Economy-wide Private Impact Quantification Model

EPIQ Ethiopia Pilot

Estimating and Analyzing Expected Impacts of Private Investments in Ethiopia

LET'S WORK
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ECONOMY-WIDE PRIVATE IMPACT ASSESSMENT QUANTIFICATION MODEL - EPIQ ETHIOPIA PILOT

Sector Economics and Development Impact Department

International Finance Corporation

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Disclaimer

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Acronyms

CAB	Current Account Balance
CGE	Computable General Equilibrium
DBE	Development Bank of Ethiopia
EIB	Ethiopian Investment Board
EIC	Ethiopian Investment Commission
EPIQ	Economy-wide Private Impact Quantification
EU	European Union
FIES	Family Income and Expenditure Survey
GAMS	Generalized Algebraic Modeling System
GNI	Gross National Income
GoE	Government of Ethiopia
GTPI	Growth and Transformation Plan, Phase 1
GTPII	Growth and Transformation Plan, Phase 2
HIPC	Highly Indebted Poor Countries
IFC	International Finance Corporation
IFI	International Financial Institutions
IFPRI	International Food Policy Research Institute
ILO	International Labor Organization
IMF	International Monetary Fund
LIC	Low Income Countries
LMI	Lower Middle Income Countries
NBE	National Bank of Ethiopia
PPP	Parity Purchasing Power
PWT	Penn World Tables
RER	Real Exchange Rate
SAM	Social Accounting Matrix
SDG	Sustainable Development Goals
SNA	System of National Accounts
SSA	Sub Saharan Africa
TFP	Total Factor Productivity
UN	United Nations

URAP	Universal Road Access Program
VENSIM	Ventana Systems
WBG	World Bank Group
WDI	World Development Indicators

Executive summary

This report presents a novel analysis of the expected impacts that alternative industry-sector focused investment strategies would have in Ethiopia. We focus not only on economic growth and employment but also on impacts on poverty and inequality. The analysis is based on the results of an innovative structural simulation modeling approach (Economy-wide Private Impact Quantification model - EPIQ), which links investments in one or more industry-sectors to the World Bank Group (WBG) twin goals of ending extreme poverty and improving shared prosperity. EPIQ Ethiopia is the second of two country pilots for EPIQ. While the first pilot focused on the Philippines, EPIQ Ethiopia tests the development of a complex structural model for a country on an earlier stage of economic development. This leads to several additional challenges for the economic modeler. First, Ethiopia is undergoing vast structural change from an agricultural dominated economy to one that is going to rely more on the secondary sectors of the economy. Second, data availability poses more of a challenge for Ethiopia than for the Philippines. The EPIQ Ethiopia model implementation was piloted by IFC with support from the Let's Work Global Partnership.

Along these lines, the main contribution of this report is to provide a comprehensive quantification of the impacts that potential private sector interventions could have on the Ethiopian economy going forward. For this purpose, the analysis considers alternative investment scenarios for the period 2016-2030, benchmarked to a baseline case that assumes the continuation of the status quo. Simulated scenarios aim to highlight the different effects of investment strategies targeting individual industry sectors (agriculture, services, and manufacturing). While this report highlights the model's usefulness to access sector-specific investment strategies, other types of investments and counterfactuals could be run. Most notably, the model allows detailed investigation of tax and transfer policies, and the implication for fiscal issues such as debt and the policies feedback on the distribution of income.

The first step to build the baseline case is calibrating the model to reflect the economic structure and key trends observed in the Ethiopian economy during the historical period 2005-2015. In this regard, the model reproduces the fact that growth in Ethiopia has been inclusive so far; and that together with solid GDP growth rates averaging over 10 percent since 2005, the poverty rate has decreased substantially over the same period. Consistent with the data, the model shows that this is partly explained by the growth of rural productivity. The model calibration is based on a series of industry-sector focused and macroeconomic empirical facts for the historical period (2005-2015) including:

- **Subsistence Farming and agriculture dominate the Ethiopian economy.** Agriculture accounted for almost 40 percent of GDP in 2013, and employed 70 percent of the work force. At the same time, services and manufacturing (predominantly urban) accounted for about 60 percent of GDP and 30 percent of employment. However, while rural poverty in Ethiopia is large, poverty in urban areas is not much lower. The service sector in Ethiopia is dominated by retail and wholesale trade, an activity that accounted for roughly one fourth of economic activity while employing most of the non-agricultural labor force.
- **Fast poverty reductions over the past two decades.** Poverty rates have declined significantly over the past two decades; from over 66 percent in 1995 to below 34 percent in 2010. This sizeable reduction has been made possible by high annual growth rates beyond 10 percent, while extensive industrial policies targeted at agriculture aimed at significant increases in the use of chemical fertilizers and improved seeds, land expansion, increased labor use, and productivity increases (World Bank, 2015).
- **Large investment programs over recent years helped propel economic growth.** Ethiopia's investment accounted for the highest share in GDP (40 percent in 2013) among its peers and in the

region, and has been dominated by public investment: the country occupies the top third place in terms of public investment rate, and the sixth lowest private investment rate in the world (World Bank, 2016). These patterns reflect the strong presence of state-owned enterprises in several key sectors of the economy and an underdeveloped private sector due to various constraints. Ethiopia significantly lags behind other countries in infrastructure despite enormous improvements in the past decade. Indeed, massive public investments in roads resulted in an increase in the federal and regional road network from 26,500 km in 1997 to 60,000 km in 2014 that, in turn, contributed substantially to recent agricultural growth and welfare improvement among other factors (World Bank, 2015). In addition, power generation capacity increased from 473 MW in 2002 to 2,268 MW in 2014, and was projected to reach 4,138 MW in 2015.

– **Given the importance of public investment, public debt is a key constraint.** In 2004 Ethiopia benefited from debt relief under the Highly Indebted Poor Countries (HIPC) initiative. Prior to debt relief the ratio of public debt to GDP was 87.1 percent, and fell to 35.4 percent following the debt relief in 2009 (of which about one third was foreign debt). By 2016, and despite high growth in GDP, this ratio increased to 54.1 percent (of which more than half, 30.1 percentage points, is foreign debt).

