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Taxation, infrastructure investment, growth, and poverty reduction: A case study of Zimbabwe*

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Abstract

In recent decades, Zimbabwe's development record has been disappointing. In the last few years, a severe drought and the Covid-19 pandemic have added to the country's development challenges. This paper is concerned with the long-run need to find a path toward faster growth in GDP, employment, and incomes, accompanied by more rapid progress on poverty reduction and other parts of the global sustainable development agenda. As part of this search, the country will need to address structural constraints including a large infrastructure gap, an inefficient government, and unhospitable business climate. Among these, this paper is focused on infrastructure and alternative means of financing scaled-up investments – what are the consequences of relying on domestic taxes compared to foreign financing?

To address these questions, the paper draws on simulations with SDGSIM, a computable general equilibrium (CGE) model, designed for SDG analysis but applicable to analysis of policies in a wide range of areas, including growth, fiscal space, and external shocks. The model was adapted to the Zimbabwean context and calibrated to a database for 2016. The simulations cover the period 2016-2030 and analyzes the effects of alternative levels and priorities for government spending and resource mobilization (domestic and foreign). The simulation results cover a wide range of economic indicators, including some related to the global Sustainable Development Goal (SDG) agenda.

The differences between the scenario results for GDP growth, household consumption, and poverty point to the importance of strong public investment management and, other things being equal, of targeting TFP gains to tradable sectors. The advantages of reliance on domestic taxation for the funding of expanded investment include slower debt accumulation and less reliance on the decisions of external actors. Tax reliance may also give the funders, the citizens, a stronger sense of ownership and right to monitor how the money is used, with a positive impact on investment productivity. On the other hand, before the investment have yielded sufficient returns, reliance on taxes reduces private purchasing power, leading to some combination of lower private consumption and investment. Raising the tax burden by 2-3 percent of GDP may also be administratively difficult. It would of course be possible to consider scenarios that split the funding burden between domestic taxes and foreign financing.

JEL Codes: C68, H54, O55.

1. Introduction

In recent decades, Zimbabwe's development record has been disappointing. In the last few years, external shocks – in 2019, the economy suffered from a severe drought and, in 2020, like the rest of the world from the Covid-19 pandemic – have added to the severe challenges faced by the country's government and population. However, the objective of this paper, which is based on research done in 2019, is not to address short-run issues. Instead, the paper considers issues related to Zimbabwe's search for a long-term path toward faster growth in GDP, employment, and incomes, accompanied by more rapid progress on poverty reduction and other parts of the global sustainable development agenda. As part of this search, the country will need to address structural challenges including a large infrastructure gap, an inefficient government, and unhospitable business climate. This paper is focused on these long-term challenges, in particular infrastructure and alternative means of financing scaled-up investments – what are the consequences of relying on domestic taxes compared to foreign financing?

To address these questions, the paper draws on simulations with SDGSIM, a computable general equilibrium (CGE) model, designed for SDG analysis but applicable to analysis of policies in a wide range of areas, including growth, fiscal space, and external shocks. The model was adapted to the Zimbabwean context and calibrated to a database for 2016. The simulations cover the period 2016-2030 and consider alternative policies and shocks starting from 2019, with a focus on alternative levels and priorities for government spending and resource mobilization (domestic and foreign). The simulation results cover a wide range of economic indicators, including some related to the global Sustainable Development Goal (SDG) agenda.

In outline, this paper is organized as follows: For context, Section 2 starts with a brief background on Zimbabwe's economy and policy challenges, including a cross-country analysis of Zimbabwe's economic structure and performance during the period 2000-2014, comparing the country to the Africa region as a whole. The simulations are presented and analyzed in Section 3. The concluding Section 4 summarizes the main findings. More details on the model structure, data, and additional simulation results are presented in three appendices.

2. Background on Zimbabwe's economy and policy challenges

To provide context for the simulation analysis, this section reviews key aspects of Zimbabwe's economy and policy challenges. A large part of the quantitative information is extracted from the 2016 Zimbabwe macro and meso SAMs, which are part of the model database.[1] Additional information from a cross-country database extracted from World Bank (2018b) is used to analyze the current status of Zimbabwe's economy and its performance since 2000 from a regional African perspective.

[1] Parts of this section draw on Cicowiez and Lofgren (2018, pp. 17-23). For more information about the data sources and the SAM construction, see this paper.

Economic structure in 2016

Tables 2.1-2.6 cover Zimbabwe's GDP structure (from the spending side), balance of payments (split into current and capital accounts), government budget, sector structure, structure of sector factor use, and demand structure, respectively. In terms of GDP spending structure (Table 2.1), absorption (domestic final demands) exceeds total GDP by 14 percent thanks to a trade deficit of the same magnitude. Among domestic final demands, the private sector and the government account for 86.1 and 27.8 percent, respectively. Compared to private final demands, government final demands are more investment-focused: the ratios between investment and consumption are 0.24 for the government and 0.11 for the private sector. The current account of the balance of payments (Table 2.2) shows that the trade deficit and absorption in excess of GDP were made possible by foreign savings (a current account deficit) at 2.6 percent and a surplus for non-trade items in the current account at 10.5 percent (with non-government transfers or "worker remittances" as the main inflow). In the capital account of the balance of payments, the current deficit is covered by FDI (2.6 percent) and financing, both government and non-government.

Table 2.1. GDP Structure, Zimbabwe in 2016
(nominal and percent of GDP)

Item	millions of US$	% of GDP
Absorption	18,949	114.0
Private consumption	12,791	77.0
Government consumption	4,131	24.9
Fixed investment	2,015	12.1
Private fixed investment	1,525	9.2
Government fixed investm	491	3.0
Change in inventories	12	0.1
Exports	4,098	24.7
Imports	-6,427	-38.7
GDP at market prices	16,620	100.0
Net indirect taxes	-2,073	-12.5
GDP at factor cost	14,547	87.5

Source: Authors' calculations based on 2016 Zimbabwe SAM.

Table 2.2. Balance of Payments, Zimbabwe in 2016 (nominal and percent of GDP)

Item	millions of US$	% of GDP
Current account, inflows of foreign exchange		
Exports	4,098	24.7
Transfers to non-government	1,942	11.7
Factor income	211	1.3
Foreign savings	591	3.6
Total	6,842	41.2
Current account, outflows of foreign exchange		
Imports	6,427	38.7
Transfers from non-government	16	0.1
Transfers from government	0	0.0
Factor income	399	2.4
Total	6,842	41.2
Capital account		
Net foreign financing to non-government	90	0.5
Net foreign financing to government	76	0.5
Foreign direct investment	426	2.6
Total	591	3.6

Source: Authors' calculations based on 2016 Zimbabwe SAM.

In the government budget (Table 2.3), taxes, at 20.1 percent of GDP, are the main receipt while non-tax revenues amount to 1.8 percent. In turn, government savings are negative (-3.0 percent) while government investment amounts to 3.0 percent. The resulting government deficit (6.0 percent) is covered by domestic and foreign financing.

Table 2.3. Government budget, Zimbabwe in 2016 (nominal and percent of GDP)

Item	millions of US$	% of GDP
Recurrent receipts		
Direct taxes	1,261	7.6
Activity taxes	195	1.2
Commodity taxes	1,605	9.7
Tariffs	273	1.6
Domestic transfers	295	1.8
Total	3,629	21.8
Recurrent spending		
Consumption	4,131	24.9
Foreign transfers	0	0.0
Total	4,131	24.9
Savings*	-502	-3.0
Investment	491	3.0
Surplus**	-992	-6.0
Financing		
Net domestic financing	917	5.5
Net foreign financing	76	0.5
Total	992	6.0

*Savings is the difference between the totals for recurrent receipts and recurrent spending.
**Surplus is the difference between savings and investment.
Source: Authors' calculations based on 2016 Zimbabwe SAM.

Drawing on the more disaggregated information in the SAM, Tables 2.4 summarizes the sectoral structure of production and trade. The columns "Exports" and "Imports" show the share of each sector in total exports and imports, while the columns "Export-Output ratio" and "Import-Demand ratio" present, for each sector, the share of exports in output and the share of imports in domestic demands. In terms of broad sectoral characteristics, the table shows that, while the share of agriculture in value added is merely 11.1 percent, the sector represents a significant share of export revenue (33.1 percent) and is strongly export-oriented (the export-output ratio is 39.4 percent). Likewise, manufacturing – which comprises semi-manufactured forms of gold (Zimbabwe's main export product) -- makes an important contribution to exports and is also quite export-oriented (although less so than agriculture). However, compared to agriculture, manufacturing accounts for a slightly smaller share of value added and a much larger share of imports (73.8 percent vs. 6.8 percent for agriculture) with an import-demand ratio that also is much higher (46.8 percent vs. 20.3 percent for agriculture). By contrast, with the partial exceptions of "Trade, hotels, and restaurants" and "Transport and communications", the service sectors have no direct links to the international economy.

Table 2.4. Sectoral structure, Zimbabwe in 2016
(percent)

Commodity	Value added	Production	Exports	Export-Output ratio	Imports	Import-Demand ratio
Agriculture, forestry and fishing	11.1	10.7	33.1	39.4	6.8	20.3
Mining and quarrying	8.0	5.3	16.6	39.6	0.2	1.5
Manufacturing	9.9	22.9	39.6	22.0	73.8	46.8
Electricity and water supply	2.0	1.2	0.2	2.3	2.3	31.4
Construction	2.6	1.6	0.0	0.0	0.0	0.0
Financial intermediation	6.7	12.5	0.0	0.0	0.0	0.0
Real estate and business activities	4.8	4.0	0.0	0.0	0.0	0.0
Trade, hotels and restaurants	15.3	9.2	6.6	9.1	4.0	10.7
Transport and communications	10.3	16.4	3.9	3.0	12.9	16.8
Public administration	11.1	6.4	0.0	0.0	0.0	0.0
Education	13.0	7.0	0.0	0.0	0.0	0.0
Health	2.9	1.7	0.0	0.0	0.0	0.0
Domestic services	0.3	0.2	0.0	0.0	0.0	0.0
Other services	2.0	1.0	0.0	0.0	0.0	0.0
Total	100.0	100.0	100.0	12.7	100.0	21.5

Source: Authors' calculations based on 2016 Zimbabwe SAM.

Table 2.5 shows the factor shares in the value added of each sector. Among other things, it suggests that agriculture is relatively intensive in unskilled labor and land. On the other hand, sectors such as public administration, education, and health are relatively intensive in the use of skilled labor. Finally, Table 2.7 shows the demand structure for each commodity in the SAM. For instance, more than 60 percent of the mining output is used as intermediate input by the manufacturing sector.

The information showed in this section, extracted from the SAM, is an important input and starting point when the results from SDGSIM simulations are analyzed. In fact, the task of the CGE model is to generate and explain how the values in the different SAM cells change under different scenarios, including how the values often depend on changes in prices, quantities, and tax rates.

Table 2.5. Sectoral factor intensity, Zimbabwe in 2016
(percent)

Activity	Labor, unskilled	Labor, skilled	Capital	Land	Extractive resource	Total
Agriculture, forestry and fishing	41.4	21.1	17.8	19.7	0.0	100.0
Mining and quarrying	6.0	55.2	25.2	0.0	13.6	100.0
Manufacturing	8.5	51.7	39.9	0.0	0.0	100.0
Electricity and water supply	6.5	56.6	36.9	0.0	0.0	100.0
Construction	12.9	62.3	24.8	0.0	0.0	100.0
Financial intermediation	5.3	12.9	81.8	0.0	0.0	100.0
Real estate and business activities	17.6	42.5	39.9	0.0	0.0	100.0
Trade, hotels and restaurants	12.1	33.4	54.5	0.0	0.0	100.0
Transport and communications	9.9	27.4	62.6	0.0	0.0	100.0
Public administration	6.9	85.6	7.6	0.0	0.0	100.0
Education	6.7	83.3	10.0	0.0	0.0	100.0
Health	6.5	80.8	12.8	0.0	0.0	100.0
Domestic services	100.0	0.0	0.0	0.0	0.0	100.0
Other services	24.8	60.1	15.1	0.0	0.0	100.0
Total	13.2	49.6	33.9	2.2	1.1	100.0

Source: Authors' calculations based on 2016 Zimbabwe SAM.

Table 2.6. Sectoral demand composition, Zimbabwe in 2016 (percent)

Commodity	Interm use	Dist marg	Private cons	Gov cons	Exports	GFCF	Stock change	Total
Agriculture, forestry and fishing	57.5	0.0	8.5	0.0	33.9	0.0	0.1	100.0
Mining and quarrying	60.9	0.0	0.0	0.0	38.1	0.0	0.9	100.0
Manufacturing	35.4	0.0	41.1	0.0	11.9	11.8	-0.1	100.0
Electricity and water supply	38.8	0.0	59.7	0.0	1.6	0.0	0.0	100.0
Construction	43.2	0.0	2.0	0.0	0.0	54.8	0.0	100.0
Financial intermediation	67.9	0.6	31.5	0.0	0.0	0.0	0.0	100.0
Real estate and business activitie	0.3	0.0	99.7	0.0	0.0	0.0	0.0	100.0
Trade, hotels and restaurants	36.7	52.8	2.2	0.0	8.2	0.0	0.0	100.0
Transport and communications	42.9	5.2	49.4	0.0	2.5	0.0	0.0	100.0
Public administration	0.1	0.0	1.0	98.9	0.0	0.0	0.0	100.0
Education	0.2	0.0	10.5	89.2	0.0	0.0	0.0	100.0
Health	3.4	0.0	27.9	68.7	0.0	0.0	0.0	100.0
Domestic services	0.0	0.0	100.0	0.0	0.0	0.0	0.0	100.0
Other services	59.1	0.0	40.9	0.0	0.0	0.0	0.0	100.0
Total	38.0	4.8	31.7	10.2	10.2	5.0	0.0	100.0

Source: Authors' calculations based on 2016 Zimbabwe SAM.

Zimbabwe and Africa: Performance and structural change since 2000

Drawing on a cross-country database for Africa (defined to include both North and Sub-Saharan Africa) extracted from World Bank (2018b), this section reviews the performance of Zimbabwe's economy relative to other countries in the region during this millennium. The analysis is focused on two years, 2000 and 2014.

Figures 2.1 and 2.2 and Tables 2.7-2.8 show the Zimbabwe's performance since 2000 in two broad areas: SDG outcome indicators (i.e. development objectives that are related to the global SDG agenda) and what may be viewed as determinants of economic performance, including the evolution of the SDG outcomes. The figures and tables are based on World Bank (2018b) and indicators are only shown if data are available for at least 18 countries (i.e. 1/3 of the countries in Africa, including Zimbabwe). Information is shown for two periods, referred to as 2000 and 2014 and represented by averages for the years 1998-2002 and 2012-2016, respectively. When 2000 and 2014 rankings are reported for an indicator, then the country coverage is identical for the two years – this is needed to make ranking comparisons meaningful. However, the country coverage will vary between the different indicators.

Starting with the SDG indicators, Figure 2.1 shows Zimbabwe's percentile rankings in 2000 and 2014 – note that the ranking is based on the numerical value and does not consider whether what is measured is a "desirable" (like a high graduation rate) or an "undesirable" (like some

mortality rate. In education, Zimbabwe's performance (relative to other African countries) has declined for all indicators with data for both periods. For health (for which a low ranking is better for indicators measuring "undesirables" like mortality), the figures also point to a deteriorating picture compared to the rest of Africa with the exception of wasting, which declines strongly. Similarly, infrastructure-related indicators (access to water, sanitation, and electricity) also indicate that Zimbabwe has been falling behind its African compatriots. Finally, the ranking for CO2 emissions per unit of GDP is roughly unchanged.

Figure 2.1. Zimbabwe: Percentile ranking in Africa in 2000 and 2014 -- selected SDG indicators

Table 2.7. SDG indicators: Zimbabwe and Africa in 2000 and 2014

	Zimbabwe		Africa median		Zimbabwe percentile ranking		
	2000	2014	2000	2014	2000	2014	Δ (2014 *minus* 2000
School enrollment, preprimary (% gross)	58.7	41.5	10.8	24.3	91.1	64.7	-26.4
Primary completion rate, total (% of relevant age group)	90.7	88.5	52.3	74.9	87.8	80.4	-7.4
School enrollment, primary (% gross)	103.2	100.0	91.8	103.7	68.0	42.5	-25.5
School enrollment, primary (% net)	85.8	86.2	65.5	82.3	75.7	60.6	-15.1
Net intake rate in grade 1 (% of official school-age population)	45.3	37.8	36.3	59.1	71.4	14.2	-57.2
Lower secondary completion rate, total (% of relevant age group)		64.1		44.5		75.5	
School enrollment, secondary (% gross)	43.8	46.8	26.2	43.7	82.3	52.9	-29.4
School enrollment, secondary (% net)	41.0	43.5	19.6	35.2	76.4	64.7	-11.7
School enrollment, tertiary (% gross)		6.8		8.8		36.5	
Mortality rate, under-5 (per 1,000 live births)	96.8	65.3	125.4	69.3	26.4	45.2	18.8
Maternal mortality ratio (modeled estimate, per 100,000 live births)	589.2	398.0	654.6	400.5	44.2	48.0	3.8
Prevalence of stunting, height for age (% of children under 5)	33.7	27.6	37.6	30.7	35.4	41.9	6.5
Prevalence of wasting, weight for height (% of children under 5)	8.5	3.3	9.4	6.5	35.4	9.6	-25.8
People using at least basic drinking water services (% of population)	70.5	67.0	54.3	66.2	72.5	52.9	-19.6
People using at least basic sanitation services (% of population)	41.7	38.9	24.7	33.3	71.1	59.6	-11.5
Access to electricity (% of population)	34.6	35.6	21.3	39.0	62.2	41.5	-20.7
CO2 emissions (kg per 2010 US$ of GDP)	0.89	0.74	0.33	0.31	93.8	91.8	-2.0

Source: World Bank (2018)

*Data for 2000 and 2014 are averages of available data for the periods 1998-2002 and 2012-2016, respectively.

