPV is calculated from the equivalent variation, which measures the change in welfare experienced by Ugandan households. This indicator answers the following question: How much income should be transferred to Ugandan households to

achieve the same change in welfare as is generated by the increased government investment in agricultural sectors?[15]

Figure 23 shows that the NPV ranges from 125 to 2 566 billion 2017 Uganda shillings when comparing the results obtained under the scenarios that focus the new public investment on different sectors of Ugandan agriculture. In other words, the NPV reports the net gain over the 1 491 billion 2017 Uganda shillings of additional government investment in agriculture. The ranking of sectors, from highest to lowest impact, is similar to that previously used for private consumption (see Figure 17). Most scenarios show positive effects for NPV. The sugar cane, bananas, goats and vegetables scenarios are located at the top of the NPV ranking. That is, public investment that boosts productivity in the agricultural sectors associated with these scenarios results in the largest discounted gains in the welfare of Ugandan households. On the other hand, the NPV for flowers and wheat is negative, due to their relatively smaller positive impact on private consumption, as previously discussed (see Figure 17).

FIGURE 23 Net present value of government investments in government investment scenarios for individual agricultural sectors with mixed financing



Source: Authors' calculations based on simulation results.

[15] The formula used in this estimate is:

$$NPV = \sum_{t=2022}^{t=2030} \frac{\Sigma_{h \in H} EV_{h,t}}{(1 + intrat)^{2022-t}}$$

$EV_{h,t}$ is the equivalent variation or measurement of welfare of Ugandan households and *intrat* is the interest rate that is assumed to be 8 percent. The equivalent variation measures the change in welfare experienced by households. In the equation above, the welfare of all representative households identified in the CGE model is weighted in the same way. That is, a utilitarian social welfare function is implicitly used. The results of the scenarios indicate that the increase in overall welfare would be higher if a welfare function were used that gives a higher weighting to households with the lower-consumption per capita.

5 Conclusions and recommendations

Uganda's economy needs a strong and sustained recovery. Economic developments in recent years, including the economic contraction in 2020, define the starting point for recovery. Both the productive structure (and its dynamism) and existing public policies and national development plans will determine, together with the available fiscal space, what new public policies Uganda will be able to implement to reactivate the economy.

Economic stimulus measures must focus on the sectors that are important, not only to the economy but also in terms of employment generation and the livelihoods of large segments of the population. Reactivating agriculture should thus be one of the drivers of economic recovery in Uganda. Here, agriculture is a key contributor to GDP growth; it employs a significant number of workers and is the main basis for rural livelihoods. It provides Ugandans with food not only directly but also indirectly by supplying inputs to the food industry. In addition, agriculture is linked to international trade, both through exports and imports. For all these reasons, investing in Ugandan agriculture will help the country to recover from the COVID-19 crisis and will generate medium- to long-term benefits in terms of rural poverty reduction and food security.

In fact, the NDP III gives agriculture a central role, which is encapsulated under the strategic programme on agro-industrialisation. Nonetheless, the NDP III was developed prior to the unprecedented COVID-19 pandemic with all of its health, economic and social repercussions. Implementation will now have to consider the effects of the pandemic and include well-aligned recovery strategies for a post-COVID-19 era.

This study has provided an analysis of prospective investment scenarios based on a modelling tool that represents the Ugandan economy and its multiple sectors. Validated and thoroughly discussed with Ugandan Government authorities, in particular the National Planning Authority (NPA) and the Ministry of Agriculture, Animal Industry and Fisheries (MAAIF), this study has addressed two questions:

- Will public investment that promotes agricultural productivity drive growth in agrifood production with a positive impact on the economy and on rural poverty reduction?
- In which sectors or branches of Uganda’s agriculture will this public investment result in the most significant socio-economic payoffs, thus maximizing its cost-effectiveness?

To answer these questions, a base scenario was developed for the period 2016–2030, in order to both reproduce the past and current behaviour of the Ugandan economy (2016–2021), including its sectoral structure, and to project it forward (2022–2030) assuming no policy shifts or external shocks that would disrupt it. The base scenario was compared with 28 scenarios to help us gauge the effects of government investment in selected agricultural sectors, starting in 2022.