The results presented in this report are derived from alternative scenarios simulated throughout the projection period (2016-2030). The baseline case during the projection period is defined as the continuation of the status quo in terms of economic structure, technology and dynamics observed and calibrated from the historical period (2005-2015). All other scenarios assume changes in investment focused on specific sectors of the economy. The findings summarized below provide an overview of the different implications and impact channels that alternative private sector development strategies could have on growth, labor markets, poverty, and shared prosperity:

– **A "trickle-down" growth approach that follows the status quo does not deliver on poverty and shared prosperity along the lines of the WBG twin goals.** Under the baseline case, despite solid average GDP growth of around 6.9 percent for the next 15 years, poverty declines gradually to about 10 percent by 2030.[1] This is more than three times the poverty rate target implied by the WBG twin goals. In addition, inequality starts to rise, and no substantial progress is observed in terms of shared prosperity going forward. These results are mainly explained by persistent wage and employment gaps between rural agriculture and other industry sectors.

– **Capital deployment per unit of labor drives most of the economic growth over the historical and projection periods.** Over the projection period, 3.5 percentage points out of the 4.8% annual growth of per capita GDP can be attributed to capital, while only 1.3 percentage points are related to increases in total factor productivity, human capital improvements, an increased labor force and other demographic trends.

– **Investing in manufacturing would boost economic development more than investing in agriculture or services.** A significant increase in FDI targeting manufacturing, equivalent to 1.0 percent of GDP between years 2016-2020, generates a surge in intermediate demand (including agricultural products, besides power and other manufactured intermediate goods). This scenario

[1] While additional investment across scenarios helps to decrease poverty considerably, the additional impact of increasing FDI inflows decreases. Thus, the levels of FDI required to reach a poverty rate below 3.0 percent by 2030 are unreasonably high.

implies a considerably larger impact on economic growth. The GDP growth rate for the projection period would increase from 6.9 percent to 7.7 percent.

- **Investments in manufacturing oriented to exports are an effective way of directly reducing poverty through quality job creation.** A large increase in FDI (equivalent to 1.0 percent of GDP between years 2016-2020) into the manufacturing sectors and largely oriented towards export markets would imply a poverty rate of just above 7.0 percent by 2030 (3 percentage points below the baseline). This scenario implies a significant increase in labor income for workers moving from subsistence farming to paid manufacturing jobs, as well as productivity gains in agriculture. Poverty is reduced more than in the scenario that assumes direct agricultural stimulus as GDP effects are larger, urban poverty rates in Ethiopia are high, and rural residents benefit from the expansion of urban sectors through increases in agricultural productivity.
- **The manufacturing stimulus leads to more quality jobs, and, associated higher labor income will help to decrease poverty and increase the bottom 40's income.** Since Ethiopia's working age population consists mainly of subsistence farmers, quality job creation can have a significant impact on the income of the poor. While capital incomes would also rise with additional investment in manufacturing, and make the distributional impact less focused on the poorer deciles, poorer deciles will directly benefit from rising average labor income. EPIQ shows that, while primary wages do not increase much compared to the baseline due to abundant unskilled labor, an additional investment in manufacturing might lead to roughly 400,000 people moving from low paying agricultural occupations and subsistence farming to higher paying formal employment over the projection period.
- **Labor and total factor productivity drive most of the incremental growth under a manufacturing stimulus scenario.** While most of the economic growth under the baseline and the scenarios can be attributed to capital deployment per unit of labor, under a manufacturing stimulus, less than 0.2 percentage points of the additional 0.7 percent of GDP per capita growth per annum can be attributed to capital. At the same time, increased employment in the more productive manufacturing sectors will contribute 0.5 percentage points of additional GDP per capita growth.

While EPIQ Ethiopia is an ideal tool to assess many different investment scenarios, access for users, interested in running their own set of scenarios, is costly. EPIQ Ethiopia is, by nature, a large and complex model. In addition to the model's inherent complexity, a potential user also faces a steep learning curve to master the software in which EPIQ Ethiopia is implemented. The combination of these issues requires for users to invest a substantial amount of time to build up the necessary skills. To facilitate access, the project team pilots an easy to use interface. Appendix 5 presents this web-based interface for EPIQ Ethiopia. The interface allows a user to design and run their own scenario, based on different investment scenarios and assumptions surrounding the economy and the labor markets. If access is granted, no specialized software will be necessary for a user to access EPIQ over the interface.

1. Introduction

In 2013, the World Bank Group (WBG) embarked on a new era in its development agenda by setting twin goals to benchmark the performance of its operations: end extreme poverty and boosting shared prosperity. More specifically ending extreme poverty implies reducing the share of people living below the World Bank's international poverty line to 3 percent by 2030, and boosting shared prosperity implies growing the incomes of the poorest 40 percent of the population in any given country.[2] Along these lines, IFC launched a pilot modeling initiative – *EPIQ: Economy-wide Private Impact Quantification model* – with the objective of linking IFC private sector interventions with the WBG twin goals. Following the first pilot implementation in Philippines, IFC decided to run a second pilot in Ethiopia to test the feasibility of this analytical approach in a low-income country. The development of EPIQ Ethiopia has been supported by the Let's Work Global Partnership.

The EPIQ initiative aims at providing a rigorous modeling framework to assess the impact of IFC industry sector-focused strategies, including both, investments and advisory services, on the twin goals as well as on the recently announced Sustainable Development Goals (SDGs) that are relevant to IFC operations. In other words, EPIQ was envisioned as a tool to help IFC quantify its economic impact and provide insight in the design of country-level strategies. In this context, job creation and effects on the labor market are a central focus of EPIQ as the main channels through which industry sector interventions in a country translate into impacts on the income distribution.