**For each indicator, Africa includes all countres in the region with data for at least one year in both periods. The sample size varies between 18 and 54. For any indicator with data for both periods, the country coverage is identical for both periods.

Table 2.7 adds information about the levels for the indicators in Figure 2.1, showing both Zimbabwe and the Africa median in both periods. In general terms, Zimbabwe's declining rankings for education are underpinned by unchanged or declining rates of enrollment, intake, and completion for Zimbabwe at the same time as the median for Africa improved noticeably. For the health indicators, the situation in Zimbabwe has improved but, for most of these indicators (wasting being the noted exception), not as strongly as for the region. In the area of infrastructure, Zimbabwe's access rates changed by little at the same time as Africa registered improvements. Finally, while Zimbabwe reduced its CO2 emissions per 2010 US$ of GDP more than others, the country is still at more than twice the regional median. An unweighted average of the indicators suggest that Zimbabwe's ranking declined from the 73rd to the 56th percentile (which, out of a group of 54 countries translates into a fall from 15th to 23rd position).[2]

Figure 2.2 and Table 2.8 show data for factors that may have contributed to Zimbabwe's deteriorating status relative to the rest of the region, covering the levels for Zimbabwe and Africa's median as well as Zimbabwe's percentile ranking in 2000 and 2014.

[2] In the computation of the average, Zimbabwe's percentile ranking for indicators measuring undesirables like mortality were reversed so that a high ranking corresponds to a low value. Given that the countries that are underrepresented in the database may do less well than others (including no or little data for Somalia and South Sudan), Zimbabwe's ranking in a database with full country coverage would probably be slightly higher.

Figure 2.2. Zimbabwe: Percentile ranking in Africa in 2000 and 2014 -- selected determinants of economic performance

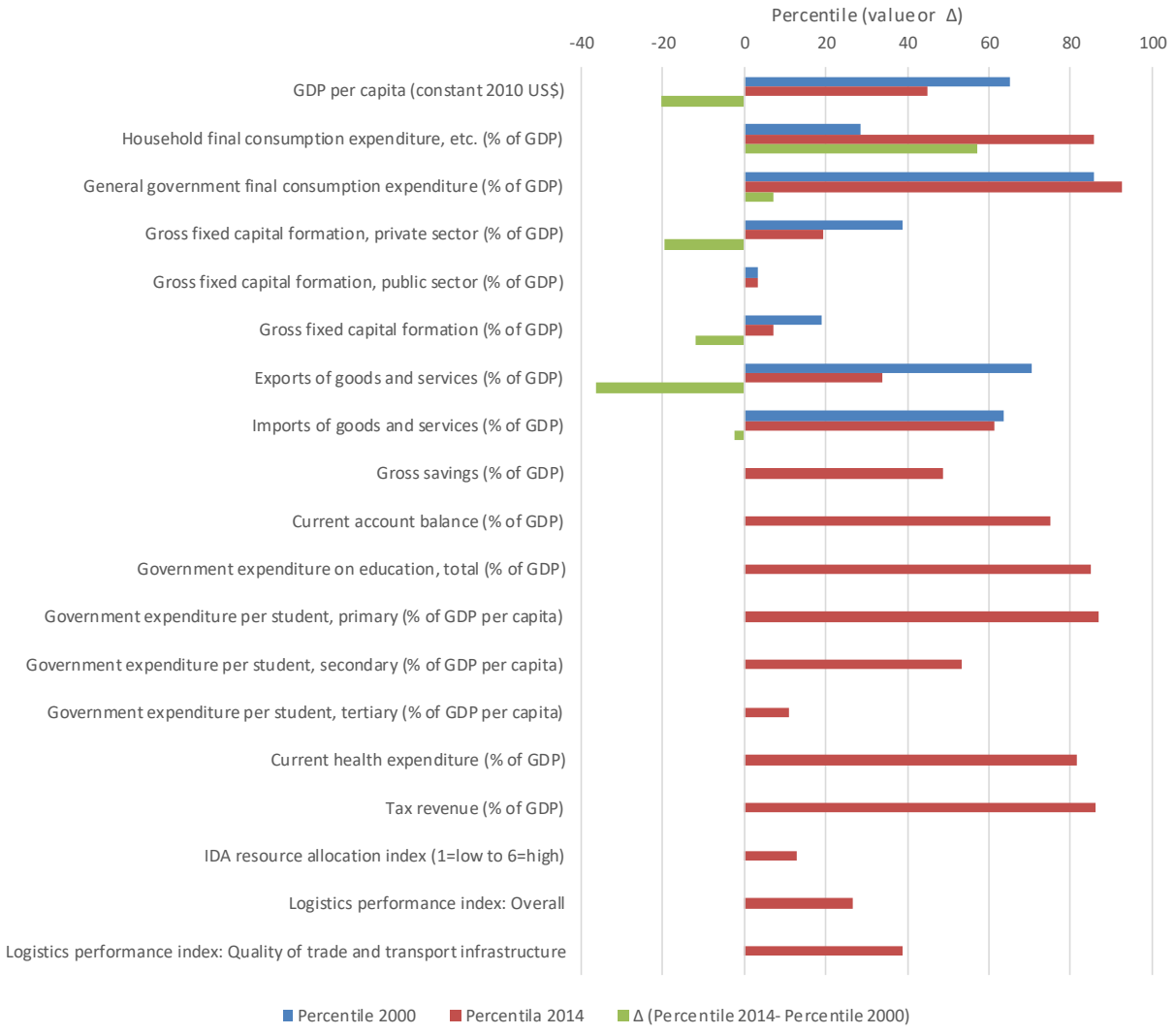


Table 2.8. Determinants of economic performance: Zimbabwe and Africa in 2000 and 2014

	Zimbabwe		Africa median		Zimbabwe percentile		
	2000	2014	2000	2014	2000	2014	Δ (2014 minus 2000)
GDP per capita (constant 2010 US$)	1266.2	929.3	876.1	1153.1	65.3	44.8	-20.5
Household final consumption expenditure, etc. (% of GDP)	67.9	84.2	75.4	72.0	28.5	85.7	57.2
General government final consumption expenditure (% of GDP)	18.7	23.8	14.0	15.1	85.7	92.8	7.1
Gross fixed capital formation, private sector (% of GDP)	9.6	9.9	12.0	14.6	38.7	19.3	-19.4
Gross fixed capital formation, public sector (% of GDP)	1.9	2.5	7.1	7.0	3.2	3.2	0.0
Gross fixed capital formation (% of GDP)	11.4	12.4	17.3	22.9	19.0	7.1	-11.9
Exports of goods and services (% of GDP)	37.2	26.2	26.0	30.5	70.4	34.0	-36.4
Imports of goods and services (% of GDP)	36.5	46.1	33.6	40.3	63.6	61.3	-2.3
Gross savings (% of GDP)		-7.2		16.3		48.7	
Current account balance (% of GDP)		-11.3		-7.9		75.0	
Government expenditure on education, total (% of GDP)		7.4		4.5		85.2	
Government expenditure per student, primary (% of GDP per capita)		19.2		10.4		87.0	
Government expenditure per student, secondary (% of GDP per capita)		30.4		19.7		53.5	
Government expenditure per student, tertiary (% of GDP per capita)		224.9		92.2		11.1	
Current health expenditure (% of GDP)		8.8		5.5		81.6	
Tax revenue (% of GDP)		21.4		15.3		86.2	
IDA resource allocation index (1=low to 6=high)		2.5		3.2		12.8	
Logistics performance index: Overall		2.3		2.5		26.5	
Logistics performance index: Quality of trade and transport infrastructure		2.2		2.3		38.7	

Source: World Bank (2018)

*Data for 2000 and 2014 are averages of available data for the periods 1998-2002 and 2012-2016, respectively.

**For each indicator, Africa includes all countres in the region with data for at least one year in both periods.The sample size varies between 29 and 52. For any indicator with data for both periods, the country coverage is identical for both periods.

Among the indicators in Figure 2.2 and Table 2.8, a higher real GDP per capita may contribute to and be reinforced by better SDG outcomes across the board through multiple channels (including links related to household incomes and government revenues); for this indicator, Zimbabwe's level declined between 2000 and 2014 while Africa's median increased significantly, causing Zimbabwe's ranking to fall by 20 points.

Relative to other countries, Zimbabwe's final demand composition switched toward consumption and away from investment (measured as a share of GDP like most of the indicators in Table 2.7). Growth may have suffered from this given that consumption tends to be more directed toward satisfaction of current needs. Among government final demands, Zimbabwe ranks very high for consumption (and increasingly so) but very low for investment while the total for government final demands is relatively high.

The data are consistent with Zimbabwe's severe external imbalances, compared to other countries manifested in reduced exports and higher imports, something that eventually contributed to foreign debt default; among other things, Zimbabwe's export percentile ranking fell by more than 36 points. While, by definition, the increase in the trade deficit made it possible to maintain higher domestic absorption for any given level of GDP, the resulting macro imbalance may have contributed to low growth. Most of these developments took place in the context of sanctions imposed by the US, the EU, and others, the declared aim of which was to encourage more democratic rule.

In terms of education spending relative to GDP, Zimbabwe was the leading country in Africa in 2014 – data for 2000 are not available. Its spending per student (measured as share of GDP per capita) was also relatively high, in the range of 80th-90th percentile for each of the primary, secondary, and tertiary levels. Likewise, the country's *current* spending on health (which represents most of health spending) is among the highest in the region (in the 94th percentile). Its tax revenues are in the 77th percentile, suggesting that the scope for raising these revenues may be limited.

Apart from the level and composition of private and government spending, institutions and infrastructure may be important determinants of economic performance. In this regard, the World Bank IDA resource allocation index for Zimbabwe is low (only in the 12th percentile), suggesting that the country's policies and institutional arrangements were not considered supportive of growth and poverty reduction. The "Logistics Performance Index" (which is on a scale from 1 to 5 with a higher value being better) reflects the extent to which infrastructure and institutions facilitate trade, an essential component of successful development throughout the world. Zimbabwe is here positioned in the bottom half of the Africa ranking both for the overall index and in the area of trade- and transport-related infrastructure.

Going beyond the database used for the above tables and figures, the Africa Infrastructure Index of the African Development Bank provides a more comprehensive assessment of the level of infrastructure in the countries of the region (AfDB 2018a, pp. 71-72). According to the index (which is based on data for transport, electricity, ICT, and water and sanitation infrastructures), Zimbabwe meets merely 25-30 percent of its infrastructure needs, nevertheless ranking 18 out of 53 countries (i.e. in the 67th percentile). On balance, empirical evidence is consistent with the view that closing infrastructure gaps is necessary for accelerated development in Zimbabwe and most other countries of the region; however, to realize desired effects, progress on infrastructure would have to be accompanied by advances in other areas, including human development and the broader policy environment (AfDB 2018, pp. 65-68). The AfDB resident country representative for Zimbabwe Mateus Magala suggests that, to address its needs, the country may have to raise its total spending on infrastructure from US$0.2 to US$2.0 billion per year over the next decade (New Zimbabwe 2018).

In sum, this comparison between Zimbabwe and the rest of the Africa shows that (a) according to almost all indicators of SDG outcomes, Zimbabwe has done less well than typical for the region; and (b) this outcome is consistent with the evolution of drivers of development, including prioritization of consumption over investment and weak policies and institutions, with the latter preventing relatively high spending on education and health from yielding stronger performance in these areas. In order to generate the growth needed to improve well-being and reduce poverty, it seems essential for Zimbabwe to start closing its infrastructure gap.

3. Scenario Analysis with SDGSIM

After a brief description of SDGSIM (Section 3.1), this section presents the simulations, splitting them into a base scenario (Section 3.2) and a set of counterfactual scenarios (Section 3.3). Our analysis treats 2018 as the analytical base year and considers alternative scenarios for 2019-2030.[3] The assumptions for the initial years, described below, lead to that, at the sectoral level, the structural changes in the economy of 2018 are very limited compared to the structure in 2016, captured in the SAM from which information was presented in Section 2.

3.1. A brief note on SDGSIM

CGE models, the class of models to which SDGSIM belongs, have been widely used for policy analysis since the 1970s, including a large number of applications to developing countries. The models have been applied to a wide range of policy areas, including taxation and fiscal issues, foreign trade, poverty and inequality, and the environment. The issues have typically been addressed from medium- to long-run perspective. The models are invariably economywide – the "economy" is typically defined to coincide with what is covered by the national accounts for a single country.[4] The fact that they are economywide means that they provide a comprehensive view of the economy, including linkages between production, the incomes it generates, households, the government (its budget and fiscal policies), and the balance of payments. Mathematically, most CGE models are made up of a set of simultaneous linear and non-linear equations that are programmed in specialized software, for SDGSIM in GAMS.[5]

Like other CGE models, SDGSIM is built around features from basic economics, including the fact that the different agents in the model (producers, households, government, and the nation in its dealings with the outside world) are subject to budget constraints: receipts and spending are fully accounted for and by construction equal (as they are in the real world). Producers and households are assumed to maximize profits and utility, respectively, while the government is not assumed to optimize but follows rules specific to each receipt and spending item with some clearing item (like a tax rate). For the nation, the real exchange rate or foreign financing typically adjusts to ensure that the external accounts are in balance. Wages, rents and prices play a crucial role by clearing markets for factors and commodities (goods and services). For commodities that are traded internationally (exported and/or imported), domestic prices are influenced by international price developments. Given that Zimbabwe is a small country, it is assumed that international markets demand and supply exports and imports at given world prices.

[3] In the background, the first simulation year is 2016, for which the solution replicates the 2016 model SAM.
[4] There are many exceptions. Models may be global, splitting the world into multiple regions (which may be countries) and, at least at the country level, the economy has been broadened to cover production that is not part of GDP, such as the services that households produce for own consumption.
[5] For more on GAMS, see www.gams.com. Along with GAMS, the other leading software for CGE modeling is GEMPACK (http://www.copsmodels.com/gempack.htm).

CGE models may be static or dynamic. SDGSIM belongs to the class of recursive dynamic models that are solved for one year at a time with updating of parameters, including those related to policies and factor stocks, before the model is solved for a new year. Over time, production growth is determined by growth in factor employment (constrained by stocks) and changes in total factor productivity (TFP). Growth in capital stocks is endogenous, depending on investment and depreciation. For other factors, the growth in employable stocks is exogenous. For labor (disaggregated by skill) and natural resources (with sector-specific factors for agriculture and mining), stock growth rates are exogenous, reflecting projections based on available data. For labor, the projections reflect the evolution of the population in labor-force age, labor force participation rates, and the impact of expanded education. The unemployment rate for labor is endogenous. TFP growth is made up of two components, one that responds positively to growth in government infrastructure capital stocks and one that, unless otherwise noted, is exogenous.

The basic accounting structure and much of the data required to implement SDGSIM is derived from a Social Accounting Matrix (SAM). Most features of a SAM for SDGSIM are familiar from SAMs used for other models. However, a SDGSIM SAM has some non-standard features to provide data needed for its explicit treatment of financial flows and different investment types. Furthermore, the required SAM disaggregation is often relatively fine in areas related to SDGs (e.g. labor and education). In this study, SDGSIM was calibrated to a newly constructed SAM for 2016 and other data for Zimbabwe. Table 3.1.1 shows the accounts in the SAM, which determine the disaggregation of the model. Appendix B provides additional details on Zimbabwe's SDGSIM database.