The 28 investment scenarios simulate an increase in TFP in selected agricultural sectors, brought about by new public investments in productive infrastructure amounting to 0.25 percent of GDP (on average, about 373 billion 2017 Uganda shillings) during the years 2023–2025. This type of productivity shock is supported by empirical evidence that suggests that it can be achieved by improving rural roads, irrigation systems, storage infrastructure, etc. All of the scenarios assume that TFP in the targeted sectors increases by the equivalent of 30 Uganda shillings for each additional 100 Uganda shillings invested. The scenarios in

which all public investment was financed by foreign resources were found to result in the fastest recovery of economic growth in the short term – because the crowding-out effect of domestic financing sources (for example, on private consumption when direct taxation is used, or on private investment when domestic borrowing is mobilized) is avoided. However, our analysis of public investment scenarios assumed a mix of financing sources (i.e., tax revenue, non-tax revenues, oil revenues, grants, domestic borrowing, and foreign borrowing), based on our reading of the NDP III and 2021/22 Budget Framework's MTEF and a recommendation from Ugandan Government authorities.

The Ugandan agricultural sectors generally exhibit relatively high values for the ratio between employment and value added. Consequently, it was known *a priori* that an increase in TFP would promote, all other things being equal, a reallocation of resources from agriculture to other production sectors. Ugandan agricultural products are not highly export-oriented when compared to industrial manufacturing goods; as such, some sectors can be promoted by new public investments (such as vegetables, potatoes and cassava) and yet their gains may be limited by the size of the domestic market. Taking into account these key characteristics, the scenarios considered sectoral disaggregation within Uganda's agricultural sector and as well as sectors of the food industry that use agricultural products as intermediate inputs for production. A number of important conclusions and recommendations have been drawn from the analysis.

First, **public investment that promotes agricultural productivity can drive economic growth and rural poverty reduction, but the magnitude of the impacts will depend on the sector that that benefits from the investment**. The scenario that promotes sugar cane shows the largest gains; specifically, private consumption and GDP are both around 0.41 percent larger in 2030 relative to the base scenario. Because sugar cane has the lowest initial value added per worker, boosting TFP in this sector allows more workers to be reallocated to other production activities, generating important economy-wide impacts. Moreover, the production of sugar cane has strong forward linkages with the sugar industry: virtually all output is used as an intermediate input by the industry. Investing in the cattle, banana, goat, vegetable, maize, potato and cassava sectors also has important impacts on private consumption (and GDP) because the output of these sectors is – directly or indirectly – important for household consumption and the price of this output diminishes as productivity drives increased supply. GDP is also positively affected by increased exports; as expected, the agricultural sectors that generate the highest increases in exports are coffee, cocoa, vanilla, cotton, and flowers.

As government investment increases output in the targeted sectors, it also stimulates growth in non-agricultural sectors, both by increasing intermediate demand for agricultural output and/or final demand for non-agricultural products and by lowering input prices and fostering upstream processing. Agrifood GDP – the sum of the value added generated by agriculture and the food industry – is highly impacted by public investment in sugar cane, sorghum, and rice. The impact increases in the case of sectors that are directly or indirectly export- or import-oriented (crops relatively more than livestock). Production linkages with the food industry are less important when government investment targets crops that are consumed directly without processing, such as vegetables and potatoes. Increased agricultural production also generates additional demand for chemicals and transport services, which further stimulates growth in other manufacturing and service sectors.

In short, if Uganda's objectives are to maximize growth and post-pandemic recovery, it will be critical that government investments: i) promote sectors that are currently integrated into value chains, and/or ii) promote the entire value chain for sectors that are not. Sectors that are integrated into world markets can increase production and exports without being limited by the size of the domestic market. A key finding is that public investment that boosts

productivity in agricultural sectors, such as sugar cane, bananas, goats and vegetables, results in the largest discounted gains in the welfare of Ugandan households.

Consistent with the results for private consumption and given that greater agricultural productivity raises the income of rural households, the promotion of agriculture sectors reduces the average price of food in all scenarios. This reduction is not trivial, since food represents a relatively large proportion of the consumption basket in Uganda's poorest households. In general, all scenarios lead to reductions in rural poverty rates by 2030, ranging from 0.02 to 0.18 percentage points.