As mentioned before EPIQ Ethiopia is one of two pilots that have been developed under this initiative.[3] There are three main reasons for this choice: First, the country presents a particularly interesting case to analyze the potential impacts of alternative investment strategies going forward. As described in the next Section, Ethiopia is riding the wave of a high, sustained growth process that has already lasted more than 15 years. The growth spell has led to significant gains in welfare, and to a process of structural transformation, which is marked by growth and relocation of factors of production across economic activities, changes in technology, in patterns of consumption and in the demographics and labor structure. Such a successful story has been mainly founded on extensive investments programs in infrastructure, the buildup of a minimum base of human capital, and increases in rural productivity, all under the so-called Growth and Transformation Plan (GTP) (Government_of_Ethiopia, 2014), the country's overarching strategy for achieving long term development goals, including SDGs. Having successfully achieved goals set forth in the initial phase of the GTP, the focus of the country's development strategy has shifted -under the second stage of the plan (GTPII, that comprises the period 2015-2020)- to an industrial policy that seeks to rein in the process of structural transformation, by accelerating the transitioning away from traditional primary activities, and the building up of the country's agro-industrial and nonagricultural manufacturing base. The strategy involves a policy stance that combines the maintenance of a strict state control of selected sectors of economic activity, along with incentivizing private participation (including Foreign Direct Investment) in other activities, mainly in agro-processing and light manufacturing, with a view to increasing good quality employment, value addition, exports, product sophistication and diversification. It is thus of interest to ascertain what will be the expected development impacts of alternative investment strategies, which could, in turn, serve as guidance for IFC strategies, especially in what relates to creating and expanding markets for the private sector in the country.

A second reason for choosing Ethiopia precisely relates to the ambitious targets included in the country's long-term development strategy. Following a mission trip of IFC to Ethiopia carried out in July 2016, it

[2] 1.90 U.S. dollars based on 2011 Parity Purchasing Power (PPP)

[3] A report on EPIQ Philippines, the first pilot implementation under this initiative, is also available.

became clear that there was a great need for a consistent, economically sound analytical framework to assess the expected impacts of shocks and alternative policies, including those formulated under the umbrella of the Growth and Transformation Plan. So far, the definition of specific objectives under the GTPII, including period targets for selected socio-economic outputs, has been more or less loosely defined based on the observation of empirical regularities (stylized facts) from emerging economies that successfully managed to transition to higher levels of development based on industrial-driven, government directed strategies, and mainly from East Asia. The question remains whether such strategy and the specific objectives defined under GTPII are achievable based on Ethiopia's socio-economic structure and given the country's current conditions. One important question refers to the ability of the country to reach ambitious targets given the constraints imposed by availability of financing resources for development, and without jeopardizing hard won gains in welfare and macroeconomic stability so far. EPIQ Ethiopia may be able to identify reasonable targets for a large and varied set of socio-economic variables identified in the GTPII under a consistent economic framework, and to assess the implications of pursuing strategies aimed to achieve given goals for GDP and employment generation.

Third, the development of EPIQ Ethiopia has been of special interest for, and is supported by the Let's Work Initiative. Let's Work is a global partnership of International Financial Institutions (IFIs), private sector and Donors with the goal of creating more and better private sector jobs.[4] One of the main pillars of Let's Work is that of generating *"new methods and approaches to measure, understand, and strengthen the creation of more and better jobs"*. The EPIQ model, in general, can contribute with one such approach; while the Ethiopia model, in particular, presents an opportunity for an empirical analysis of labor employment issues in a large, growing economy.

A few explanations are also in order regarding the nature and motivation for the selected modeling approach. The EPIQ model has been conceptualized based on the fundamental observation that policy interventions, including those focusing on private sector development take place and have effects over a long period of time; they have direct effects, which are followed by indirect impacts through supply chains and distribution channels, which finally expand to the overall economy through the induced effects of consumption and investment cycles that involve households, firms and government decisions interacting in labor and capital markets. In order to model these relationships and functions of the economy, EPIQ is built as a structural micro-founded macroeconomic dynamic simulation model that reflects the interactions between different types of households and firms (grouped within industry sectors) through labor and goods & services markets over time.[5] Therefore, EPIQ can provide measures of GDP and job creation by industry, household income, price adjustments (including wages), poverty and inequality, among others, over specific time periods; making it possible to quantify direct, indirect, and induced effects over time. In addition, the model is built in an environment that facilitates modeling specific industry sectors of the economy in greater detail to better reflect the reality of their operations, well beyond what the traditional reduced-form production function approach implies. Finally, its micro-foundation allows one to assess impacts on the income distribution, making it possible to explore relationships between

[4] See: https://jobsanddevelopment.org/lets-work/

[5] The model follows the rigorous approach of structural macroeconomic frameworks through endogenous price determination for all sectors, but allows prices and markets to converge dynamically to their steady state equilibrium over time in the absence of exogenous shocks – as opposed to imposing full equilibrium at all time. This implies that the time dimension is reflected naturally, without requiring abstract definitions of short or long-term closures.

investment activities across industry sectors and labor markets, and their ultimate effects on the WBG twin goals.[6]

In order to quantify the impact of investments on the WBG twin goals, it is necessary that a methodology goes beyond the capabilities of most standard modeling approaches used to access such efforts. EPIQ does this by introducing heterogeneous households that represent the Ethiopian society with the appropriate resolution. Households in this modeling approach differ in their level of education, location, household size, number of wage earners in a household, age of the wage earners, whether they receive remittances and transfers, and the extent of their capital ownership. This distinction is necessary to compute endogenous poverty rates and distributional impacts of policies and investment interventions.

In addition, to assess the impact of any investment strategy scenario for Ethiopia, three major steps need to take place from the modeling perspective. First, the model needs to be structured and calibrated to reflect key features of the Ethiopian economy. In this regard, Section 2 describes a series of empirical facts, used not only to describe the structure and characteristics of the Ethiopian economy, but also to serve as a calibration benchmark for a recent historical period. Section 3 provides a non-technical description of the EPIQ model structure while Section 4 elaborates on the model calibration for the defined historical period (2000-2015).

The second major step is to define a baseline case (scenario) for the future that will serve as a benchmark to measure the relative impact of alternative investment strategies implemented during the projection period (2016-2030 in this case). The second part in Section 4 reviews the main assumptions that define the baseline used for the analysis in this report.

The final step is to design a set of future investment scenarios for the projection period and implement them in the model. Section 5 describes the assumptions and results implied by these alternative scenarios, which consider investments in specific sectors with differentiated characteristics.