Table 3.1.1. Disaggregation of Zimbabwe SDGSIM

Category - #	Item	Category - #	Item
Sectors (activities and commodities) (14)	Agriculture, forestry and fishing	**Distribution margins (3)**	Margin, domestic
	Mining and quarrying		Margin, imports
	Manufacturing		Margin, exports
	Electricity and water supply	**Taxes (4)**	Tax, activities
	Construction		Tax, commodities
	Financial intermediation		Tariffs
	Real estate and business activities		Tax, inst incomes
	Trade, hotels and restaurants	**Inst, current acc (4)**	Household, rural
	Transport and communications		Household, urban
	Public administration		Government
	Education		Rest of the world
	Health	**Inst, capital acc (4)**	Capital acc, rural household
	Domestic services		Capital acc, urban household
	Other services		Capital acc, government
Factors (6)	Labor, unskilled		Capital acc, rest of the world
	Labor, skilled	**Investment (3)**	Investment, non-government
	Capital, private		Investment, government
	Capital, government		Change in stocks
	Land		
	Extractive resource		

3.2. Base Scenario

The base scenario is designed to provide a central, business-as-usual case for the evolution of Zimbabwe's economy up to 2030 without major changes in economic policy; it serves as a benchmark to which the results for non-base scenarios are compared. The overall expansion of the economy is driven by growth in GDP at factor cost, which is exogenous for the base scenario (but not for the other scenarios). For 2017-2019, GDP growth estimates and projections are based on African Development Bank (2018). After this, the growth rate converges to the IMF growth projection for 2023 (5.0 percent), a rate that is maintained up to 2030. For the period 2019-2030, the resulting average growth rate is around 4.2 percent, something that corresponds to a per-capita growth rate of 2.2 percent.[6]

[6] For the *non-base* scenarios, GDP growth is endogenous starting from 2019. With regard to the *base*, the variable GDP at factor cost is fixed at the projected levels. At the same time, an endogenous variable is added; in each year, it scales TFP in all or selected production activities so that the exogenous GDP level is generated. Given that one variable is added, and one removed, the model continues to have an equal number of equations and variables. For all non-base scenarios, this is reversed: the GDP variable is flexible whereas the TFP adjustment variable is fixed *at the levels generated under the base scenario*. The point *in italics* is important: this means that the results for the non-base scenarios are no different if the only change is a switch from exogenous to endogenous GDP. However, given that other shocks are introduced, the GDP level (and other results) will deviate from the base.

The macroeconomic assumptions for the base scenario are designed to mimic an unchanged economic policy environment subject to long-term debt sustainability, domestically for the government and externally for the government and the private sector. Most macro aggregates expand at the same pace as the economy. This is achieved by keeping rates fixed for taxes and by imposing exogenous and for the most part unchanged shares of GDP or absorption (total consumption and investment spending) for other items with macro significance, including investment (government and private, including FDI) and transfers payments involving the government and/or the rest of the world. For domestically financed private investment, the absorption share increases over time, bringing Zimbabwe to a level close to the African country median; given that, at the same time, domestic financing of the government declined relative to GDP, the household savings rates remain close to their initial levels. (Foreign investment is self-financed from abroad while government investment is financed as part of the budget.) Balance between foreign exchange inflows and outflows is realized via a flexible real exchange rate, which influences both export and import quantities. The rate adjusts via changes in the domestic price level while the nominal exchange rate is fixed. A depreciation of the real exchange rate, at an annual rate of 0.6 percent, is needed to maintain external balance.

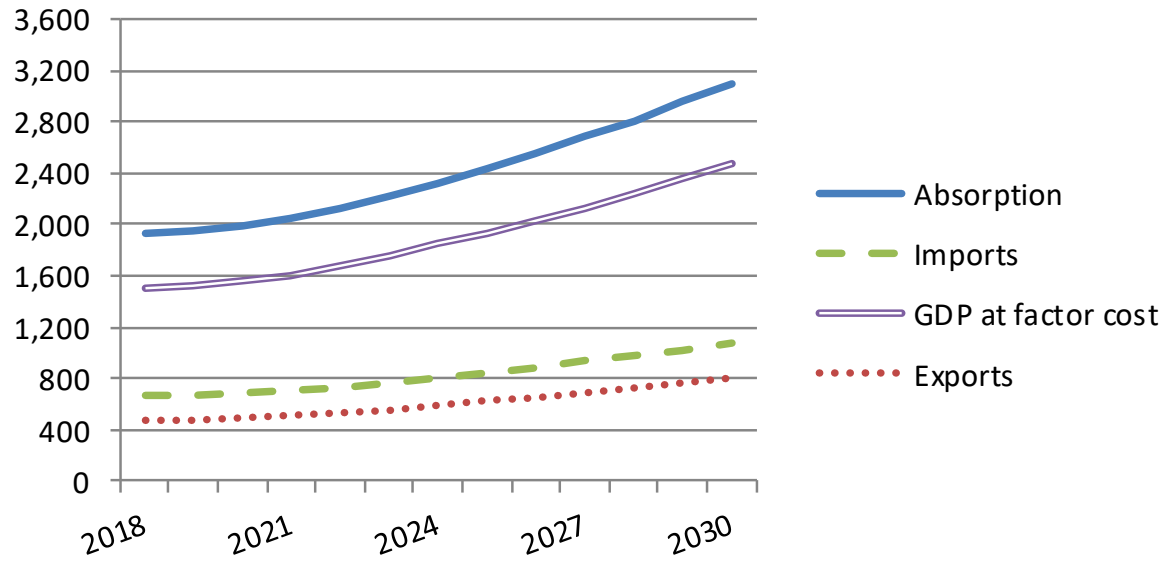
The results for the base scenario are summarized in Figures 3.2.1-3.2.8. Additional and more detailed results are presented in Tables C.1-C.7 in Appendix C, which also cover the non-base scenarios.

During the period 2019-2030, the economy grows along a smooth path. Thanks to a remaining substantial trade deficit, absorption is well above GDP at factor cost (and to a lesser extent above GDP at market prices; Figure 3.2.1). Among the components of domestic final demands (absorption), private (household) consumption (the only aggregate measured on the left axis) is the largest by a wide margin, followed by public consumption as a distant second (Figure 3.2.2). Average annual growth rates are in the range of 3-5 percent for all macro aggregates except private investment, for which it is close to 8 percent (Figure 3.2.3). Slightly faster growth for exports than for imports reflects the impact of real exchange rate depreciation, needed for Zimbabwe to live within its balance of payments constraint in the context of a projected decline in the mining export price. The latter is based on projected annual price decline of 3 percent for gold, Zimbabwe's main export, for the period 2018-2030 (World Bank 2018a, p. 32).

Among the aggregate sectors (Figure 3.2.4), private services (on the left axis; defined to include the education and health sectors) have the largest GDP by a wide margin. Among the other sectors (on the right axis), agriculture and manufacturing are the largest. (More detailed sector data are presented in Table C.5.) Annual growth is quite even (4-5 percent) for all sectors except for mining, which grows less rapidly, at least in part due to downward trend for the export price (Figure 3.2.5). Similarly, for exports, mining has the lowest growth (a slight decline) while other sectors grow at rates in the range of 4-6 percent (Figure 3.2.6). (Among the sectors, exports account for large output shares for agriculture, mining, and manufacturing; cf. Table 3.4).

Given an annual population growth rate of 2 percent, aggregate household consumption growth at 3.4 percent translates into a per-capita growth rate of around 1.3 percent, or an increase of 17 percent in national per-capita household consumption between 2019 and 2030 (Figure 3.2.7).[7] At a more disaggregated level, annual per-capita consumption growth is at 1.9 percent for the rural households and 1.0 percent for the urban households, raising their per-capita levels in 2030 to 25 and 13 percent above the 2018 level, respectively. The main reason for more rapid per-capita income growth for the rural households is its large share in agricultural land rents, which grow faster than other factor incomes. The change in the national poverty rate (defined on the basis of a national poverty line) is driven by the change in national private per-capita consumption: between 2018 and 2030, the poverty rate declines by 6.7 percentage points (Figure 3.2.8). [8] The results are shown in Figure 3.2.6. (See also Table C.1).

Figure 3.2.1. Base: Selected macro indicators 2018-2030 (2016 bn US$)



[7] The results for household incomes (in contrast with consumption) are very similar given small changes in the shares of the total incomes that are allocated to consumption (rather than direct taxes, transfers, or savings).
[8] The poverty calculation draws on simulated national level data on private consumption per capita and assumes unchanged inequality. The rural and urban inequality data needed to compute separate urban and rural poverty rates are not available. More specifically, the poverty analysis assumes a log-normal distribution, a 2016 national poverty rate of 73.2, and a national Gini-coefficient of 43.2. Both are the most recent available estimates, based on 2011 data. The 2018 poverty rate, slightly lower, is based on the model simulation.

Figure 3.2.2. Base: Domestic final demands 2018-2030 (2016 bn US$)

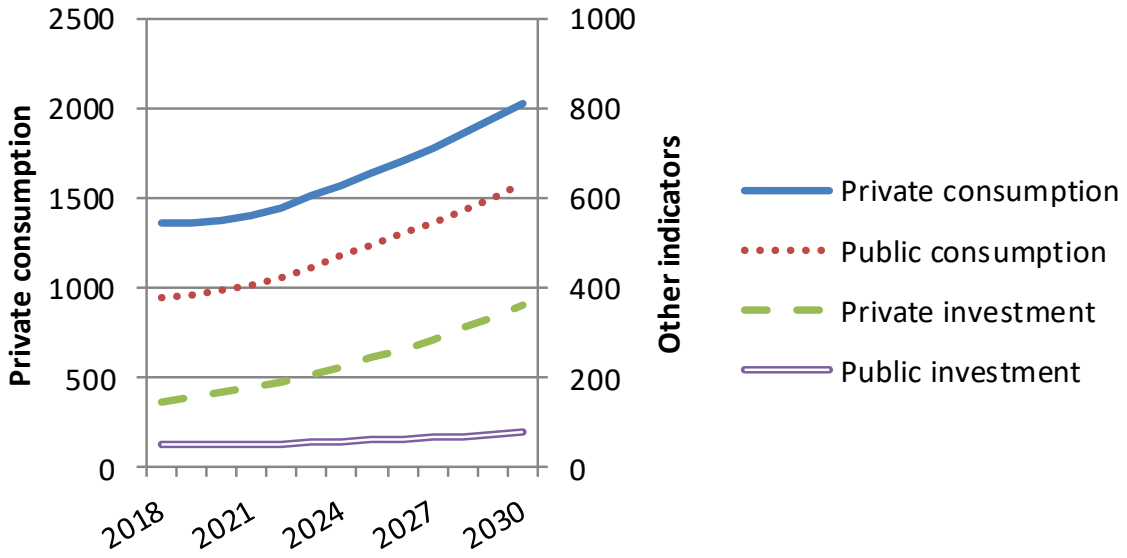


Figure 3.2.3. Annual macro growth 2019-2030 (%)

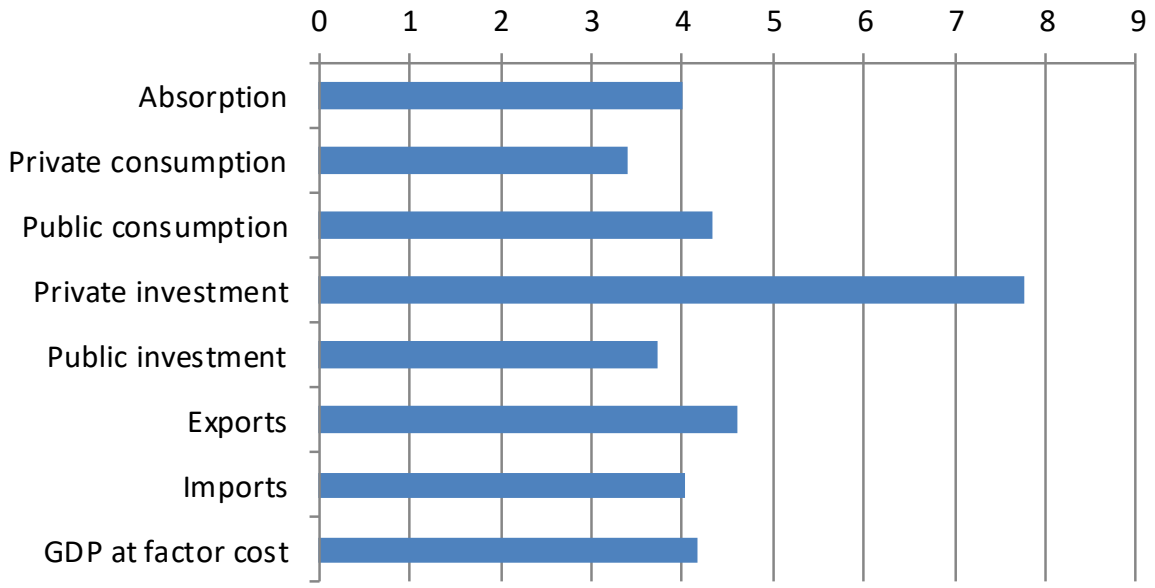


Figure 3.2.4. Base: Aggregated sector GDP 2018-2030 (2016 bn US$)

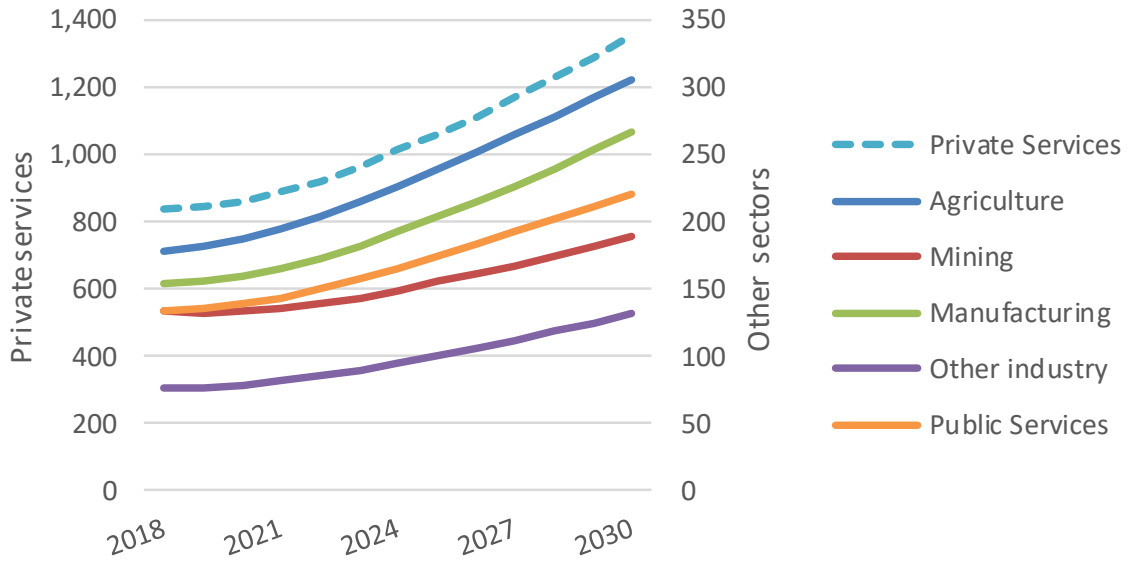


Figure 3.2.5. Base: Annual sector GDP growth 2019-2030 (%)

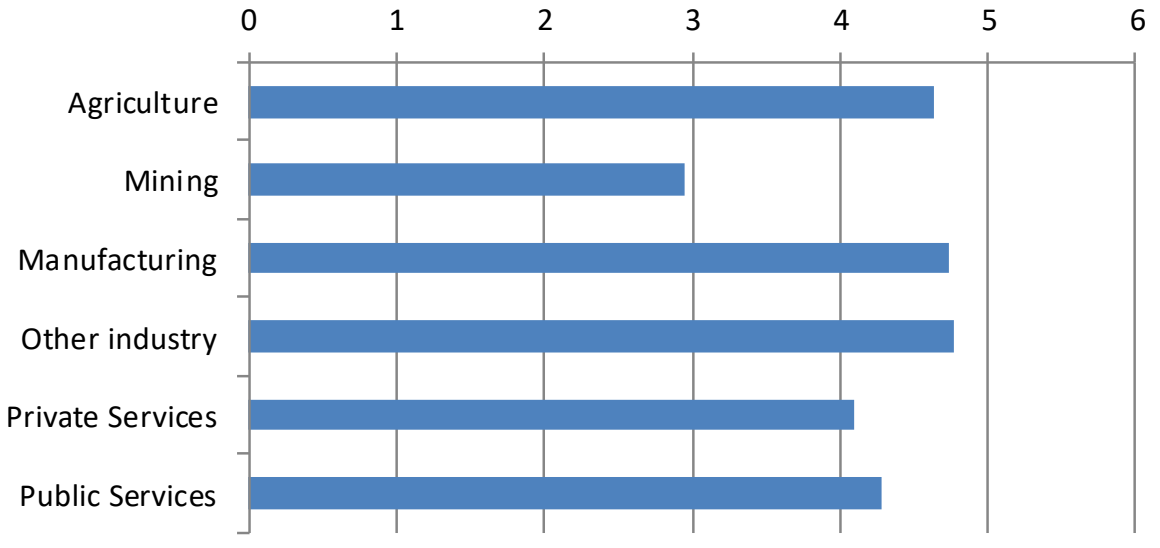


Figure 3.2.6. Base: Annual sector export growth 2019-2030 (%)