Second, it is possible to rank the sectors that should be prioritized for public investment in infrastructure, based on the effects on household consumption (welfare), national and agrifood GDP growth, export growth and rural poverty. Table 6 ranks the scenarios that focus on individual agricultural sectors (scenarios 5–28 in Table 5). These sectors are positioned in terms of their impact (from highest to lowest) on the aforementioned key variables. **The sugar cane sector comes first in three out of five indicators (private consumption, GDP and agrifood GDP) and it also ranks among the top five sectors in terms of export growth and rural poverty reduction**. But the picture that emerges is quite heterogeneous. **For example, the economy-wide gains of promoting sectors such as cattle or goats are higher than when the investment is allocated to staple sectors such as cassava and potatoes; but the contrary is seen in terms of rural poverty reduction. Investments in export-oriented crops, such as tea, coffee and cocoa, push up sales to the rest of the world, but their effect on agrifood GDP and the economy at large are not impressive and, in terms of rural poverty reduction, new investment does not place these sectors among the top ten in the ranking**.

Third, these findings provide important information about the priorities of the NDP III and the government's vision for agriculture, which falls under the strategic programme on agro-industrialisation, as well as new priorities for economic recovery with increased well-being post-COVID-19. To foster agro-industrialization, the government has selected ten priority commodities (coffee, tea, fisheries, cocoa, cotton, vegetable oil, beef, maize, dairy and cassava). **Our findings validate the importance of including cattle, coffee, maize, tea, cotton, cocoa and cassava in the government priorities**, since investing in these sectors is expected to have major impacts on at least one of the five variables presented in Table 6. Our findings also align with the government decision to include tea, coffee, cotton and cocoa on the grounds of boosting agricultural exports. In addition, our analysis suggests that commodities included for food security reasons (i.e., maize and cassava) rank quite high in terms of rural poverty reduction. However, **our results highlight other sectors (i.e., sugar cane, bananas and goats), which do not currently figure on the government's priority list despite findings that they are very cost-effective receptors of public investment. At the same time, subsectors that are prioritized in the government's plans, such as beef and dairy, do not appear to be the most cost-effective in terms of the variables analysed**.[16] In the case of cattle (beef and dairy), while it does not rank high in terms of boosting export revenues (the government's justification to include beef as a priority commodity), it does nevertheless rank high in terms of boosting GDP and private consumption.

[16] Findings for other subsectors that are prioritized in the government's plans, such as fisheries and vegetable oil, are inconclusive in this regard. In the case of fisheries, we did not have enough information to calibrate a natural resource supply function that – as part of the CGE model – would have allowed us to take into account the growth process of the fish stock. In turn, vegetable oil was not targeted for research because it belongs to the food processing industry, while our simulated investments were focused on primary agricultural sectors.

TABLE 6 Sectoral ranking by the impact of government investment on five socio-economic indicators

#	Private consumption	GDP	Agrifood GDP	Exports	Rural poverty
1	Sugar cane	Sugar cane	Sugar cane	Tea	Cassava
2	Cattle	Goats	Sorghum	Coffee	Potato
3	Banana	Cattle	Rice	Cocoa	Sugar cane
4	Goats	Bananas	Coffee	Vanilla	Banana
5	Vegetables	Maize	Cotton	Sugar cane	Vegetables
6	Maize	Tea	Millet	Cotton	Beans
7	Potato	Simsim	Tea	Flowers	Maize
8	Cassava	Vegetables	Cocoa	Sorghum	Millet
9	Poultry	Millet	Soybean	Goats	Goats
10	Beans	Groundnut	Flowers	Maize	Poultry
11	Groundnut	Poultry	Simsim	Soybean	Rice
12	Millet	Rice	Cattle	Millet	Vanilla
13	Simsim	Coffee	Wheat	Simsim	Groundnut
14	Rice	Cocoa	Maize	Cattle	Cocoa
15	Vanilla	Beans	Cassava	Beans	Cotton
16	Cocoa	Potatoes	Vanilla	Groundnut	Simsim
17	Coffee	Vanilla	Beans	Poultry	Coffee
18	Tea	Cotton	Vegetables	Banana	Sorghum
19	Cotton	Soybean	Banana	Vegetables	Cattle
20	Pigs	Wheat	Groundnut	Pigs	Soybean
21	Soybean	Cassava	Potato	Potato	Pigs
22	Sorghum	Sorghum	Poultry	Cassava	Tea
23	Flowers	Flowers	Goats	Rice	Flowers
24	Wheat	Pigs	Pigs	Wheat	Wheat

Source: Authors' calculations based on simulation results.