The main results of these simulations show that under the designed baseline case, which maintains the status quo regarding demographics, trends in the structure of the economy, technology parameters across sectors as well as investment trends, poverty would be reduced from 33 percent in 2010 to 10 percent by 2030. This is mainly driven by a "trickle-down" approach based on steady GDP growth around 7 percent for the period 2016-2030. This economic growth is linked to similar increases in labor income. Rural as well as urban wages at all education levels increase, but because of a large share of low skilled domestic labor being employed in subsistence farming, upward pressure on wages for primary educated workers is limited. Therefore, without significant transfer programs, shared prosperity fails to improve and in contrast, inequality starts to rise.

Finally, different scenarios are presented, where additional investment of 1.0 percent of GDP enters the economy as FDI inflows annually between 2016 and 2020 into specific sectors. Due to the additional inflow of foreign financing, GDP grows quicker in all scenarios with additional investment. The most promising in terms of GDP growth is the scenario where all investment goes to the manufacturing sector. Such a stimulus can lead to an additional 0.8 percentage points of annual GDP growth over the projection period. However, as the economy only grows by an additional 0.4 percentage point under an agricultural stimulus program, poverty would drop more under a manufacturing stimulus. An additional investment in manufacturing can decrease the poverty rate to 7.3 percent by 2030, while the investment in the other scenarios only achieve to decrease poverty just below 8 percent. This is mainly driven by a stronger growth effect of a manufacturing stimulus together with high urban poverty. In addition, rural residents benefit as well of

[6] This is possible thanks to the fact that the model generates an endogenous income distribution across heterogeneous household types over time.

the expansion of urban areas which increase agricultural productivity and demand for agricultural goods. While there is not much additional upwards pressure on low skilled workers' rural or urban wages, additional jobs in urban sectors will lead to an additional 400,000 people taking up higher paid quality jobs by 2030 under a manufacturing stimulus, hence increasing average incomes for primary educated households. The income share of the bottom 40 percent fails to increase under all considered scenarios. While under all scenarios with additional investment the income of the bottom 40 percent grows more than in the baseline case, the income gap widens as the income of the richer part of the population grows at a higher pace.

In sum, the analysis presented in this report sheds some light on the different impacts that private sector development strategies focused on alternative sectors of the economy imply, not only for the labor market, but also on poverty and shared prosperity. The model results are quite rich and, therefore, the report includes estimated impacts on job creation, wages, and labor demand (by area and education types). All in all, this work and the Ethiopia pilot provide more elements to improve our understanding of the relationship between industry-specific investment and growth, labor market dynamics, as well as poverty and inequality implications.

2. Socio Economic Background

Ethiopia is the second most populous country in Sub Saharan Africa with a total population that reached 100 million people in 2016.[7] It is a primary-based, non-resource rich, low-income economy, but one that, out of sheer population size, ranks 6th in Sub-Saharan Africa (SSA) in terms of total GDP.[8] The country has embarked in a process of structural transformation that characterizes low-income economies as they move towards higher levels of development. As part of this process, Ethiopia began to experience a demographic transition, but still maintains a relatively high population growth rate (currently at about 2.5 percent per year).[9] According to the UN, the country is expected to reach 138 million people by 2030 and 200 million by 2055.[10] Ethiopia is the oldest independent country in Africa, and, for that measure, one of the oldest independent countries in the World (for at least 2 Millennia). It is the only one in all Sub Saharan Africa that maintained absolute freedom from colonial rule.[11]

The country's economic performance in the last two decades has been impressive. Real GDP increased at a rate of 10.6 percent rate annually between 2000 and 2016 (Figure 1). This was the second largest per capita growth rate in Sub Saharan Africa during the period, and the sixth across all countries in the World.[12] Annual growth in Gross National Income (GNI) per capita was 8.7 percent for the period, enabling the country to move from the very bottom among all countries in the World in year 2000, with 120 US$ per person, up to 660 US$ per person in 2016.[13] Services have been the primary driver of economic growth in Ethiopia like in many other developing countries (Figure 2).

This has led to substantive welfare improvements across the board, including a reduction in the poverty headcount ratio from 66.4 percent of total population in 1995 to 36.3 percent in 2005 and further down to 33.5 percent in 2010 (Figure 3).[14] Poverty remains high due to elevated rates of population growth and

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[7] The population of Ethiopia was 102.4 million in 2016 according to the United Nations (World Population Prospects: The 2017 Revision). The Ethiopian Central Statistical Agency (CSA), however, reports a population of 94.4 million by 2017. While both institutions base their numbers on the same census data, the UN estimates a higher population based on perceived underreporting in young cohorts.

[8] See: https://datahelpdesk.worldbank.org/knowledgebase/articles/906519. This uses World Bank Country and lending groups classification based on the so-called World Bank's Atlas Method. With a per capita income of 660 US$ in 2016, Ethiopia falls under the 1,005$ per capita threshold that separates low income from lower-middle income countries.

[9] A process whereby a continuous decrease in fertility ratios and increase in life expectancy leads to a decline over time in the growth rate of population and change of its age structure. The transition from low to higher income levels brings about a reduction in the age dependency ratio and what many economists refers to as a demographic dividend.

[10] https://esa.un.org/unpd/wpp/

[11] With an exception of a short 5-year spell (1936-1941) when it was occupied by Italian forces.

[12] Among SSA countries, Equatorial Guinea exhibited the highest real GDP growth per capita in the period (9.2 percent). Other non-SSA fast growing economies include Qatar, Myanmar, Azerbaijan and China (Source: World Bank, WDI, using GDP per capita in US$ at 2010 prices).

[13] GNI equals GDP plus factor income of nationals abroad minus factor income of foreigners in the country. GNI of Ethiopia in 2016 is comparable to that of countries such as Uganda and Rwanda, slightly above the average for Low Income Countries (LIC) but still below the threshold that separate LICs from Lower Middle Income Countries (LMI). See footnote 1.