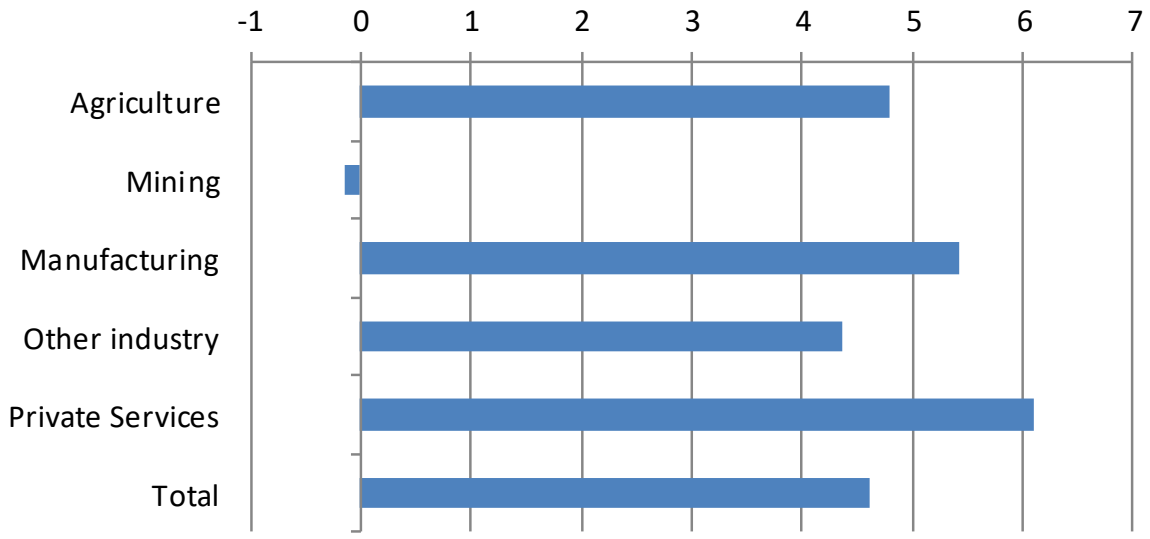
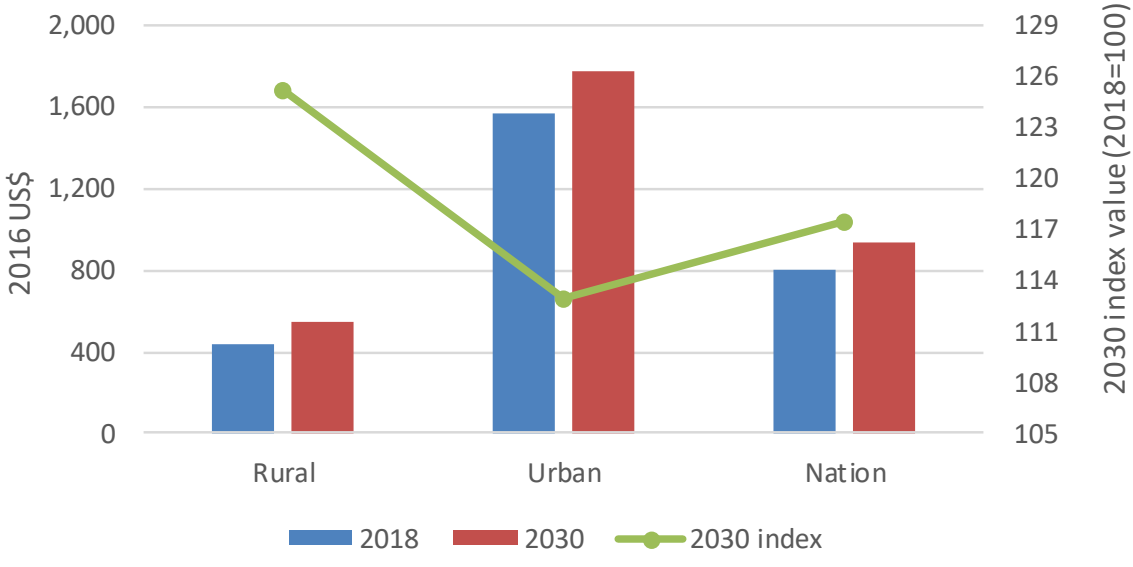


Figure 3.2.7. Base: Household consumption per capita in 2018 and 2030



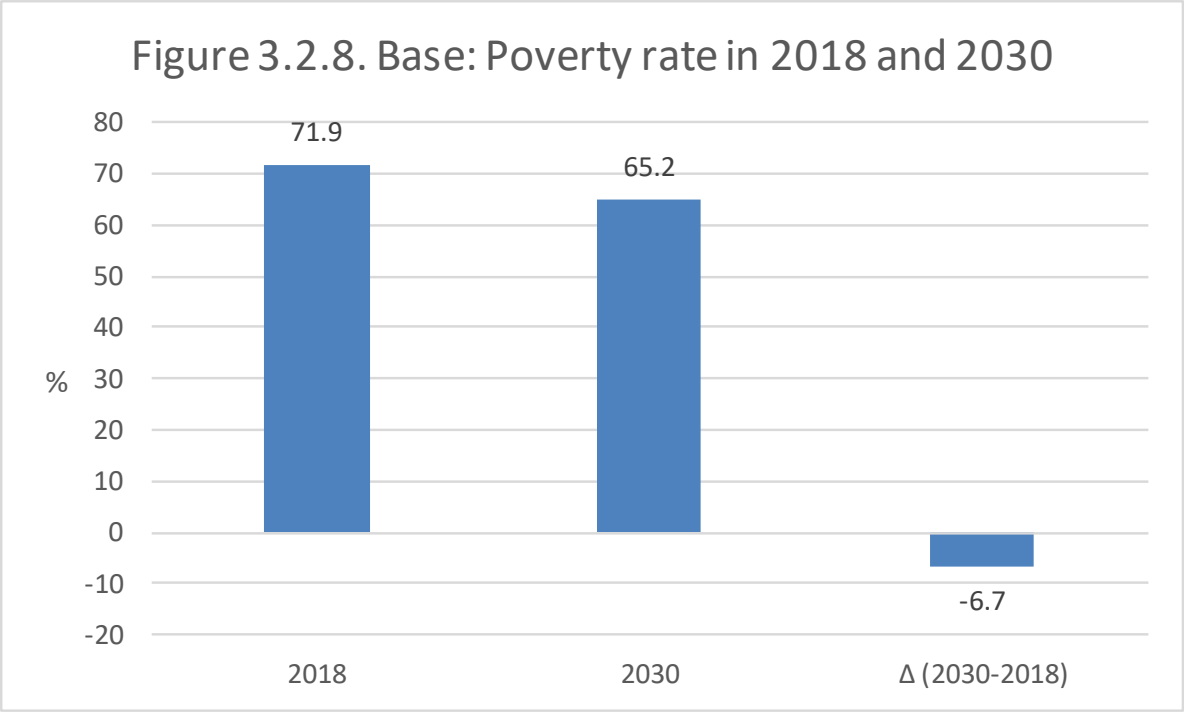


Figure 3.2.8. Base: Poverty rate in 2018 and 2030
80
70
60
50
40
%
30
20
10
0
-10
-20
71.9
65.2
-6.7
2018
2030
Δ (2030-2018)

3.3. Non-Base Scenarios

The non-base scenarios are designed to explore the economic impact of scaled up investments in infrastructure in Zimbabwe, helping the country to close its infrastructure gap. The scenarios differ in terms of the level of the infrastructure investment expansion, the marginal product (MP) of new infrastructure capital, its sectoral targeting (reflected in a higher TFP in one or more production activities), and in how the extra spending is financed. The non-base scenarios are defined in Table 3.3.1. The results are summarized in Figures 3.3.1-3.3.8. (Additional simulation results are found in Tables C.1-C.7 in Appendix C).

Table 3.3.1. Definitions of non-base scenarios.

#	Name	Sector targeting	MP of new infrastructure capital	Marginal government revenue source	Investment expansion (% of GDP)*
1	**all-30-tx+3**	All	0.30	Domestic taxes	3
2	**all-30-ff+3**	All	0.30	***Foreign financing***	3
3	**all-00-tx+3**	All	***0.00***	Domestic taxes	3
4	**all-60-tx+3**	All	***0.60***	Domestic taxes	3
5	**trd-30-tx+3**	***Traded****	0.30	Domestic taxes	3
6	**trd-60-tx+3**	***Traded***	***0.60***	Domestic taxes	3
7	**all-30-tx+6**	All	0.30	Domestic taxes	***6***

Note. For simulations 2-7, assumptions in bold italics deviate from simulation 1.

*% of GDP refers to the value of the real investment expansion under base simulation GDP and prices.

** Agriculture, manufacturing, and trade, hotels, and restaurants (including tourism), all of which are highly traded and employment generating.

All non-base scenarios deviate from the base scenario starting from 2019 – in the absence of any new shocks, the simulated results for 2017 and 2018 are always identical to the base. In terms of assumptions, for all non-base scenarios, GDP is endogenous and, instead of letting private investment drive savings (as was done for the base, with private investment defined as a share of absorption), private savings drive private investment (more specially the part that is domestically financed). This means that, other things being equal, a household income increase translates into increases in private savings, private investment spending, private real investment, private capital stocks, and GDP; however, the precise links between changes in investment spending, real investment (the investment quantity), and change in the capital stock depend on how prices change. Public investment is a policy tool that is covered within the government budget. Across the non-base simulations, real government consumption and real government investment in non-infrastructure areas both follow the base trajectory (in real quantities). Real government investment in infrastructure is changed as part of the scenarios.

Except for factor income outflows (primarily profits due to past FDI), non-trade payments to and from the rest of the world (financing and transfers) are the same as under the base scenario (measured in foreign currency). As a result, except for the scenarios in which infrastructure is financed from abroad, the changes in Zimbabwe's net foreign assets are uniform and the same as for the base.

The non-base scenarios differ in terms of sector targeting, the MP of additional infrastructure capital, the source of marginal government revenue, and the level of the investment scale-up.

Regarding sector targeting, it is possible to implement investment packages that, taken as a whole, have a relatively uniform impact across all sectors, including investments in areas like roads, mobile phone networks, or electricity access, all of which benefit the economy broadly (albeit still with differential impacts across sectors for any specific investment). At the other end, sector targeting may be narrower, which is the case for investments in irrigation or in industrial zones that facilitate export-oriented manufacturing. In the simulations, the central case is a uniform impact across all sectors and the alternative case targeting of the major labor-absorbing export sectors in today's Zimbabwe: agriculture, manufacturing, and the trade, hotels, and restaurants sector.

Assessments of the MPs of public capital vary widely, a reflection of that they also vary widely in the real world due to differences in government investment management record and infrastructure capital stock scarcity. In the simulations, the central case is a MP of 0.30, which is translated into a *ceteris-paribus* or direct GDP increase (due to a TFP gain) of $0.30 for every $1 of new capital stock. However, the total impact will differ due to the effects of the GDP changes in selected sectors on prices, incomes, production, and trade throughout the economy as well as due to the repercussions of creating the fiscal space needed for the investment.[9] In the absence of sufficient continued investment, the gain declines over time due to depreciation. In relative terms, the gain from one unit of capital becomes less significant as time passes if TFP increases for other reasons (including the trend imposed under the base simulation). In alternative simulations, we consider MPs of 0.60 and 0. In the latter case, the investment has a negative impact on economic indicators since it absorbed resources but produced no benefits.[10]

[9] Drawing on results of selected simulations, Table C.7 shows BOTE (back-of-the-envelope) calculations of the economywide MP of the infrastructure investment program for the scenario *all-30-tx+3* and *trd-30-tx+3*. The change in GDP is split into two parts: (a) change due to the productivity effect (by comparing 2030 GDP to the 2030 GDP level for the relevant scenario with zero MP); and (b) change due to financing (by comparing the 2030 GDP of the zero MP scenario to the 2030 GDP of the base). The capital stock change is the difference between the 2030 infrastructure capital stock for the scenario compared to base. MPs are computed by dividing GDP change by the capital stock change. As indicated, the productivity MP is close to 0.30 for *all-30-tx+3* but larger for *trd-30-tx+3*, the latter an indication of positive repercussions from the focus on tradables, inter alia by lowering of the prices of tradable goods, which boosts purchasing power and reduces the cost of capital goods.

[10] To exemplify, the estimated MPs of public capital from cross-country regressions are 0.52 for Gupta et al. (2014, p. 171; 0.30 for middle-income countries and 0.65 for low-income countries; and 0.142 for Dessus and Herrera (2000, p. 413) whereas, using a variety of approaches, Easterly et al. (2003) find no evidence that public (or private

While targeted investments may yield higher returns when they are at a smaller scale, it may be difficult to scale them up without facing diminishing returns, i.e. for the case of a large scaling up of investment spending, the MP of new infrastructure capital may be higher if the targeting is broad. Technically, the MP of new infrastructure capital (0.30 for the central case) is allocated across targeted sectors on the basis of their 2016 GDP shares, i.e., for any given MP, the broader the sectoral focus, the smaller the relative TFP and GDP gains in any individual sector. If the MP is zero, then the sector targeting is irrelevant.

The simulations consider two sources for meeting marginal government revenue needs due to the investment expansion: domestic taxes (by scaling of all direct and indirect tax rates, not including trade taxes) and foreign financing (government borrowing net of interest payments). The more positive the growth impact of the investment expansion, the smaller the need for additional government revenue – if it is strong enough, the investment expansion could pay for itself and generate a decline in taxes or foreign financing.

Finally, the level of real investment expansion is measured relative to GDP under base simulation conditions (using base scenario prices) and introduced gradually. Two expansions are considered: 3 and 6 percent of GDP. For the first, the additional public investment value amounts to 1 percent of base GDP in 2019, 2 percent in 2020, and 3 percent for the period 2021-2030, which may be compared to a simulated infrastructure investment level of 1.5 percent of GDP in 2018; i.e., infrastructure investment growth is very rapid during 2019-2021 after which it expands at a speed similar to or somewhat slower than the rest of the economy. The case of a 6 percent is constructed in the same way; for this case, the real additions to infrastructure investment amount to 2, 4, and 6 percent of base scenario GDP in 2019, 2020, and 2021-2030, respectively.

Infrastructure investment expansion: the central case (*all-30-tx+3*)

Under the scenario *all-30-tx+3*, the government undertakes a tax-financed expansion of infrastructure investment that amounts to 3 percent of GDP and for which the resulting new capital stock has an MP of 0.30.

The growth rates for absorption and GDP at factor cost increase by roughly 0.3 percentage points (Figure 3.3.1; unless otherwise noted, the growth rates to which we refer are the geometric average annual real growth rates for the period 2019-2030, i.e. using 2018 simulation results as the starting point.) Given the trade deficit, and the absence of accelerated growth for the foreign exchange inflows that finance it, export growth has to increase relative to import growth, a trend that is encouraged by slight increase in depreciation compared to the

investment is productive in Sub-Saharan Africa. The three MPs considered in this paper (0.60, 0.30, and 0.00) exemplify high, medium and low cases.

base (Table C.1). For the period 2019-2030, aggregate public investment growth increases by more than 6 percentage points while private consumption only gains 0.1 percentage points and private investment gain is even more marginal (Figure 3.3.2). By assumption, growth in real government consumption is the same as for the base.

The increase in government tax revenue needed to finance the investment expansion reaches its peak in 2021, when the total tax burden increases by 2.7 percent of GDP compared to the base in the same year, reaching a total of 23.1. However, over time the GDP growth gain translates into a government revenue gain that gradually reduces the need to tax relative to GDP. By 2030, the burden has declined to 22.4 percent of GDP, which is 1.6 percentage points above the 2030 base ratio of 20.8. From a different angle, if the government in 2030 had brought down its infrastructure investment to the base 2030 GDP share (2.9) and cut taxes, private consumption could have increase by close to 4 percentage points (as percent of GDP from 72.0 to 75.9), raising its annual growth gain compared to the base to close to 0.5 percentage points.

At the broad sector level, the GDP growth acceleration amounts to 0.5-0.7 percentage points for all sectors except private services which are relatively non-traded – cf. sector export-output and import-demand rations in Table 3.4. As a result, private services suffer from real depreciation and only gain around 0.2 percentage points (Figure 3.3.3; cf. the sector export-output ratios in Table 3.4). The percentage point gain in export growth is quite uniform across the different sectors even though, as noted above, the importance of this growth to the individual sectors vary greatly due to the differences in export-output ratios (Figure 3.3.4).

The gain in private consumption growth of 0.1 percentage point per year means that, in 2030, per-capita consumption is a mere 1.5 percent above the 2030 base level (Figure 3.3.5). However, the level declines 2019-2021 and 2027 is the first year it reaches above the base level. This trajectory is strongly influenced by the increase in taxation which, as noted, is at its peak in 2021 and after that gradually declines.