It goes without saying that the ranking of sectors ignores other criteria that may be important to consider in prioritizing investments. For example, the sugar cane sector ranked first in our findings, based on the impact that public investment in this sector would have on GDP growth, agrifood linkages, private consumption, and rural poverty reduction. However, if the government was also aiming to improve consumption patterns and nutrition, this might introduce additional considerations since the sugar cane sector is strongly linked to sectors of the food industry producing sugars, chocolates, sweets and beverages. There may also be environmental sustainability elements of the entire sugar cane value chain that have not been taken fully into account in our analysis, and new investments may be needed to modernize and increase the sustainability of the sector's production processes.

Having said that, the ranking of sectors is just a starting point – albeit a key one – for a more focused analysis. It enables decisions-makers to consider how investing in agriculture can promote economic recovery and rural poverty reduction and where such investments are best placed. As a next step it will be important to identify the territories where investing in priority sectors could have the greatest socio-economic impact, due to the high environmentally-friendly production and poverty reduction potential (**where to invest**). Then, having identified priority sectors and territories with great potential, it will also be crucial to identify the specific components of primary production requiring support (**what to invest in**) and the amount of resources needed to support them (**how much to invest**). These can be important steps to take in the framework of FAO's support for the Government of Uganda.

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Annexes

Annex A. Steps to derive the financing scenario

To design the investment scenarios using mixed financing, we used the information provided in Table 2 of this study, in order to separate donor financing and national financing for agriculture. However, this information did not allow us to further disaggregate the sources of financing for the national component of the expenditure. From a modelling perspective, this is important, since financing through tax revenue or through grants has very different implications in terms of the results of the model, as explained in Section 4. For this reason, we are forced to make an assumption regarding the sources of financing for these expenditures. For this exercise, we assume that the financing composition of the national expenditure is the same as the composition of domestic revenues (shown in Table A1). The final assumptions regarding the financing are shown in Table A1 and the steps we followed to arrive to this set of assumptions are detailed further below.

TABLE A1 Assumptions on the sources of funding used to finance agriculture expenditures during the NDP III implementation period

	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26
	Share of agriculture expenditure					
Tax revenues	0.37	0.50	0.52	0.51	0.51	0.51
Non-tax revenue	0.03	0.04	0.04	0.04	0.04	0.04
Oil revenues	0.00	0.00	0.00	0.00	0.02	0.06
Grants	0.04	0.05	0.04	0.06	0.05	0.04
Domestic financing	0.13	0.07	0.05	0.04	0.04	0.01
External financing	0.43	0.34	0.35	0.35	0.35	0.35
Total	1.00	1.00	1.00	1.00	1.00	1.00

Source: Authors' calculation based on NPA (National Planning Authority). 2020. *Third National Development Plan (NDP III) 2020/21 – 2024/25*. Kampala; and Ministry of Finance, Planning, and Economic Development. 2020. *National Budget Framework Paper FY 2021/22 – FY 2025/26*. Kampala.

We followed the following steps to determine the sources of financing used in the mixed financing scenarios.

Step 1. Calculating the share of expenditures financed by external sources

From the information provided in Table 2, we derive the share of expenditures that are financed by foreign borrowing/donors. From this, we obtain the following shares (see Table A2).

TABLE A2 Share of donor versus national financing

	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26
	Share of agriculture expenditure					
National financing	0.57	0.66	0.65	0.65	0.65	0.65
External financing	0.43	0.34	0.35	0.35	0.35	0.35

Note: National financing includes revenues, grants and domestic borrowing (domestic net financing, as per the terminology used in the budget framework).

Source: Ministry of Finance, Planning, and Economic Development. 2020. *National Budget Framework Paper FY 2021/22 – FY 2025/26*. Kampala.

Step 2. Apportioning the non-external financing by source

Step 2.1. Deriving the source of financing for the full budget. Since we need to break down domestic financing by source, we start by using information on the financing of the full budget. Using the information in Table 1, we calculate the contribution of each financing source to the total expenditure,[17] which gives us the results shown in Table A3.