[14] http://iresearch.worldbank.org/PovcalNet/povOnDemand.aspx

from having started at such a low base in terms of per capita income. By 2016, per capita income was still 55 percent below the average for SSA countries. Notably, while most poor are found in rural areas, urban poverty rates are not much lower, and urban poverty remains a large issue (Figure 4). On the other hand, the country maintained one of the lowest levels of income inequality in the World over this high growth period (Figure 5).[15]

Figure 1: Cumulative GDP and Per Capita GDP (%)

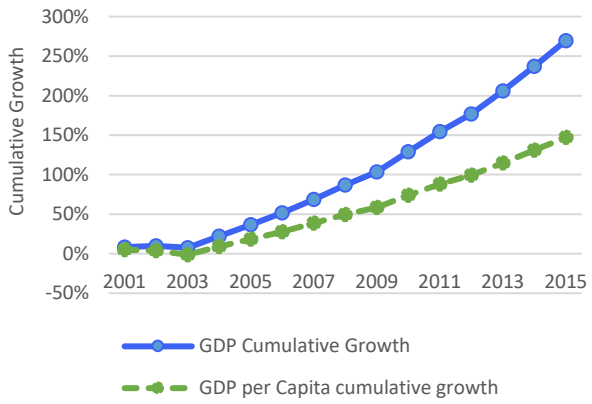
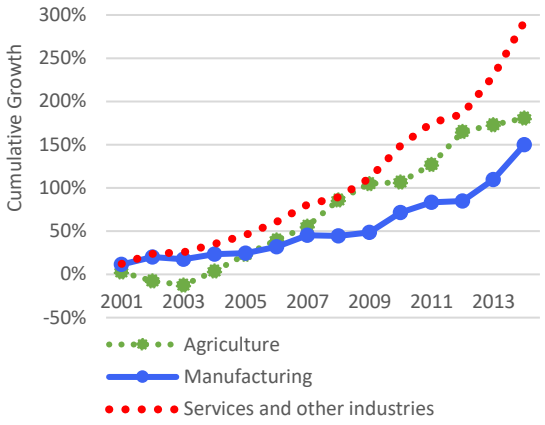


Figure 2: Industries' Growth Rates (%)



Source: Authors' calculation using the National Accounts of Ethiopia

Ethiopia is a centrally planned, state driven economy. All land is state-owned.[16] About 40 percent of total investment between 2010 and 2016 originated in the public sector, and was partially financed by a policy that mandates a fraction of private savings to be directed to public investment programs.[17] The country's financial sector is dominated by the state, with public banks accounting for two thirds of deposits and more than half of credits. Capital flows are restricted. The National Bank of Ethiopia (NBE) has a monopoly on all foreign exchange transactions and supervises all foreign exchange payments and remittances. The Ethiopian Investment Law limits investments in selected sectors to government, nationals of Ethiopia or domestic companies only, in some cases in joint ventures with the state. Postal services, power generation and distribution, and most air transport services are restricted to the public sector. Financial services, travel and shipping agency services; broadcasting services; and other air transport services (not restricted to the public sector) are exclusive for Ethiopian nationals. In turn, most domestic trade activities (Retail and wholesale), non-petroleum and petroleum products import trade, the export trade of selected commodities and other activities are restricted to domestic investors only.[18]

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[15] The GINI coefficient was reported at 0.30 in 1999 and 0.33 in 2010. See: http://iresearch.worldbank.org/PovcalNet/povOnDemand.aspx

[16] With a disposition that allows long-term leases to tenants.

[17] The policy is one that mandates banks to use a fraction of their deposits to purchase bonds from country's Central Bank (the National Bank of Ethiopia) to finance the Development Bank of Ethiopia.

[18] See Appendix 1 for full description of activities restricted to government, nationals and domestic investors.

Figure 3: Poverty in Ethiopia (%)

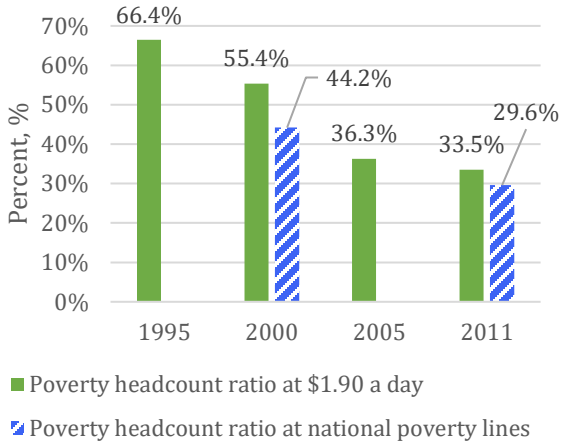
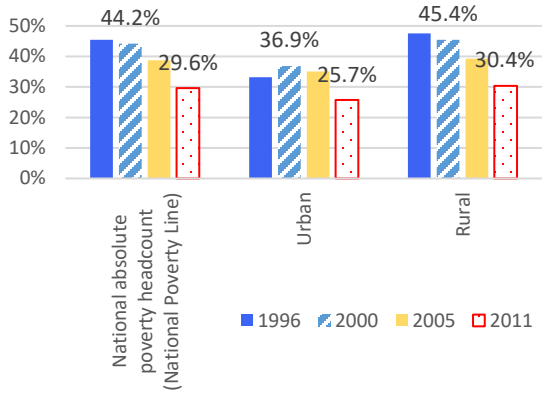
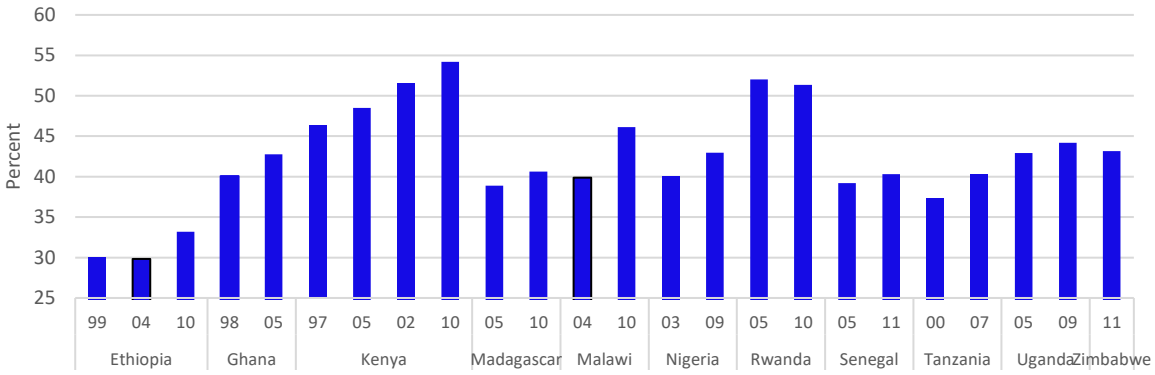