Foreign financing (*all-30-ff+3*)

The scenario *all-30-ff+3* deviates from the central case scenario in one respect: marginal revenue adjustments come through foreign financing instead of domestic taxes. The change in net foreign financing (government borrowing net of government interest payments) compared to the base (and the scenario *all-30-tx+3*, which has the same foreign financing as the base) follows the pattern of the tax change, peaking in 2021 at 2.3 percent of GDP and declining to 1.1 by 2030. Relative to GDP, the foreign government debt in 2030 (computed on the assumption that the government borrows at a real interest rate of 2 percent) is 58 percent for the foreign financing scenario (but by 2030 no longer increasing). This value may be compared to debt ratios of 48 percent in 2018 for all scenarios and a base scenario value of 45 percent in 2030 (Table C.2).

While debt increases, for the foreign financing scenario, growth is more positive thanks to the fact that domestic resources are not diverted from private investment. The growth gains for absorption, GDP, private consumption, and private investment are around 0.4-0.5 percentage points compared to the base (and 0.1-0.2 points compared to the preceding tax scenario) (Figures 3.3.1-3.3.2). These gains are facilitated by more rapid import growth. Among sectors other than government services, similar GDP growth gains are registered whereas, for exports, growth rates are very close to those of the tax scenario (Figures 3.3.3-3.3.4).

In addition to a 3 percent gain in the level private consumption in 2030, the switch from taxes to foreign financing also has a noticeable impact on the path to 2030 (Figure 3.3.5): private consumption is above the base level throughout the period 2019-2030 thanks to the combined impact of a higher GDP and real exchange rate appreciation. The drawback of a higher foreign debt was noted above.

Low and high marginal products of new investments (*all-00-tx+3* and *all-60-tx+3*)

The next two simulations explore the role of the MPs of new infrastructure investments, considering the cases of MPs at zero (*all-00-tx+3*) and 0.60 (*all-3-tx+3*). Otherwise they are identical to the central case scenario. (For the case of a zero MP, sector targeting is irrelevant.)

Compared to the base, a zero MP reduces the absorption, GDP, and trade growth rates by 0.1-0.2 percentage points (Figure 3.3.1). Among the final demands that make up absorption, the increase is public investment is the same as for the central case, something that in the context of lower GDP growth requires declines in private consumption and investment growth by 0.4-0.6 percentage points (Figure 3.3.2). This private demand decline is brought about by a gradual increase in the tax burden, which in 2030 reaches close to 24 percent of GDP (as opposed to 22 percent for the tax scenario with an MP of 0.30). In terms of level, in 2030, private consumption (per-capita and total) is 5 and 6.5 percent below the levels for the base and initial tax scenario (*all-30-tx+3*), respectively (Figure 3.3.5). Among the sectors, the scenario involves a 0.2 percentage point growth gain for other industry (which includes the construction sectors) coupled with losses of 0.1-0.2 for the other sectors, with the strongest growth loss for private services that depend on domestic demand growth.

The picture is obviously very different if the MP of new infrastructure investment instead is 0.60 (*all-60-tx+3*). Compared to the tax scenario with the 0.30 MP, 0.4-0.7 percentage points are added to GDP, absorption and trade growth rates, private consumption, and private investment (Figures 3.3.1-3.3.2). Among the sectors, GDP and export growth are in the same range with the strongest gains for the relatively tradable sectors (agriculture, mining, and manufacturing) (Figures 3.3.3-3.3.4). As a ratio to GDP, the initial increase in the tax burden is similar to the central case but it declines more rapidly, by 2030 it is only 0.2 percent about the base level. Thanks to more rapid growth, private consumption reaches above the base level already in 2023 and by 2030 it is more than 13 percent above the base level (as opposed to only 1.5 percent above the base for tax scenario with an MP of 0.30).

Focusing on tradables (*trd-60-tx+3*)

Instead of the broad sector focus of the preceding simulations, infrastructure investments may be designed to meet the needs of sectors that seem more attractive due to considerations like potential in terms of exports (being less constrained by domestic demand growth), import substitution, employment creation, and diversification, perhaps more able to absorb an increasingly educated labor force. It is also conceivable that a narrower focus makes it possible to maintain a higher MP for relatively limited scaling-up of investment volumes but more difficult for if the increase is larger. The simulation *trd-30-tx+3* is identical to the first non-base simulation (*all-30-tx+3*) except for that, instead of generating productivity gains throughout the economy, the gains are limited to agriculture, manufacturing, and trade, hotel and restaurant services (which include tourism). These three sectors account for the bulk of employment, exports, and imports (in 2018, the simulated shares are 84, 80, and 82 percent, respectively) but have a much smaller share of value-added (38 percent).

Compared to the scenario where all sectors benefit from TFP gains due to the added infrastructure investments, the trade and employment focused scenario boosts GDP, and absorption, and private consumption growth by 0.2 percentage points and investment growth by as much as 0.4 points. The boosting of productivity for tradables reduces real depreciation (cf. Table C.1), boosting domestic purchasing power and lowering the price of new capital compared to the economywide scenario (as manufactured goods is the main component in new capital) (Figures 3.3.1-3.3.2). Among the aggregate sectors, the GDP growth gains are particularly strong for agriculture and manufacturing; among the disaggregated sectors, the gain is also strong for the trade, hotels, and restaurant sector; the same patterns apply to exports (Figures 3.3.3-3.3.4). This relatively strong growth gain means that the economy is more able to benefit from the TFP gain. It is related to the fact that these sectors are less constrained than others by a limited domestic market, which reduces prices and profitability in the face of TFP-driven supply expansions. In the end year, private consumption is at the same level as the equivalent foreign financing scenario and around 3 percent higher than for the economywide scenario. However, due to the effect of taxation, private consumption is below the base level during the years 2019-2023 (Figure 3.3.5). In 2030, the tax GDP share is 22.3, i.e. marginally lower than for the economywide scenario.

The next scenario, *trd-60-tx+3* is identical to the preceding one, except for the fact that the MP of new infrastructure capital is raised to 0.60, reflecting greater success in identifying high-productivity investment projects. It may also be compared to the scenario *all-60-tx+3,* which has a different sector focus. Compared to the preceding scenario, the percentage point changes in the absorption, GDP, and trade growth rates are all roughly twice as large (Figure 3.3.1, 3.3.3, and 3.3.4) whereas the rate gains are close to three times as large for the private final demands, i.e., for the domestic final demands, which are not driven by (unchanged) policy but instead respond to changes in prices and incomes (Figure 3.3.2). Private consumption reaches above the base level already in 2023 and it is almost 8 percent higher in 2030 (Figure 3.3.5). In the background, the tax GDP share in 2030 is only 0.3 percent of GDP above the base level (Table C.3).

Stronger infrastructure investment expansion (*all-30-tx+6*)

Under the final scenario, *all-30-tx+6*, the infrastructure investment expansion corresponds to 6 percent of base GDP. In all other respects, it is identical to the first non-base scenario (*all-30-tx+3*). The stronger expansion adds to the challenge of identifying and managing a larger investment project portfolio without sacrificing productivity gains.

Compared to the first scenario, absorption, GDP, and trade growth (also at the sectoral levels) are all almost doubled (Figures 3.3.1., 3.3.3, 3.3.4); to exemplify, for GDP and absorption, the growth gains increase from 0.30-0.35 to 0.6-0.7 percentage points. However, among the different domestic final demands, it is only public investment that registers a substantial growth boost; the gains in private final demands remain small, including larger initial losses (6 percent in 2021) but reaching above the base in 2027 and gaining 3 percent compared to the base by 2030 (Figures 3.3.2 and 3.3.5).

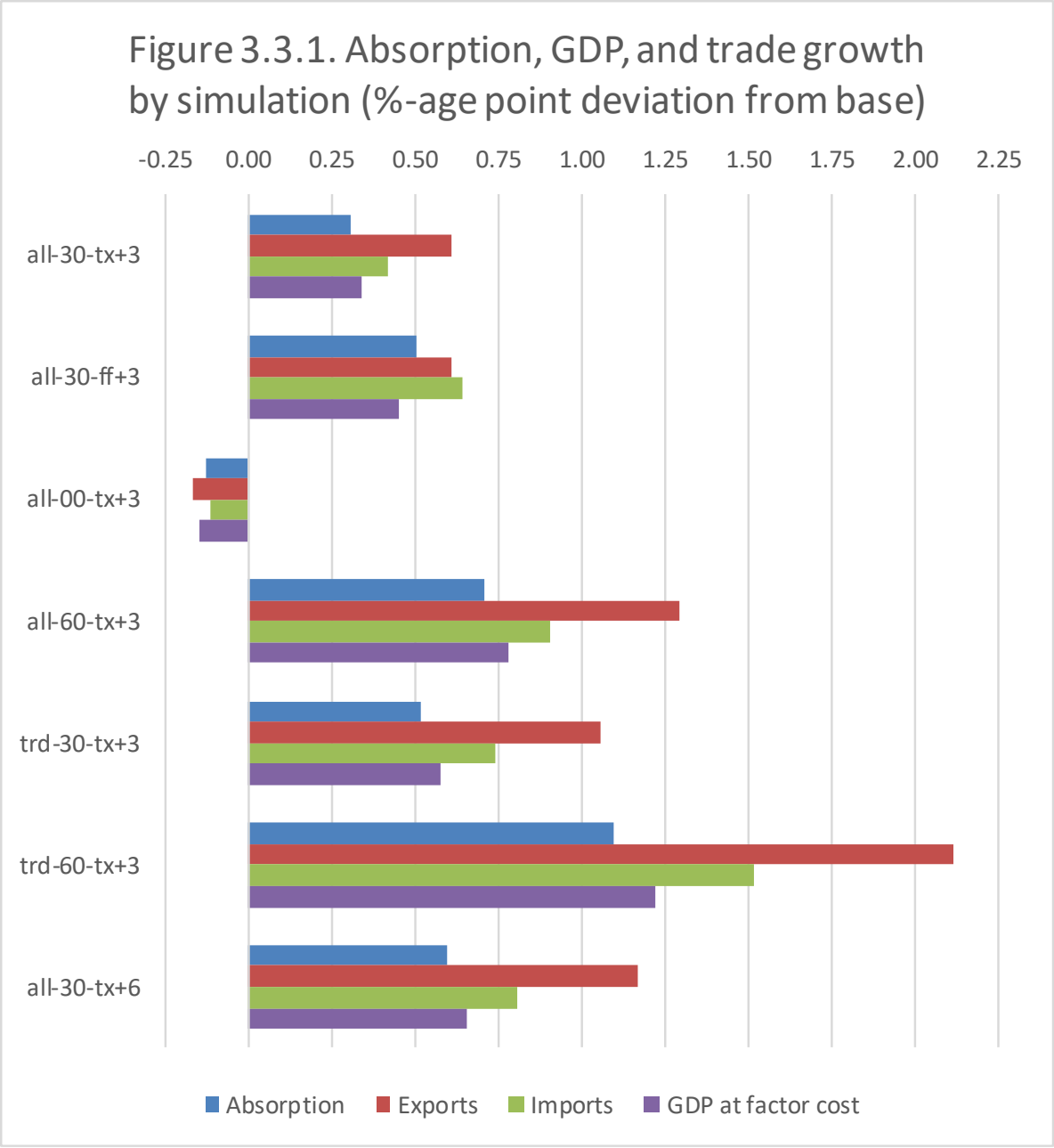


Figure 3.3.1. Absorption, GDP, and trade growth by simulation (%-age point deviation from base)
-0.25
0.00
0.25
0.50
0.75
1.00
1.25
1.50
1.75
2.00
2.25
all-30-tx+3
all-30-ff+3
all-00-tx+3
all-60-tx+3
trd-30-tx+3
trd-60-tx+3
all-30-tx+6
Absorption
Exports
Imports
GDP at factor cost

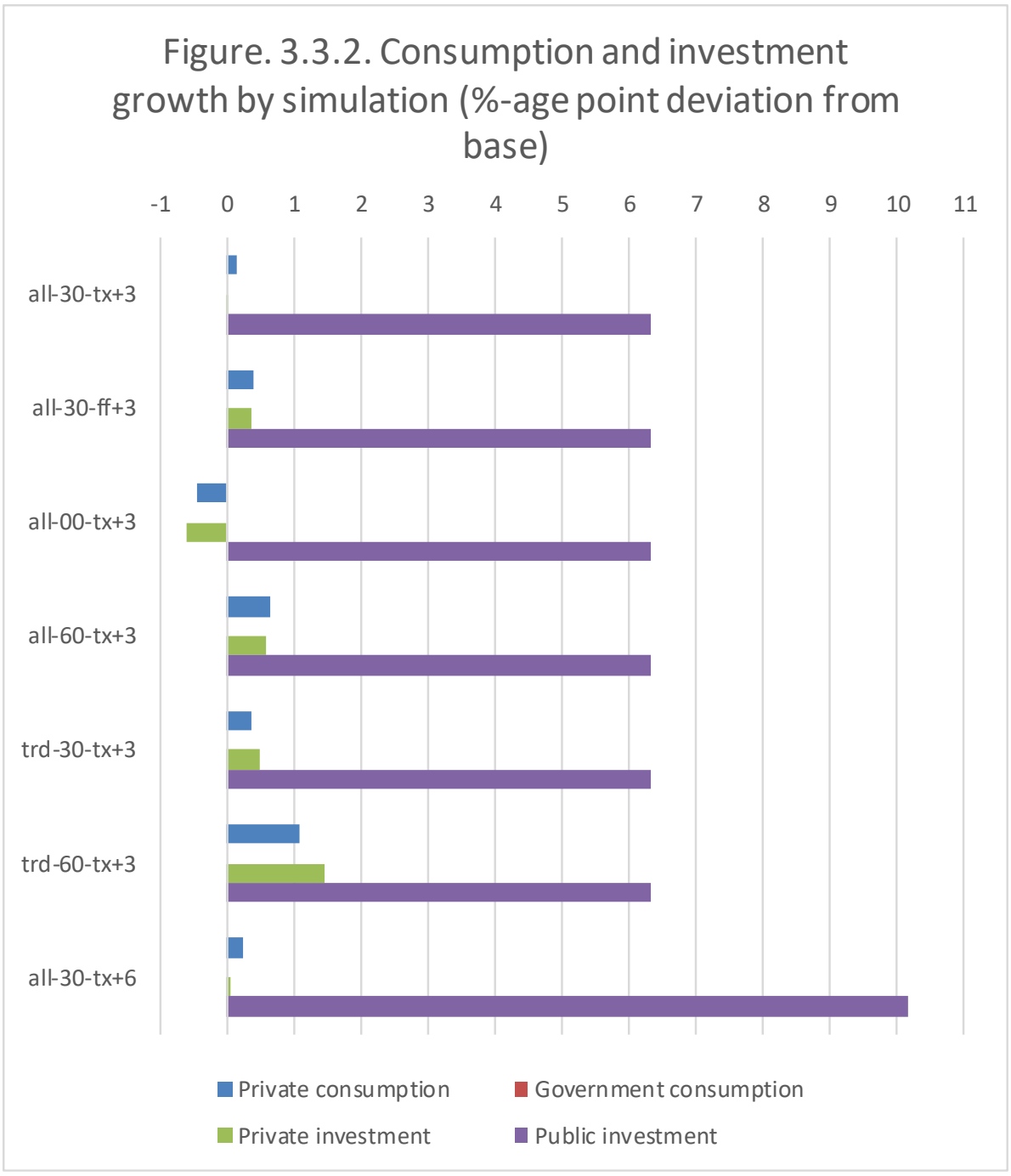


Figure. 3.3.2. Consumption and investment growth by simulation (%-age point deviation from base)
-1
0
1
2
3
4
5
6
7
8
9
10
11
all-30-tx+3
all-30-ff+3
all-00-tx+3
all-60-tx+3
trd-30-tx+3
trd-60-tx+3
all-30-tx+6
Private consumption
Government consumption
Private investment
Public investment

Figure 3.3.3. Sector GDP growth by simulation
(%-age point deviation from base)