TABLE A3 Financing sources used to finance the budget

	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26
	Share of agriculture expenditure						
Tax revenues	0.56	0.48	0.57	0.60	0.64	0.70	0.73
Non-tax revenue	0.05	0.03	0.04	0.05	0.05	0.05	0.05
Oil revenues	–	0.00	–	–	–	0.03	0.08
Grants	0.03	0.05	0.05	0.04	0.08	0.07	0.05
Domestic financing	0.14	0.17	0.08	0.06	0.05	0.05	0.01
External financing	0.22	0.26	0.24	0.25	0.18	0.10	0.08
Total	1.00	1.00	1.00	1.00	1.00	1.00	1.00

Source: Ministry of Finance, Planning, and Economic Development. 2020. *National Budget Framework Paper FY 2021/22 – FY 2025/26*. Kampala.

Step 2.2. Compute the breakdown of revenue sources, excluding external financing. Once the breakdown for the full budget is derived, we recompute the above table, excluding external financing to obtain the breakdown of national financing (own resources + domestic financing) by source,[18] which gives us Table A4.

[17] For example, the 0.48 for tax revenue in 2020/21 is derived by dividing the total tax revenue in 2020/21 (18 063) by the total expenditure (37 253). Note: all numbers are rounded to the second decimal.

[18] For example, to obtain the 0.66 number for tax revenue in 2020/21, we divided the share of tax revenue in total expenditures (0.48) by the sum of all funding sources except external financing in the total budget (0.48 + 0.03 + 0.00 + 0.05 + 0.17 = 0.74). Dividing 0.48 by 0.74 gives us approximately 0.66. Note: All numbers are approximated to the second decimal so the actual division is 0.4849 by 0.7354.

TABLE A4 Breakdown of financing sources (excluding external financing)

	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26
	Share of agriculture expenditure					
Tax revenues	0.66	0.76	0.80	0.78	0.78	0.79
Non-tax revenue	0.05	0.06	0.06	0.06	0.05	0.05
Oil revenues	0.00	–	–	–	0.04	0.09
Grants	0.06	0.07	0.06	0.10	0.08	0.06
Domestic financing	0.23	0.11	0.08	0.07	0.05	0.01
Total	1.00	1.00	1.00	1.00	1.00	1.00

Source: Authors' own elaboration.

Step 3. Construct the final breakdown of agriculture spending by source. The final step is to combine the information from the previous tables and derive the breakdown of agricultural spending by source, which is shown in Table A5.

TABLE A5 Calculated financing source for agricultural spending

	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26
	Share of agriculture expenditure					
Tax revenues	0.37	0.50	0.52	0.51	0.51	0.51
Non-tax revenue	0.03	0.04	0.04	0.04	0.04	0.04
Oil revenues	0.00	0.00	0.00	0.00	0.02	0.06
Grants	0.04	0.05	0.04	0.06	0.05	0.04
Domestic financing	0.13	0.07	0.05	0.04	0.04	0.01
External financing	0.43	0.34	0.35	0.35	0.35	0.35
Total	1.00	1.00	1.00	1.00	1.00	1.00

Source: Authors' own elaboration.

As we can see, the row on external financing is identical to that in Table 2. All other rows are obtained by multiplying the shares obtained in step 2.2 by the share of expenditures not financed using external financing from step 1.

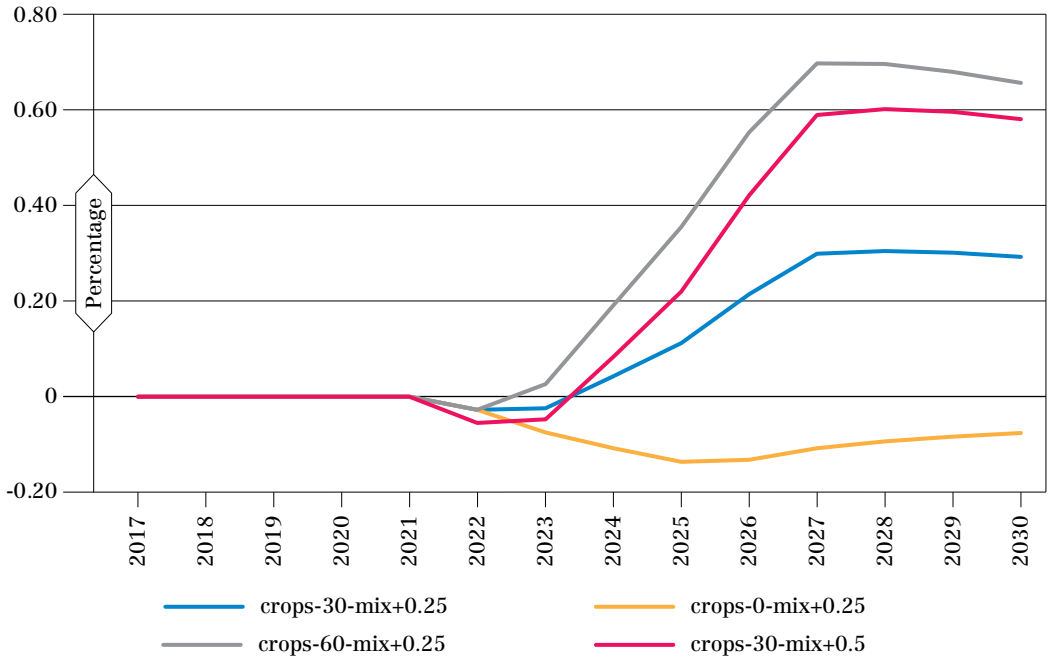
Annex B. Results with alternative productivity assumptions and investment amounts