Figure 4: Poverty headcount ratio for national poverty line (per adult)



Source: World Bank Group. Ethiopia Poverty Assessment 2014. (World Bank Group, 2015)

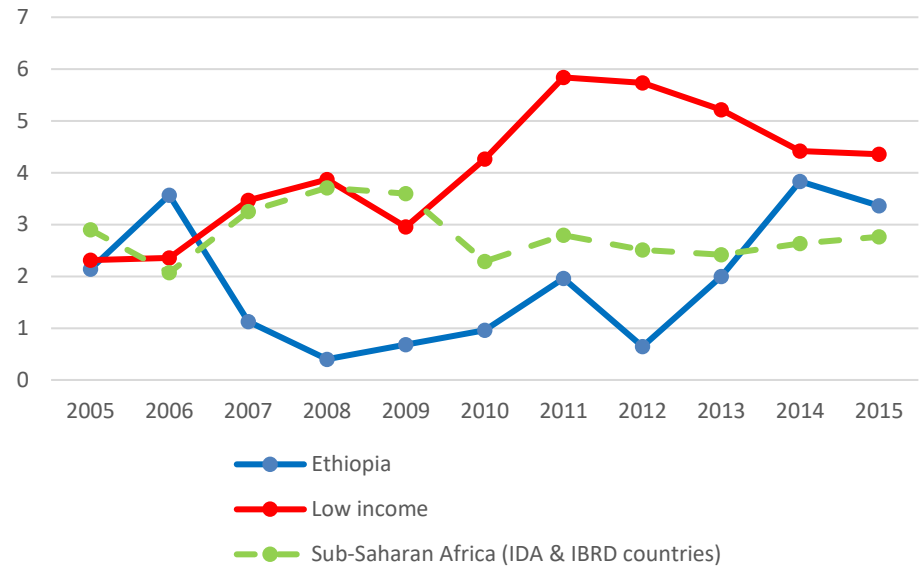
Figure 5: Gini Coefficient (%)



Source: World Development Indicators (World Bank, 2016c).

On the other hand, the country is open to, and actively seeks to attract foreign investment in many other sectors. It has indeed benefited from substantial foreign direct investment (FDI) in areas such as infrastructure, crops, horticulture, agricultural processing, textiles, leather and leather products. Main sources of FDI, by country of origin, are China, Turkey, India and the EU. Net FDI has averaged 1.6 Billion US$ annually since 2010, which is about half of average goods exports during the period and over 3.3 percent of the country's GDP (Figure 6). As part of the country's long-term development strategy, and acknowledging the need for financing the country's ambitious investment plans, for technological development and for enhancing the country's competitiveness, the Government of Ethiopia (GoE) has adopted a gradual stance for policy reform, which brings step-wise changes in the legal framework and in the opening of the economy, while maintaining its far-reaching, state-driven industrial policy.

Figure 6: FDI as a share of GDP (%)



Source: The World Bank Open Data based on International Monetary Fund, International Financial Statistics and Balance of Payments databases, World Bank, International Debt Statistics, and World Bank and OECD GDP estimates.

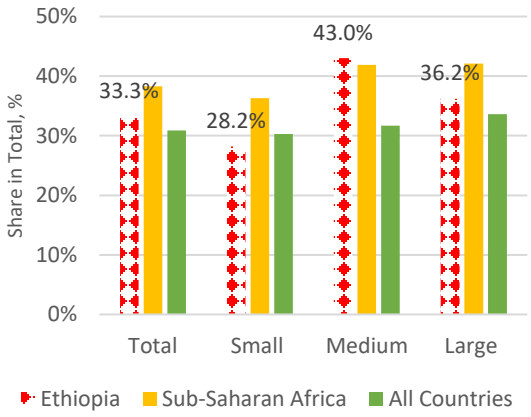
Ethiopia's economic success has been generally associated with large-scale public investment programs in infrastructure. Of particular relevance in the last two decades are the country's Universal Road Access Program (URAP), and the scaling up in power capacity and power generation. This comes as no surprise, as firms included electricity (Figure 7) and transportation (Figure 8) as top business environment obstacles according to the 2015 World Bank Enterprise Survey. The URAP has enabled the connection of remote regions of the country, including over 11,000 of the approximately 15,000 existing municipalities (*Kebeles*) between 2010 and 2015.[19] Over the last 20 years the road network increased from 26,500 km up to 110,414 km, of which about 70 percent are deemed in good condition, thus allowing for an expansion and integration of markets, and a reduction of transportation costs, with China becoming a central partner in the construction and financing of roads. Regarding power, the government of Ethiopia has taken advantage of the country's vast, still mostly untapped renewable energy potential, to increase its generation capacity mainly from continued construction of hydropower plants.[20] According to Ethiopia's

[19] Ethiopia is a Federal Democratic Republic composed of nine, ethno-linguistically based, national regional states and two Administrative states (Addis Ababa City administration and the Dire Dawa city council). The national regional states as well as the two cities administrative councils are divided into eight hundred districts (*Woredas)* and further split into some 15,000 Kebeles. Each Kebele consists of approximately 500 families.

[20] The country continues building up its power capacity. There were 18 hydropower plants with installed capacity of 3,819 MWe (Megawatt Electrical), four wind farms (capacity 325.5 MWe), and other sources including geothermal, solar and other sources (capacity 123.7 MWe), for a total installed capacity of 4,267.5 MWe. Renewable sources (hydro, wind, solar) contribute with 97.4 percent of installed capacity. Due to the quickly developing demand for electricity and continuous construction of power plants in Ethiopia it is hard to find to obtain an up to date list of power sources readily available, under construction, in rehabilitation and in stand-by mode. In: https://en.wikipedia.org/wiki/List_of_power_stations_in_Ethiopia one finds the most up to data information as of September 2017.