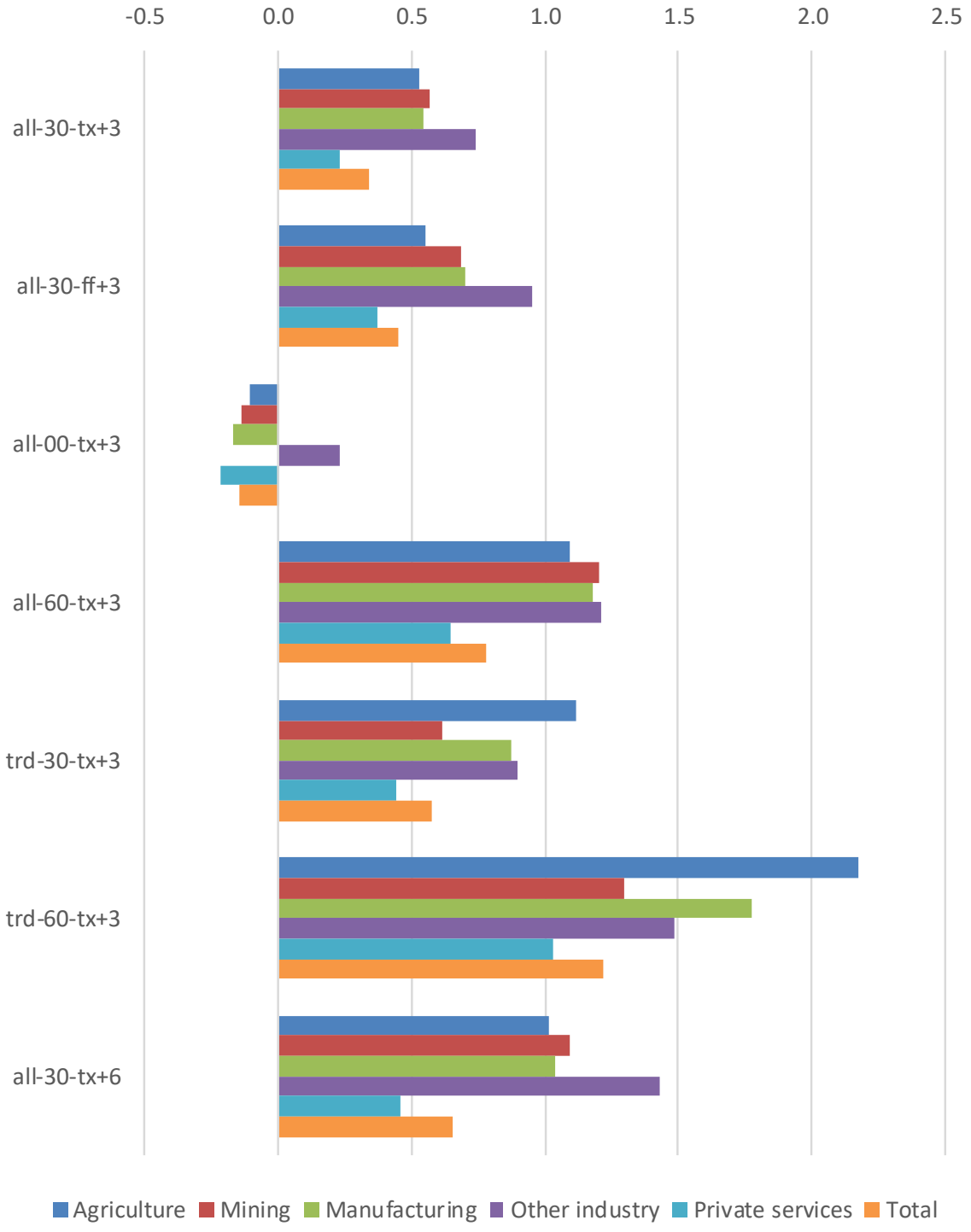


Figure 3.3.4. Sector export growth by simulation
(%-age point deviation from base)

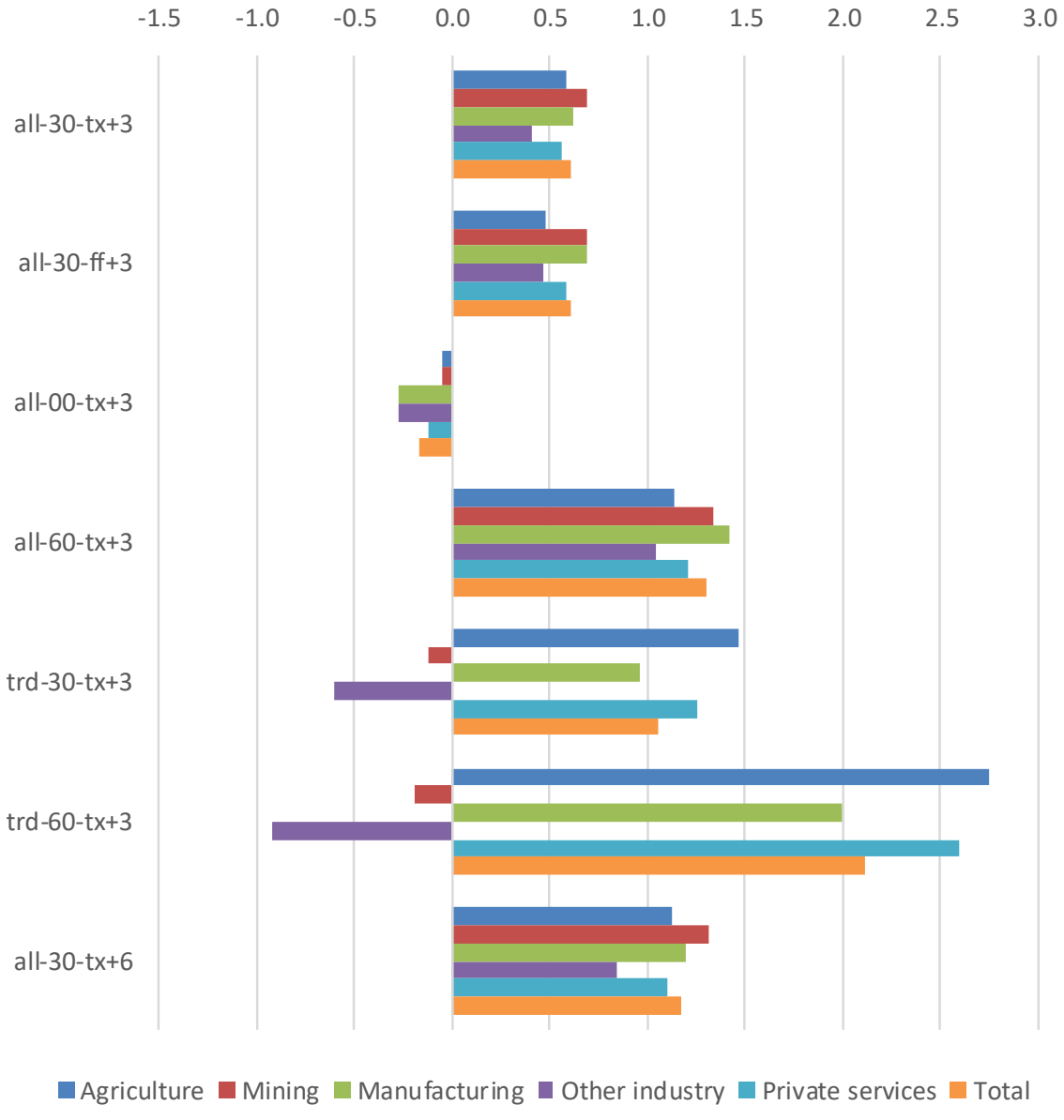
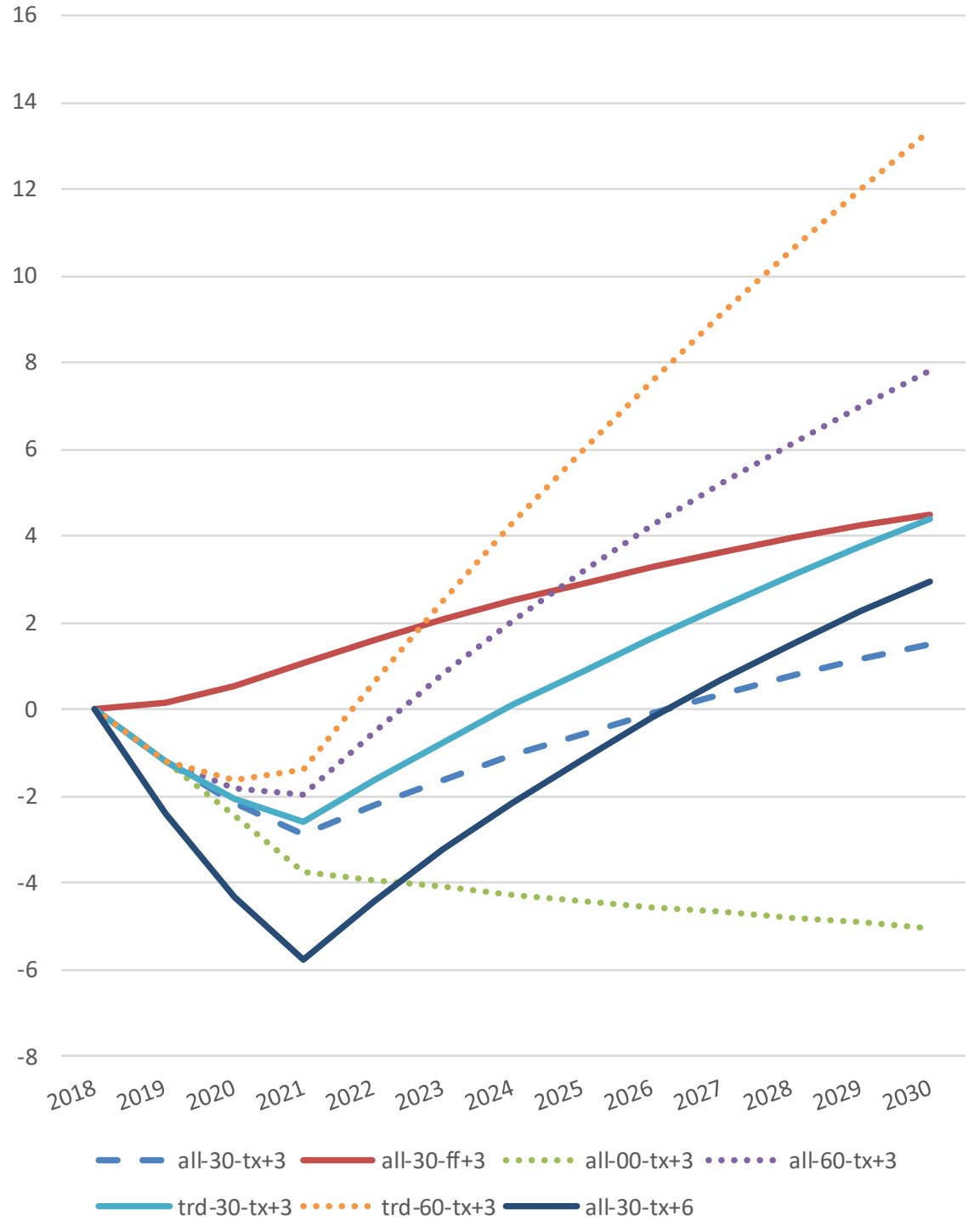


Figure 3.3.5. Private consumption per capita: Year-by-year deviation from base (%)



Rural and urban consumption, poverty, employment, and taxes

As indicated in the discussion of base results, rural households gain relative to urban households due to the relatively strong importance of land rents among their income flows – the exogenous annual growth rate for agricultural land use is 1 percent, a rate that is below labor and capital stock growth. In terms of CPI-index income growth, land rental income grows at an annual rate of around 6 percent while the growth rates for other factors are in the range of 3-4 percent. Figure 3.3.6 shows the 2030 per-capita consumption for the two household types by simulation, for each indexed so that the 2018 level is 100. As indicated, across the different simulations, the results for the two households are highly correlated. The stronger rural gains reduce average urban-rural consumption inequality: as a share of urban per-capita consumption, rural consumption increases from 28 percent in 2018 to 31-32 percent in 2030.

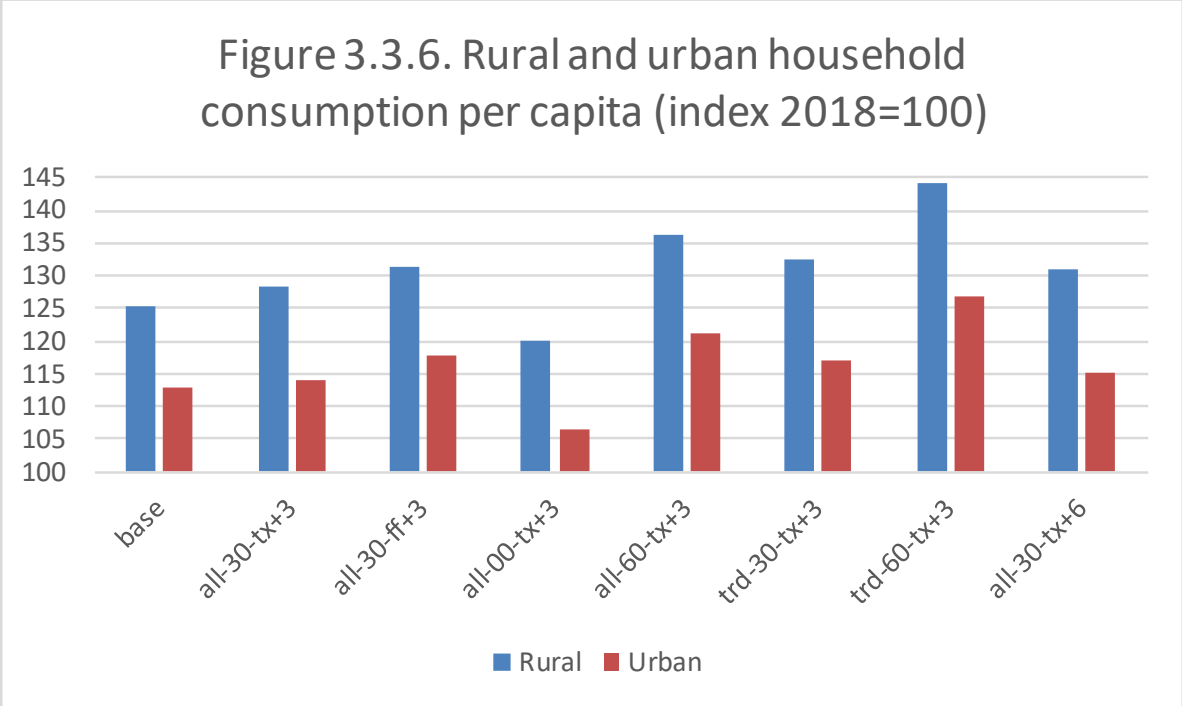
Job creation and unemployment reduction are major items on the policy agenda of most countries and labor is the main income source for many poor. In the scenarios, the unemployment rate invariably declines (see Table C.1), reflecting the fact that the labor force (and the population in labor force age) grows at an annual rate of 2.8 percent while employment grows at 3.2 percent or faster. Figure 3.3.7 shows the rates of employment growth for the different scenarios. Across the board, employment growth and unemployment reduction are strongly correlated with GDP growth – the correlation coefficient between the growth rates for GDP growth and employment is 0.94 (computed using data in Table C.1 and for Figure 3.3.7).[11] The only deviation from a perfect ranking correlation is that, for the scenario *trd-30-tx+3*, employment growth is higher than for *all-30-ff-3+* in spite of slightly lower GDP growth. (For poverty, the ranking deviation is identical.) This suggests that a focus on tradables has a relatively strong payoff in job creation and poverty reduction relative to GDP growth.

The results for headcount poverty for all simulations are shown in Figure 3.3.8. (See also Table C.1). As noted in the analysis of the base simulation, the poverty analysis is done on the national level due to a lack of data. By definition, the ranking of the level of poverty reduction matches the ranking for growth in national per-capita household consumption. Compared to the base, all scenarios with positive MPs for infrastructure capital reduce poverty compared to the base.

Finally, Figure 3.3.9 reviews the total tax burden for selected simulations, contrasting the base with scenarios for which investment expanded by 3 percent of GDP with reliance on foreign financing (*all-30-ff-3+*) or domestic taxes with marginal products of 0.30 and 0 for new infrastructure capital (*all-30-tx-3+* and *all-00-tx-3*, respectively). Initially, the tax increase is close to the spending increase (3 percent of GDP) for the two tax scenarios, with some 25-30 percent of this increase met by direct and the rest by indirect domestic taxes (cf. Table C.3). However, if the investment is relatively successful in terms of growth generation (*all-30-tx-3+*) the burden gradually declines; if the investment would have ceased in 2030, the government

[11] At the sectoral level, the main change in employment shares for all scenarios is an increase in agriculture at the expense of private services (Table C.6).

would have been able to reduce taxes relative to the base. While the foreign-financing scenario (*all-30-ff-3+*) keeps taxes at close to the base level, it has the obvious drawback of leaving Zimbabwe with a higher foreign debt – in the final year, the foreign government debts for *all-30-tx-3+* and *all-30-ff-3+* are around 43 and 58 percent of GDP, respectively (Table C.2).