Apart from the selection of sectors, the impact of targeted public infrastructure investment in Uganda will depend on several contextual factors. In this annex, we explore the importance of the marginal productivity of such interventions and the level of investment.

Recalling what has been said in Section 4 of this study, we assume that the marginal productivity (MP) of new public capital is 0.3. In other words, one million Uganda shillings of infrastructure capital, once installed, will add 300 000 Uganda shillings to the initial level of value added. As discussed, the assumption that MP is equal to 0.3 falls between available estimates at the higher and lower end.

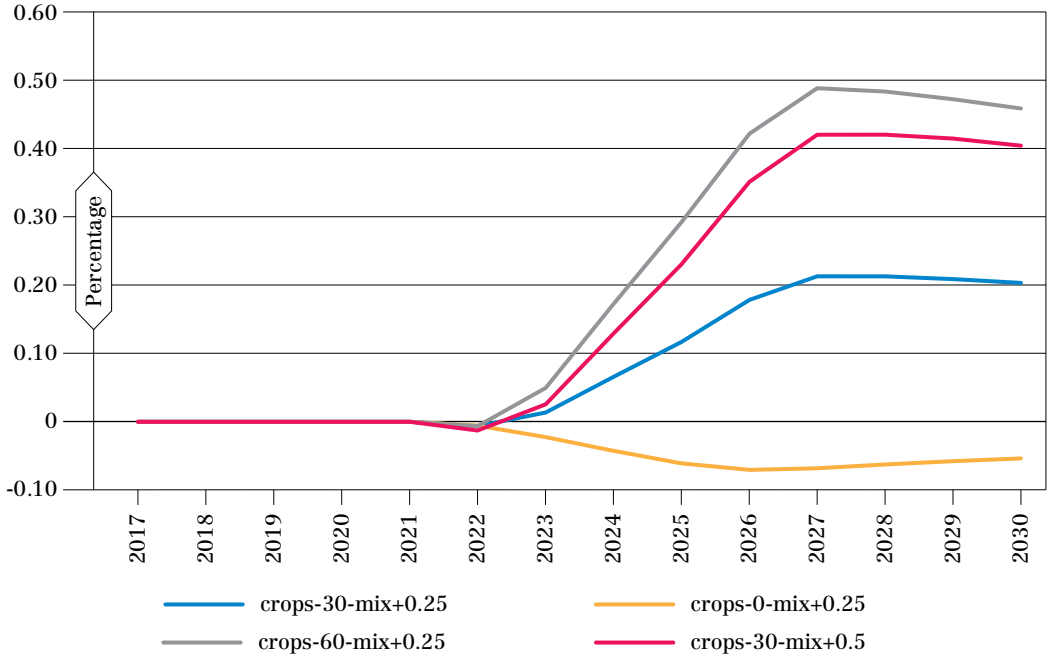
Consider the scenario **crops-30-mix+0.25**, where public investments are increased for all crops (relative to the base scenario) by the equivalent of 0.25 percent of GDP between 2022 and 2026, using a mix of financing sources, and the MP is equal to 0.3 (as in the scenario **crops-mix** in Table 5). Now consider alternative scenarios where either public investment is doubled relative to GDP (**crops-30-mix+0.5**) or the MP is reduced to zero (**crops-0-mix+0.25**) or doubled (**crops-60-mix+0.25**). The positive effects on both private consumption and GDP will be stronger the higher the investment or the marginal product of public capital (i.e., the additional public investment generates larger increases in the sectoral TFP) (see Figures A1 and A2). In this regard, an increase in TFP (e.g., an increase in agricultural yields) makes it possible to increase production with the same level of factor employment. In turn, the marginal product of public capital determines how much the TFP will increase for a given increase in public investment.