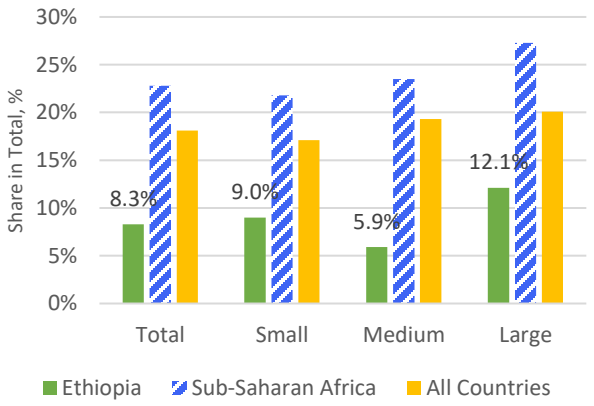
Ministry of Water and Energy, the country's electricity production *potential* from renewable sources vastly exceeds current consumption, making it capable to become a major exporter of electricity in the foreseeable future, even after considering the expected increase in domestic demand associated with higher population and augmented economic activity. However, important challenges remain regarding access to electricity due to current low interconnectivity rates, with household domestic energy consumption still being mainly dependent on traditional biomass sources.

Figure 7: Firms Identifying Electricity as a Major Constraint (%)



Source: Enterprise Surveys, World Bank Group. 2015

Figure 8: Firm Identifying Transportation as a Major Constraint (%)



Source: Enterprise Surveys, World Bank Group. 2015

Equally important, but often ignored, has been the contribution of human capital to economic performance. Ethiopia's development plans have included targets for human development indicators on education, health and women participation, in order to progress in basic service delivery and for building the necessary base of knowledge and skills. Ethiopia has been on track of meeting the Sustainable Development Goals (SDG) on health, education and gender equality. On health outcomes, life expectancy at birth increased from 55.2 years in 2005 to 58.7 years in 2010 and to 64.6 years in 2015; and under-5 years old mortality rate dropped from 75.7 (per 1,000 live births) in 2010 to 59.2 in 2015. Regarding education outcomes, the number of expected years of schooling increased from 6.6 years in 2005, up to 8.2 years in 2010 and to 8.4 years in 2015; net primary enrollment grew from 68.8 percent in 2005 to 73.6 percent in 2010, up to 85.5 percent in 2015.[21] The progress in secondary education has been less significant. Net secondary enrollment increased from 11.8 percent in 2005 to 16.1 percent in 2010 and to 20 percent in 2015. The average years of schooling augmented from 2 years in 2005 to about 3 years in 2015. Despite progresses, Ethiopia remains a low Human Development Index country.[22] In order to understand the human development challenges that lie ahead in Ethiopia, it is important to keep in mind the very low base at which the country started at the time economic growth began to accelerate in the 2000s, and the significant investments that are required to bring such a high growing population to advanced levels of human development.

[21] As a fraction of total population in cohort, that is, the number of children of corresponding primary school age.

[22] http://hdr.undp.org/sites/default/files/2016_human_development_report.pdf

Ethiopia's Growth and Transformation Plan and economic outcomes in the last decade

Since 2010, the country's medium to long term development agenda has followed guidelines set forth in the Growth and Transformation Plan (GTP), with a first phase (GTP1) having ended in 2015. GTP1's main objectives included maintaining a pace of economic growth in excess of 10 percent per year, improving quality of health and education, while maintaining a stable macroeconomic framework. All goals were achieved. This happened despite ongoing concerns regarding Ethiopia's ability to continue fueling economic growth based on public investment programs without further deterioration in public finances, in the light of the country's ambitious investment plans relative to available savings, a subject that will be discussed below.

From the point of view of so-called proximate sources of growth, namely, the contribution of factors of production, real gross capital formation was the main engine of recent economic growth. It increased by 17.8 percent annually between 2010 and 2016, bringing the investment ratio to GDP from 23.6 percent in 2010 up to nearly 40 percent in 2016. Public investment has represented about 40 percent of total capital formation during the period. A growth accounting decomposition exercise indicates that growth in total factor productivity (TFP) had been the main driver in economic growth between 2000 and 2010. Following this period, the increase in the physical capital stock per unit of labor –mainly associated to public investment in infrastructure- has contributed more to changes in per capita GDP than any other of the proximate determinants of economic growth (about 5.6 percent points out of the 7.1 percent increase in per capita GDP per year between 2010 and 2015) with a modest contribution from TFP (0.6 percent points per year during the period). The benefits of a demographic transition (that increases the ratio of working age population relative to total population), stable employment ratios, and the buildup of human capital contributed with one extra percentage point of economic growth between 2010 and 2015 (Table 1). The pace of economic growth decelerated in 2016 to about 6.3 percent per year (about 4 percent per capita) mainly as a result of a severe drought and a weaker global economic environment (IMF, 2016). The investment ratio remained at previous year's level so the contribution of capital stock per unit of labor to growth in GDP per capita remained at around 5 points during the year. With human capital, demographic and labor variables still adding one extra percentage point during the period, this has meant that TFP had a negative contribution (-2.3 percent points) to economic growth in 2016.

Table 1: Growth Accounting Decomposition for Ethiopia. Selected periods, 2000-2016.

	Annual growth rates					Avg Ratio
Period	Real GDP per capita	Capital Stock per unit of labor	Pop., labor & human capital per capita	TFP	Real total GDP	Investment to GDP
2000-2010	5.74	2.11	0.93	2.70	8.50	23.09
2010-2015	7.14	5.57	1.01	0.57	9.68	33.08
2015-2016	4.02	4.96	1.34	-2.28	6.30	39.70
2000-2016	6.07	3.37	0.98	1.72	8.73	27.57

	Annual growth rates					
Period	Pop, labor, human cap. per cap.	Human capital per unit of labor	Employment rate	Participation rate	WAP/POP (depend. ratio)	Population
2000-2010	0.93	0.02	0.25	0.29	0.38	2.76
2010-2015	1.01	0.03	-0.03	-0.04	1.05	2.53
2015-2016	1.34	0.02	0.00	0.03	1.29	2.27
2000-2016	0.98	0.02	0.15	0.17	0.64	2.66

Source: Authors' calculations based on GoE official data, IMF and World Bank, World Development Indicators.