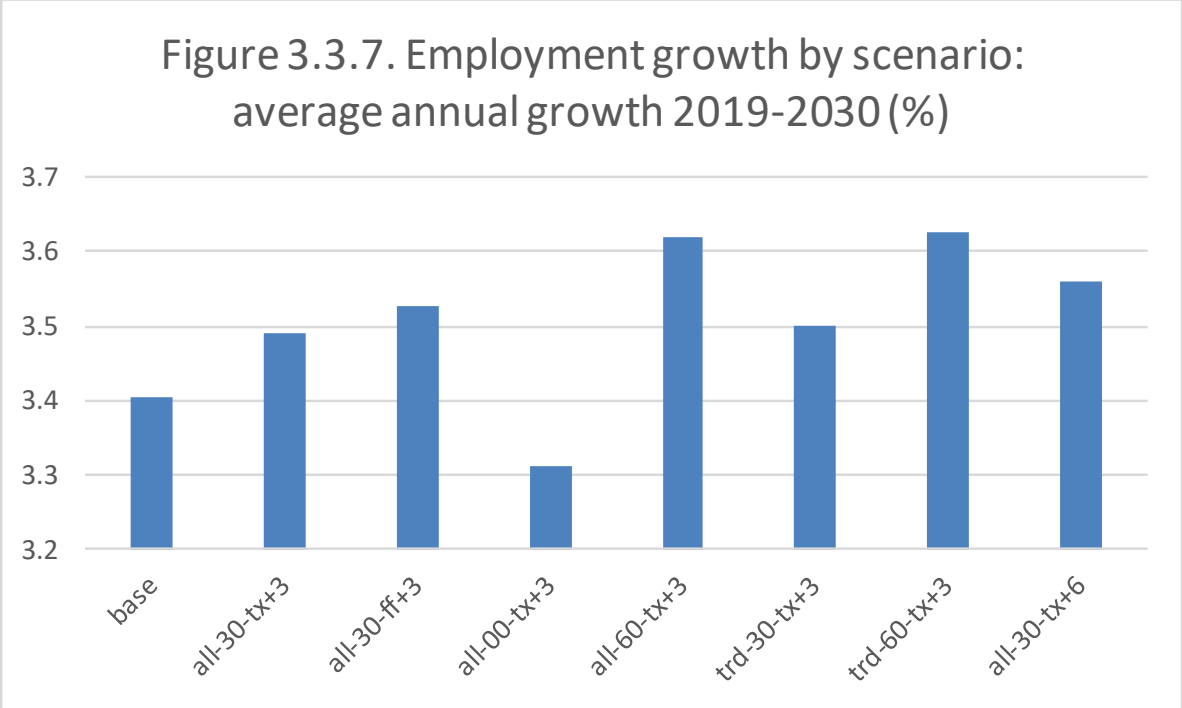


Figure 3.3.8. National poverty: rates in 2018 and 2030; reduction by simulation 2018-2030

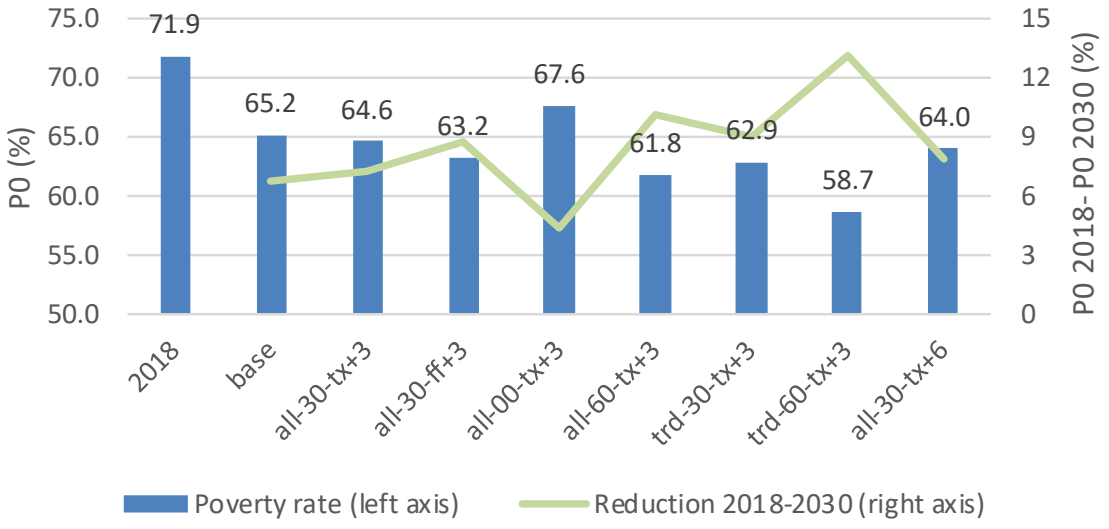
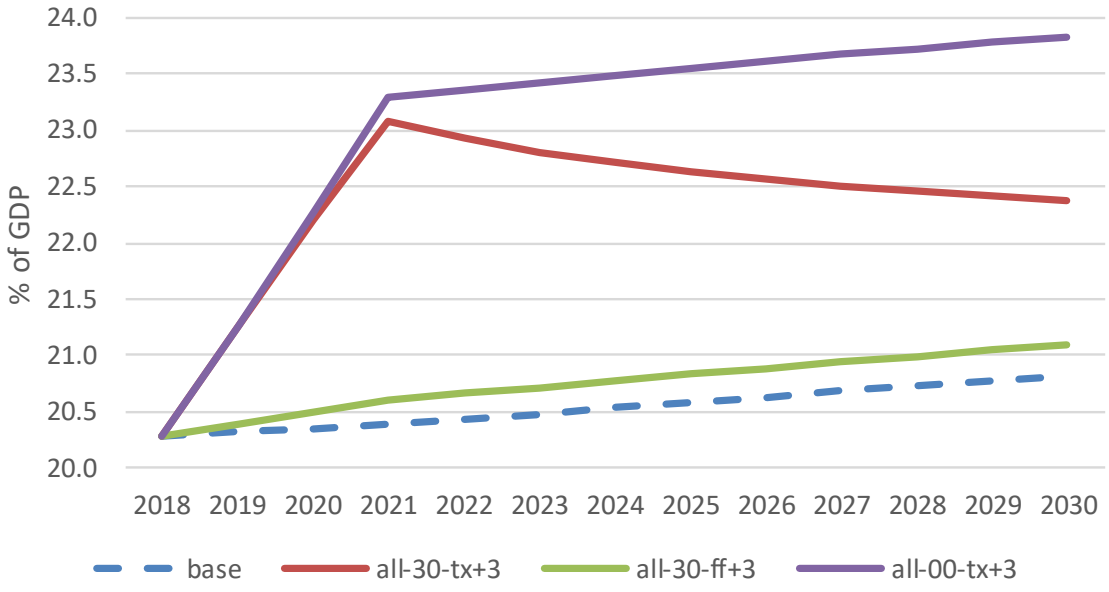


Figure 3.3.9. Tax revenue by scenario and year



4. Concluding remarks

This analysis offers a macro and economywide perspective on scaled-up infrastructure investment in Zimbabwe, highlighting the broader repercussions of micro and sector level actions by producers, households, and government officials. The results give a numerical sense

of the consequences of differences between investment programs in terms in productivity gains (high or low), revenue sources (taxes or foreign borrowing), sector focus (spreading benefits across all sectors or being focused on tradables), and scale (exemplified by expansions amounting to 3 or 6 percent of GDP).

The differences between the scenarios in terms of GDP growth, household consumption, and poverty point to the importance of strong public investment management and, other things being equal, of targeting TFP gains to tradable sectors. The advantages of reliance on domestic taxation for the funding of expanded investment include slower debt accumulation and less reliance on the decisions of external actors. Tax reliance may also give the funders, the citizens, a stronger sense of ownership and right to monitor how the money is used, with a positive impact on investment productivity. On the other hand, before the investment have yielded sufficient returns, reliance on taxes reduces private purchasing power, leading to some combination of lower private consumption and investment (cf. Figure 3.3.5). Raising the tax burden by 2-3 percent of GDP may also be administratively difficult. It would of course be possible to consider scenarios that split the funding burden between domestic taxes and foreign financing.

While the scenarios assume that the government funds the investment program, in the real world it may be beneficial to involve the private sector and consider other financing mechanisms, including public-private partnerships. Finally, while closing the infrastructure gap may be necessary for accelerated progress in Zimbabwe, it is not sufficient – in order to benefit and become competitive, firms need access to the right inputs (human and other) as well as an enabling policy and institutional environment. In this regard, lessons from policymaking in other parts of the world can offer ideas for adaptation to Zimbabwe's realities.

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Appendix A: Structure of SDGSIM

This appendix provides additional detail on SDGSIM as applied to Zimbabwe. Figure A.1 summarizes the payment flows that the model captures in in any year while Figure A.2 describes the labor market.

Activities produce, selling their output at home or abroad, and using their revenues to cover their costs (of intermediate inputs, factor hiring and taxes). Activity decisions about factor hiring, which, which determine the output level, are driven by profit maximization. The shares exported and sold domestically depend on the relative prices of their output in world and domestic markets.

SDGSIM includes three core *institutions*: households, government, and the rest of the world.

- *Households* (in the Zimbabwe application split into rural and urban) earn incomes from factors, transfers from the government, and transfers from the rest of the world. These are used for direct taxes, savings, and consumption. The savings share is exogenous or endogenous depending on the mechanism for achieving balance between private investment and available financing. Their consumption decisions change in response to income and price changes. By construction (and as required by the household budget constraints), the consumption value of the households equals their income net of direct taxes and savings.

- The *government* gets its receipts from taxes and transfers from abroad; it uses these for consumption, transfers to households, and investments (providing capital stocks used in the production of government services), drawing on domestic and foreign financing for supplementary funding. To remain within its budget constraint, it either adjusts some part(s)

of its spending on the basis of available receipts or mobilizes additional receipts of one or more types in order to finance its spending.

- The *rest of the world* (which appears in the balance of payments) sends foreign currency to Zimbabwe in the form of transfers to government and households, FDI, loans, and export payments. Zimbabwe uses these inflows to finance its imports. The balance of payments clears (inflows and outflows are equalized) via adjustments in the real exchange rate (through changes in the domestic price level, changing the ratio between the international and domestic price levels in domestic currency) which take place when the balance is in surplus or deficit.

Private investment financing is provided from domestic household savings (net of financing to the government) and foreign investment. It is assumed that household investment spending will adjust in response to changes in available funding or that household savings will adjust to finance a predetermined investment level.

In *domestic commodity markets*, flexible prices ensure balance between demands for domestic output from domestic demanders and supplies to the domestic market from domestic suppliers. The part of domestic demands that is for imports faces exogenous world prices – Zimbabwe is viewed as a small country in world markets without any impact on the import and export prices that it faces. Domestic demanders decide on import and domestic shares in their demands on the basis of the relative prices of commodities from these two sources. Similarly, domestic suppliers (the activities) decide on the shares for exports and domestic supplies on the basis of the relative prices received in these two markets.[12]

Factor markets reach balance between demands and supplies via wage (or rent) adjustments. Across all factors, the factor demand curves are downward sloping reflecting the responses of production activities to changes in factor wages. On the supply side of the labor market, unemployment is endogenous – the model includes a wage curve (a supply curve) that is upward-sloping until full employment is reached, at which point it becomes vertical (see Figure A1.2). Over time, the labor force grows due to demography (population in working ages and their labor force participation rates). For non-labor factors, the supply curves are vertical in any single year (the supply is fixed) but switch over time as supplies change (see next point).

[12] An individual production activity does not respond to changes in relative prices for exports and domestic sales if its output only has one destination, either exported in full or sold domestically in full. By the same token, domestic demanders do not have a choice between imports and domestic output for commodities if only one source is available.

Figure A1. Aggregate payment flows in SDGSIM

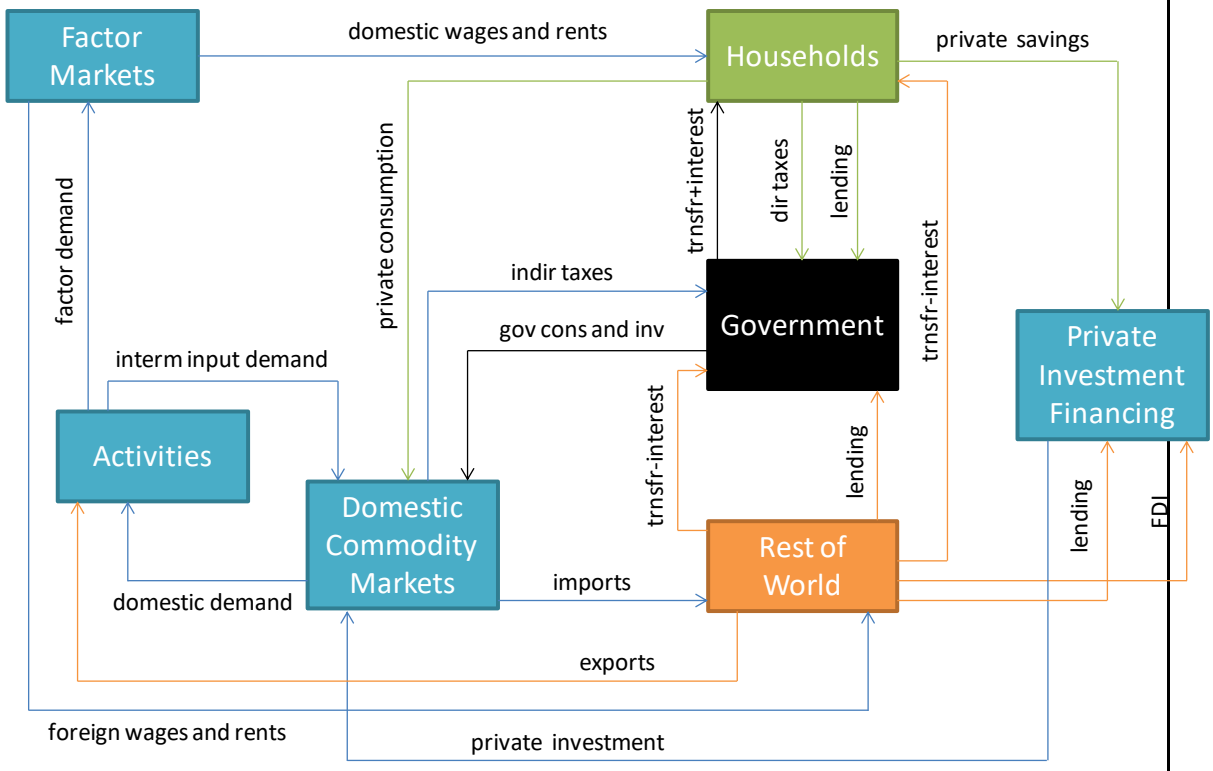
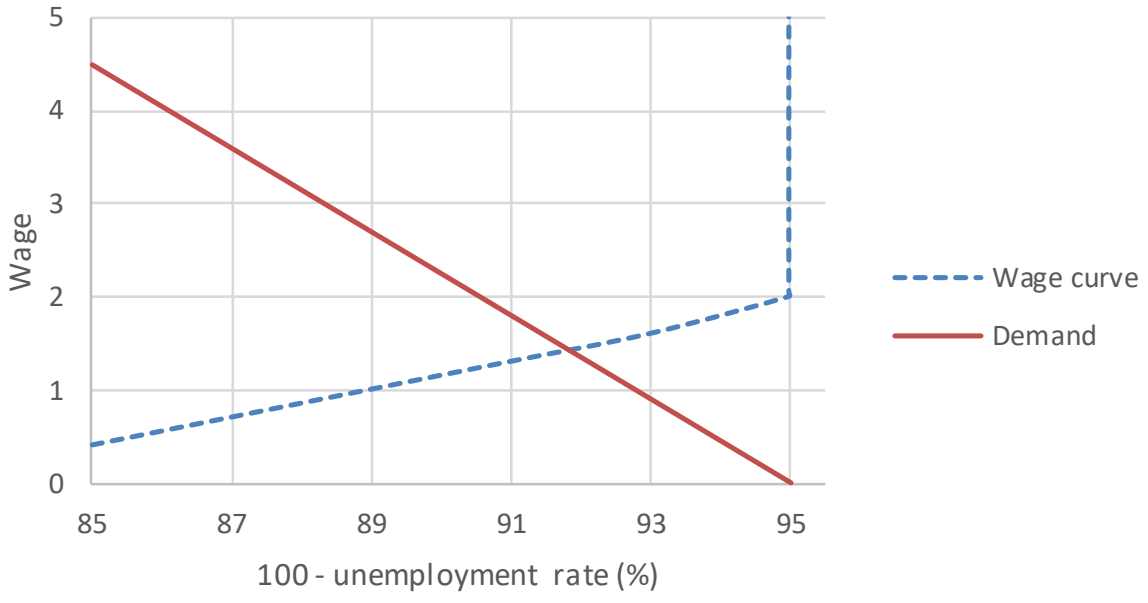


Figure A.2. The labor market in SDGSIM



The above discussion refers to the functioning of model economy in a single year. In SDGSIM, growth over time is endogenous. The economy grows due to accumulation of capital (determined by investment and depreciation), labor (determined by demography), and other factors (following exogenous growth trends), as well as because of improvements in TFP. Apart from an exogenous component, TFP depends on the levels of government capital stocks.

In a post-calculation module, information poverty rates and Gini coefficients for an initial year, and the evolution of real consumption per capita from the simulations are used to generate one or more synthetic household surveys, assuming a lognormal distribution within each household group for which poverty results are generated. In this paper, poverty results are currently only generated at the national level for an aggregate household.

Appendix B: Description of model database

The SDGSIM database for Zimbabwe developed for this analysis has 2016 as its base year. The construction of the SAM is explained in detail in Cicowiez and Lofgren (2018) and the related model and database disaggregation was shown above in Table 2.1. The other key data are elasticities (in trade, production, and consumption), factor stocks, and projections for GDP and other indicators.