FIGURE A1 **Real private consumption under four government investment scenarios for all crop sectors with mixed financing and alternative assumptions for marginal utility and level of investment, 2017–2030 (percentage deviation from the base scenario)**



Source: Authors' calculations based on simulation results.

FIGURE A2 Real GDP under four government investment scenarios for all crop sectors with mixed financing and alternative assumptions for marginal utility and level of investment, 2017–2030 (percentage deviation from the base scenario)



Source: Authors' calculations based on simulation results.

Naturally, the overall positive impacts are not observed when the marginal product of public capital is zero (scenario crops-00-mix+0.25). In other words, the extent to which the medium- to long-term impact of public infrastructure investment is positive strongly depends on whether a selected investment project has high MPs (or rates of return). In other words, our results highlight the importance of selecting infrastructure projects with high rates of return or marginal products of new infrastructure capital. To assess the realism of different levels of the MP and scenarios, government planners may review separate assessments of the anticipated rates of return of alternative investment programmes.

Annex C. Analysis of sensitivity of scenario results to changes in elasticity values

The results of a CGE model depend on the value assigned to the various supply and demand elasticities that populate various equations of the model. For the purposes of our study, the CGE model requires information on the following elasticities: substitution between production factors, on the production side; substitution between imports and domestic purchases, on the consumer side; transformation of domestic production between exports and sales to the domestic market; income (or expenditure) for each of the products consumed by households; and the level of wages with respect to unemployment (elasticity of the wage curve). The uncertainty surrounding the value of these elasticities is transferred to the results of the simulated scenarios in Section 4 of this study.

This annex evaluates the sensitivity of the results of the various investment scenarios presented in Section 4 with respect to the value assigned to the different elasticities of the model. To that end, a Monte Carlo simulation is applied, which consists of solving the model (that is, running the scenarios) several times, each time using a different set of randomly-chosen elasticities. For our study, the model was solved 500 times. Each time, the value of the elasticities was obtained from a uniform distribution with minimum and maximum values equal to 25 percent and 175 percent of the 'central' value used to obtain the results presented in Section 4. Then, using the results of all model solutions for all scenarios, the confidence intervals were calculated for each of the results presented in that section.

Table A6 shows the results of the 28 simulation scenarios used in this study (represented in columns).[19] Only two macroeconomic aggregates and the results for the year 2030 are included for the sake of simplicity. The presentation of results (by rows) starts with the estimated percentage of change of the two macroeconomic aggregates using the central elasticities (that is, the elasticities used to generate the results presented in Section 4). Then, to assess the sensitivity of the results to changes in the value of elasticities, the next results (presented by row) include the average of the 500 observations generated by the sensitivity analysis, the standard deviation, and the upper and lower bounds calculated under the assumptions that the results are normally distributed and that all the model solutions included in the Monte Carlo experiment receive the same weighting (see Table A6).

The results show that the percent changes from the base scenario for private consumption and GDP reported in Section 4 are statistically significant. For example, there is certainty that the scenario in which new public investment in infrastructure promotes productivity in the sugar cane subsector (sugcane) has the most positive effects of all considered scenarios. This conclusion is obtained by performing a test for the difference between means for the results set out in Table A6.[20] The same type of assessment can be made for the other results reported in Section 4. That is, the results discussed in Section 4 are robust to changes in the elasticity values of Uganda's CGE model.

[19] Table 5 in the main text defines the 28 scenarios.

[20] It has been determined that the differences among the averages reported in Table A6 are statistically significant.