The elasticities used are displayed in Table B.1. They were defined on the basis of the literature and author assessments, drawing on a combination of econometric evidence and experience from similar country applications; for a survey, see Annabi et al. (2006). For the extractive industry activity, the value-added and CET elasticities are at low levels to let production and export growth be driven by exogenous assumptions regarding use of the resource factor. For household consumption, expenditure elasticities are based on Muhammad et al. (2011, pp. 24 and 39). These were then recalibrated to reflect the consumption structure in the Zimbabwe SAM. In the context of the linear expenditure system (LES) demand functions, which are used in SDGSIM, estimates are also needed for the so-called Frisch parameter (technically the elasticity of the marginal utility of income with respect to income) for each household group. Using a relationship in Lluch et al. (1977, pp. 54-55), which expresses an inverse relationship between the Frisch parameter and real per-capita consumption, rural and urban Frisch parameters were estimated at -7.3 and -4.4, respectively. These values were used, in particular since they were consistent with GTAP estimates for different countries and regions (Dimaranan et al. 1997, p. 17). Population data are based on UN (2017).

For poverty and inequality, the most recent information was for 2011, covering national, rural and urban headcount poverty rates as well as a national Gini coefficient (World Bank 2018b). In order to be able to conduct rudimentary poverty analysis, we considered the national 2011 figures as valid also for 2016 but refrained from the rural-urban dimension.

Among the factors, base-year stocks are needed for private capital and labor. The private capital stock was estimated based on capital rents in the SAM, and typical rates for depreciation (4.5 percent) and a relatively modest rate of net profits (10 percent). For government capital, estimates are not need for base-year stocks as simulation results only depend on deviations of the stock from base scenario levels. Apart from simulated investment levels, these deviations depend on government capital depreciation rates, which were set at 3.5 percent.

The fact that the model is solved over time generates additional data needs. As noted in the main body of the text, the base scenario is calibrated to replicate a path of growth in GDP at factor cost that is based on data and projections from the African Development Bank (2018) and the IMF (2018). Projections are also needed for growth in the labor and mining factors. For labor, which is disaggregated into skilled and unskilled, these projections are based on projected changes in the educational composition of the labor force. For mining, growth in

resource extraction is a major determinant of mining sector growth; the relevant factor growth rate was set to generate growth in the mining sector that is close to overall GDP growth.

On a final note, it is clear that some of the data used are rough estimates. However, the analyst and the reader should take comfort in the fact that, given the consistency features of an economy-wide model like SDGSIM (in markets for factors and commodities, quantities demanded and supplied must be equal and all agents live under budgetary constraints), for most simulations, most parameters tend to play a qualitatively minor role as long as their values stay within accepted bounds. However, for any given simulation, specific parameters may be important; given this it is important to design the simulations so that the role played by such parameters are carefully considered.

Table B.1. Value-added, trade, and consumption elasticities

	VA	CET	Armington	LES-rural	LES-urban
Agriculture, forestry and fishing	0.90	2.20	0.90	0.43	0.44
Mining and quarrying	0.90	1.10		1.16	1.18
Manufacturing	0.90	2.20	0.90	1.16	1.18
Electricity and water supply	0.90	1.10	0.60	0.56	0.57
Construction	0.90			0.56	0.57
Financial intermediation	0.90			1.16	1.18
Real estate and business activitie	0.90			1.16	1.18
Trade, hotels and restaurants	0.90	2.20	0.90	1.06	1.08
Transport and communications	0.90			0.66	0.67
Public administration	0.25			1.16	1.18
Education	0.25			0.48	0.49
Health	0.25			2.22	2.26
Domestic services	0.90			1.16	1.18
Other services	0.90			1.16	1.18

VA = CES value-added function

Armington = CES aggregation function for domestic demand (elasticities of substitution between imports and domestic output);

CET = Constant Elasticity of Transformation function for domestic output (elasticities of transformation between exports and domestic supply)

LES-rural/urban = Linear Expenditure system (elasticities of household consumption with respect to total consumption spending) for rural and urban households.

Source: Annabi et al. (2006) and Authors' assessments.

Appendix C: Additional simulation results

Table C.1. Real macro indicators by simulation (% annual growth 2019-2030)

	2018	base	all-30-tx+3	all-30-ff+3	all-00-tx+3	all-60-tx+3	trd-30-tx+3	trd-60-tx+3	all-30-tx+6
Absorption	1,931.9	4.0	4.3	4.5	3.9	4.7	4.5	5.1	4.6
Consumption - private	1,355.4	3.4	3.5	3.8	3.0	4.1	3.8	4.5	3.7
Consumption - government	379.4	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3
Fixed investment - private	147.4	7.8	7.8	8.1	7.2	8.4	8.3	9.2	7.8
Fixed investment - government	49.6	3.7	10.1	10.1	10.1	10.1	10.1	10.1	13.9
Exports	466.8	4.6	5.2	5.2	4.4	5.9	5.7	6.7	5.8
Imports	669.7	4.0	4.5	4.7	3.9	4.9	4.8	5.6	4.8
GDP at factor cost	1,510.4	4.2	4.5	4.6	4.0	5.0	4.8	5.4	4.8
Total factor employment (index)		3.0	3.3	3.4	3.2	3.4	3.4	3.5	3.6
Total factor productivity (index)		1.2	1.2	1.2	0.9	1.5	1.4	1.9	1.2
GNI	1,698.6	4.2	4.5	4.7	4.0	5.0	4.8	5.4	4.9
GNDI	1,893.1	4.1	4.4	4.6	4.0	4.8	4.7	5.3	4.7
GNI per capita	1.0	2.1	2.5	2.6	2.0	2.9	2.7	3.3	2.8
GNDI per capita	1.1	2.0	2.4	2.5	1.9	2.8	2.6	3.2	2.7
Real exchange rate (index)		0.6	0.7	0.7	0.6	0.8	0.4	0.2	0.8
Unemployment rate (%)	13.9	7.8	6.9	6.5	8.8	5.5	6.8	5.5	6.2
Headcount poverty rate (%)	71.9	65.2	64.6	63.2	67.6	61.8	62.9	58.7	64.0

Note:

1. Unless otherwise noted, column for initial year shows data in billions of 2016 US$.
2. For the unemployment and poverty rates, the base-year and simulation columns show base-year rate and simulation-specific final-year rates, respectively.

Table C.2. Macro indicators in 2018 and by simulation in 2030 (% of nominal GDP)

		2030							
Indicator	**2018**	**base**	**all-30-tx+3**	**all-30-ff+3**	**all-00-tx+3**	**all-60-tx+3**	**trd-30-tx+3**	**trd-60-tx+3**	**all-30-tx+6**
Absorption	112.0	111.8	111.3	112.2	111.9	110.7	110.4	109.2	110.8
Consumption - private	78.8	73.6	72.0	72.9	71.3	72.7	71.3	71.3	70.5
Consumption - government	21.7	21.6	20.3	20.2	21.4	19.2	20.5	19.8	19.0
Investment - private	8.6	13.6	13.3	13.5	13.1	13.4	13.2	13.3	12.9
Investment - government	2.9	2.9	5.7	5.6	6.1	5.4	5.4	4.9	8.4
Exports	27.8	30.8	31.9	31.3	30.4	33.2	31.5	32.3	32.9
Imports	39.9	42.5	43.1	43.5	42.3	43.9	41.9	41.5	43.7
GDP at market prices	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Net indirect taxes	12.8	13.6	14.8	14.0	15.7	14.0	14.7	13.9	16.0
GDP at factor cost	87.2	86.4	85.2	86.0	84.3	86.0	85.3	86.1	84.0
GNI	98.2	97.9	97.9	97.9	97.9	97.8	97.9	97.8	97.8
GNDI	109.7	109.5	109.1	108.9	109.6	108.6	108.3	107.3	108.7
Foreign savings	2.3	2.3	2.2	3.3	2.3	2.1	2.1	1.9	2.1
Foreign savings	9.2	14.2	16.8	15.8	16.8	16.8	16.5	16.3	19.2
Foreign government debt	47.7	45.0	43.5	58.4	45.4	41.9	40.7	36.9	42.1
Foreign private debt	23.7	27.1	26.2	25.7	27.3	25.2	24.5	22.2	25.4
Domestic government debt	29.4	30.3	29.5	29.1	30.5	28.6	27.8	25.6	28.7

Table C.3. Government receipts and spending in 2018 and by simulation in 2030 (% of nominal GDP)

			2030						
Indicator		2018	base	all-30-tx+3	all-30-ff+3	all-00-tx+3	all-60-tx+3	trd-30-tx+3	trd-60-tx+3	all-30-tx+6
Receipts	Direct taxes	7.5	7.2	7.6	7.1	8.2	7.0	7.6	7.2	7.9
	Import tariffs	1.7	1.9	1.9	1.9	1.9	1.9	1.8	1.8	1.9
	Export taxes									
	Other indirect taxes	11.1	11.8	12.9	12.1	13.8	12.1	12.8	12.1	14.0
	Private transfers	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
	Foreign transfers									
	Factor income	0.6	0.6	0.5	0.5	0.6	0.5	0.6	0.5	0.5
	Domestic financing	2.2	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6
	Foreign financing	0.4	0.4	0.4	1.6	0.5	0.4	0.4	0.4	0.4
	Total	24.6	24.5	26.0	25.8	27.5	24.6	25.9	24.6	27.4
Spending	Consumption	21.7	21.6	20.3	20.2	21.4	19.2	20.5	19.8	19.0
	Fixed investment	2.9	2.9	5.7	5.6	6.1	5.4	5.4	4.9	8.4
	Stock change									
	Private transfers									
	Foreign transfers	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Commodity subsidies									
	Total	24.6	24.5	26.0	25.8	27.5	24.6	25.9	24.6	27.4

Table C.4. Balance of payments in 2018 and by simulation in 2030 (% of nominal GDP)

			2030						
Indicator		2018	base	all-30-tx+3	all-30-ff+3	all-00-tx+3	all-60-tx+3	trd-30-tx+3	trd-60-tx+3	all-30-tx+6
Outflows	Imports	39.9	42.5	43.1	43.5	42.3	43.9	41.9	41.5	43.7
	Private transfers to RoW	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
	Official transfers to RoW	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Factor income to RoW	3.1	3.4	3.4	3.3	3.4	3.4	3.3	3.2	3.4
	Change in foreign reserves									
	Total	43.1	46.0	46.6	46.9	45.7	47.4	45.2	44.8	47.1
Inflows	Exports	27.8	30.8	31.9	31.3	30.4	33.2	31.5	32.3	32.9
	Private transfers from RoW	11.7	11.7	11.3	11.1	11.8	10.9	10.6	9.6	10.9
	Official transfers from RoW									
	Factor income from RoW	1.3	1.3	1.2	1.2	1.3	1.2	1.1	1.0	1.2
	Private financing	0.6	0.6	0.6	0.5	0.6	0.5	0.5	0.5	0.5
	Government financing	0.4	0.4	0.4	1.6	0.5	0.4	0.4	0.4	0.4
	Foreign investment	1.3	1.3	1.2	1.2	1.3	1.2	1.1	1.0	1.2
	Total	43.1	46.0	46.6	46.9	45.7	47.4	45.2	44.8	47.1

Table C.5. Real GDP at factor cost by sector -- level in 2018 and annual growth by simulation 2019-2030 (%)

	2018	base	all-30-tx+3	all-30-ff+3	all-00-tx+3	all-60-tx+3	trd-30-tx+3	trd-60-tx+3	all-30-tx+6
Aggregate sectors									
Agriculture	176.5	4.6	5.2	5.2	4.5	5.7	5.7	6.8	5.6
Industry	354.0	4.1	4.7	4.9	4.1	5.3	4.9	5.7	5.3
Mining	132.0	2.9	3.5	3.6	2.8	4.1	3.6	4.2	4.0
Manufacturing	148.9	4.7	5.3	5.4	4.6	5.9	5.6	6.5	5.8
Other	73.1	4.8	5.5	5.7	5.0	6.0	5.7	6.2	6.2
Services	934.3	4.1	4.3	4.4	3.9	4.7	4.5	5.0	4.5
Private	806.6	4.1	4.3	4.5	3.9	4.7	4.5	5.1	4.6
Government	127.7	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3
Disaggregated sectors									
Agriculture	176.5	4.6	5.2	5.2	4.5	5.7	5.7	6.8	5.6
Mining and quarrying	132.0	2.9	3.5	3.6	2.8	4.1	3.6	4.2	4.0
Manufacturing	148.9	4.7	5.3	5.4	4.6	5.9	5.6	6.5	5.8
Electricity and water supply	29.5	3.3	3.4	3.6	2.9	3.9	3.3	3.6	3.6
Construction	43.7	5.6	6.7	6.9	6.2	7.2	7.0	7.7	7.6
Financial intermediation	100.9	3.9	4.1	4.3	3.5	4.7	4.4	5.1	4.4
Real estate and business activities	43.0	3.5	3.6	3.9	2.8	4.2	3.6	4.3	3.6
Trade, hotels and restaurants	223.4	4.8	5.2	5.3	4.7	5.7	5.7	6.6	5.6
Transport and communications	155.3	3.6	3.8	4.0	3.3	4.3	4.0	4.6	4.1
Public administration	127.7	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3
Education	188.5	3.8	3.9	3.9	3.8	4.0	3.9	4.0	3.9
Health	41.5	4.4	4.5	4.6	4.3	4.7	4.5	4.7	4.6
Domestic services	5.2	3.6	3.8	4.1	3.2	4.4	3.9	4.4	4.1
Other services	48.9	3.9	4.2	4.4	3.6	4.8	4.4	5.0	4.5
Total	1464.8	4.2	4.5	4.6	4.0	5.0	4.8	5.4	4.8

Table C.6. Sector structure in 2018 and 2030 (%)

	Value added	Produc-tion	Employ-ment	Exports	Imports	Export/ output	Import/ demand
2018							
Agriculture	12.1	11.1	68.8	31.1	7.5	41.7	20.7
Industry	23.6	31.6	7.0	59.5	73.0	25.6	42.0
Mining	8.6	5.6	1.4	15.9	0.2	42.8	1.5
Manufacturing	10.4	23.3	4.0	43.4	70.1	24.4	47.5
Other	4.6	2.8	1.5	0.2	2.6	1.1	17.1
Services	64.3	57.2	24.3	9.4	19.5	2.5	7.1
Private	55.6	51.1	23.1	9.4	19.5	2.8	7.9
Government	8.7	6.1	1.2	0.0	0.0	0.0	0.0
Total	100.0	100.0	100.0	100.0	100.0	14.2	22.0
Agriculture	14.4	12.4	71.7	32.7	7.8	42.8	20.8
Industry	23.6	33.7	6.5	55.8	74.4	24.2	41.5
Mining	7.6	4.9	1.1	6.4	0.2	21.2	1.5
Manufacturing	11.0	25.8	3.8	49.2	71.8	27.5	47.6
Other	4.9	3.0	1.6	0.2	2.3	1.1	15.0
Services	62.1	53.9	21.8	11.5	17.8	3.5	7.2
Private	53.3	47.9	20.6	11.5	17.8	3.9	8.1
Government	8.7	6.0	1.1	0.0	0.0	0.0	0.0
Total	100.0	100.0	100.0	100.0	100.0	15.4	23.0
Δ (2030-2018)							
Agriculture	2.3	1.3	3.0	1.6	0.3	1.1	0.0
Industry	0.0	2.0	-0.4	-3.7	1.4	-1.3	-0.5
Mining	-1.0	-0.7	-0.3	-9.5	0.0	-21.5	-0.1
Manufacturing	0.6	2.5	-0.2	5.8	1.7	3.0	0.1
Other	0.3	0.2	0.1	0.0	-0.3	0.0	-2.0
Services	-2.3	-3.3	-2.5	2.1	-1.7	1.0	0.1
Private	-2.3	-3.2	-2.4	2.1	-1.7	1.1	0.2
Government	0.0	-0.1	-0.1	0.0	0.0	0.0	0.0
Total	0.0	0.0	0.0	0.0	0.0	1.2	0.9

Table C.7. BOTE calculation of MP of infrastructure investment

#		all-30-tx+3	trd-30-tx+3
1	**ΔK**	436.1	436.1
2	**Δ GDP -- productivity**	139.3	210.1
3	**Δ GDP -- financing***	-41.7	-41.7
4	**Δ GDP -- total**	97.6	168.4
5	**MP -- productivity = 2/1**	0.319	0.482
6	**MP -- financing = 3/1**	-0.096	-0.096
7	**MP -- total = (2+3)/1**	0.224	0.386

Note:
BOTE = Back-of-the-envelope
ΔK = change in 2030 infrastructure stock compared to base.
ΔGDP productivity = change in 2030 GDP for scenario compared to all-00-tx+3
ΔGDP financing = change in 2030 GDP for scenario all-00-tx+3 compared to base
*The scenarios have identical investment financing costs since sector targeting only appears in distribution of productivity gains