TABLE A6 Results of the sensitivity analysis for private consumption and GDP expressed as the percentage deviation from the base scenario in 2030

Item	Private consumption					Gross domestic product (GDP)				
	Central elasticities	Mean	Standard deviation	Lower bound	Upper bound	Central elasticities	Mean	Standard deviation	Lower bound	Upper bound
crops-fbor	0.356	0.376	0.152	0.224	0.528	0.252	0.260	0.099	0.161	0.359
crops-dbor	0.097	0.120	0.152	-0.032	0.272	0.010	0.019	0.098	-0.078	0.117
crops-tdir	0.245	0.267	0.150	0.116	0.417	0.154	0.163	0.099	0.064	0.261
crops-mix	0.293	0.314	0.154	0.160	0.468	0.195	0.204	0.099	0.105	0.303
sugar cane	0.405	0.366	0.063	0.303	0.430	0.385	0.345	0.063	0.281	0.408
cotton	0.111	0.116	0.131	-0.015	0.247	0.139	0.143	0.089	0.054	0.232
flowers	0.044	0.052	0.131	-0.078	0.183	0.076	0.081	0.090	-0.009	0.171
cocoa	0.124	0.131	0.121	0.010	0.252	0.155	0.161	0.080	0.081	0.240
coffee	0.124	0.134	0.126	0.008	0.260	0.156	0.164	0.084	0.081	0.248
tea	0.121	0.122	0.122	0.000	0.244	0.203	0.188	0.102	0.086	0.290
vanilla	0.125	0.130	0.124	0.005	0.254	0.147	0.150	0.084	0.067	0.234
wheat	0.028	0.030	0.016	0.014	0.046	0.127	0.126	0.010	0.116	0.136
maize	0.264	0.281	0.140	0.140	0.421	0.210	0.219	0.092	0.127	0.311
rice	0.150	0.161	0.131	0.031	0.292	0.158	0.166	0.090	0.076	0.257
sorghum	0.071	0.083	0.127	-0.044	0.210	0.108	0.117	0.085	0.032	0.201
millet	0.200	0.181	0.141	0.040	0.322	0.188	0.149	0.116	0.033	0.265
veget	0.290	0.300	0.144	0.157	0.444	0.196	0.200	0.096	0.104	0.296
soyabeans	0.078	0.078	0.124	-0.045	0.202	0.135	0.129	0.090	0.040	0.219
groundnuts	0.200	0.203	0.019	0.184	0.223	0.177	0.176	0.011	0.166	0.187
simsim	0.178	0.186	0.030	0.156	0.216	0.199	0.203	0.022	0.181	0.224
potatoes	0.251	0.266	0.140	0.126	0.405	0.150	0.157	0.093	0.064	0.249
cassava	0.240	0.253	0.146	0.107	0.399	0.117	0.124	0.092	0.032	0.216
beans	0.216	0.225	0.137	0.088	0.362	0.154	0.159	0.090	0.068	0.249
bananas	0.347	0.369	0.172	0.197	0.541	0.225	0.233	0.105	0.128	0.338
cattle	0.377	0.402	0.119	0.283	0.520	0.353	0.385	0.129	0.256	0.513
goats	0.321	0.311	0.038	0.273	0.349	0.384	0.393	0.070	0.323	0.463
pigs	0.094	0.104	0.120	-0.016	0.224	0.072	0.073	0.088	-0.014	0.161
poultry	0.224	0.233	0.133	0.100	0.366	0.164	0.169	0.091	0.077	0.260

Note: A 95 percent confidence interval is estimated under the normality assumption.
Source: Authors' own elaboration.

This study highlights how, through a series of scenarios, public investments promoting agricultural productivity in Uganda could drive growth in agrifood production, with favourable impacts on the economy, on well-being and on poverty, especially in rural areas. Using a modelling tool to represent the Ugandan economy, with its multiple sectors and current fiscal constraints, the study ranked the subsectors of Uganda's agriculture that, through the productivity impact of public investments representing 0.25 percent of GDP (on average, about 373 billion 2017 Uganda shillings) during the years 2023–2025, will generate the greatest socio-economic benefits, maximizing the cost-effectiveness of the public investments.

Generally, economic growth and the welfare of households, as measured by their consumption, will be positively impacted, but the impacts will ultimately depend on the sector that receives the investment, which is shown in a ranking. The agricultural sectors targeted for government investment will increase their output (and food prices will thus fall), and this will stimulate growth in non-agricultural sectors, both by increasing final demand for non-agricultural products and by lowering input prices and fostering upstream processing. Lower food prices will have a significant impact since food represents a relatively large proportion of the consumption basket of poorest households. Furthermore, labour income for rural households will increase with productivity growth, and this will reduce rural poverty.

The findings of this study provide important information about the priorities of Uganda's National Development Plan (NDP) III and vision for agriculture, as well as new priorities to be considered for enabling economic recovery with increased well-being post-COVID-19.

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