Ethiopia continues to rely on primary activities as main source of value added and employment generation. However, as explained above, Ethiopia is undergoing a process of structural transformation, which is

characterized, among other features, by a shift of resources away from primary activities (Figure 9). The share of primary activities fell from about 49 percent of total value added GDP in 2000 down to 42 percent in 2014. With an annual growth of 7.7 percent per year, the sector contributed 3.3 percentage points to the 10.2 percent average annual growth in real value added GDP for the period (Table 6 in appendix).

Figure 9: Industry Composition of GDP (%)

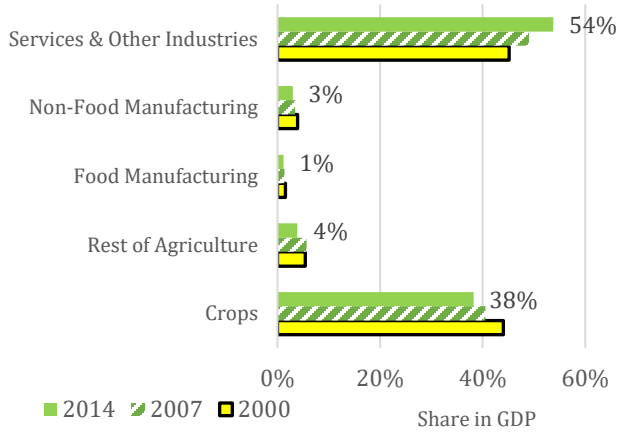
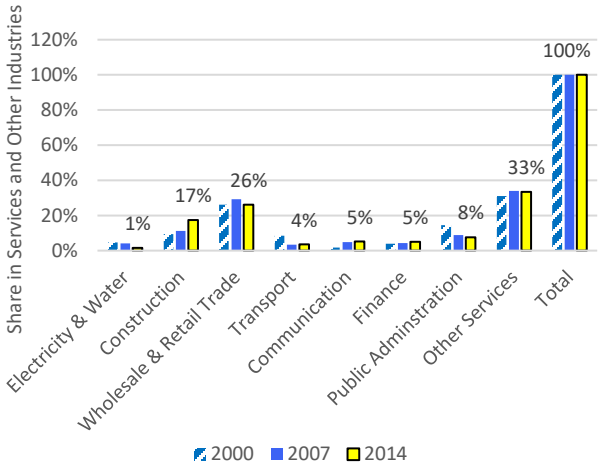


Figure 10: Composition of Services and Other Industries (%)



Source: Authors' calculations using the National Accounts of the Ethiopia

Agriculture and services have been historically the primary employer in Ethiopia and provided jobs to more than 80 percent of the population in 2013 (Figure 11). This distribution of employment across sectors has remained relatively stable since 2005. Given its high share in GDP (about 42%) agriculture hired nearly 70 percent of all workers, with 60 percent of total employment engaged only in crop production in 2013. Considering that agriculture is among the sectors with the highest level of informal employment (more than 90%), the majority of its workers receive low wages or earn subsistence income and, hence, are among the most vulnerable groups of country's population (Figure 12). Indeed, according to the WB, households in the bottom 40 percent are predominantly engaged in agriculture (World Bank, 2015). Services and other industries employed about 13 percent of all workers as of 2013 followed by trade with nearly 6 percent of employment in total. In addition to agriculture, sectors like trade and services that require low manual skills naturally demonstrated high level of informality, respectively 61 and 55 percent of total employment. At the same time, the informal employment was substantially high in non-traditional sectors such as food and non-food manufacturing (64 percent), which possibly reflects reliance on manual tasks and low level of industrialization in the country.

The employment ratios in primary activities remained relatively constant over the last decade, indicating the difficulties faced by active individuals to find better-paid jobs in secondary and tertiary activities. Simply put, despite efforts to build up the industrial base and diversify the economy, Ethiopia is not yet able to supply enough non-primary jobs for its rapidly growing labor force. Given the population growth rate, the age structure of population and participation rates, an estimated 1.6 million new workers have joined the labor force *each year* since 2010.

Figure 11: Employment Composition by Industries (%)

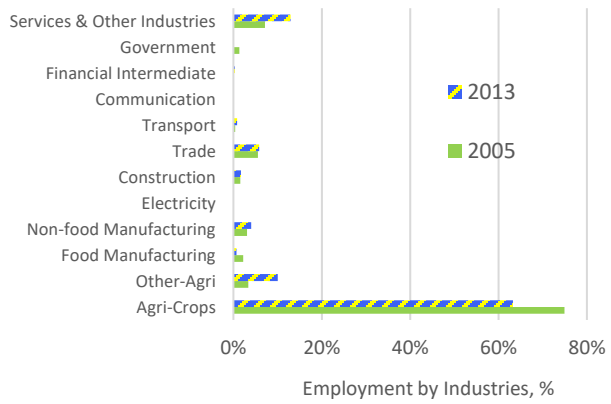
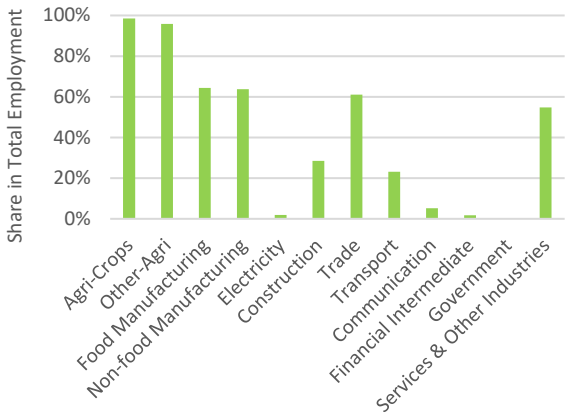


Figure 12: Informal Employees in 2013 (%)



Source: Authors' calculations using Labor Force Surveys of Ethiopia

Ethiopia exhibits a high share of self-employment and non-paid employment across many industry sectors; especially in trade (78%), food manufacturing (63%), non-food manufacturing (60%), and crops (53%) among others (Figure 13). In addition, the rest of agriculture and crops have a significant proportion of non-paid workers who are primarily family workers. Moreover, industries with high levels of non-paid and self-employment engage mostly low-skill labor for manual tasks.

Figure 13: Employment Status by Industries in 2013 (%)

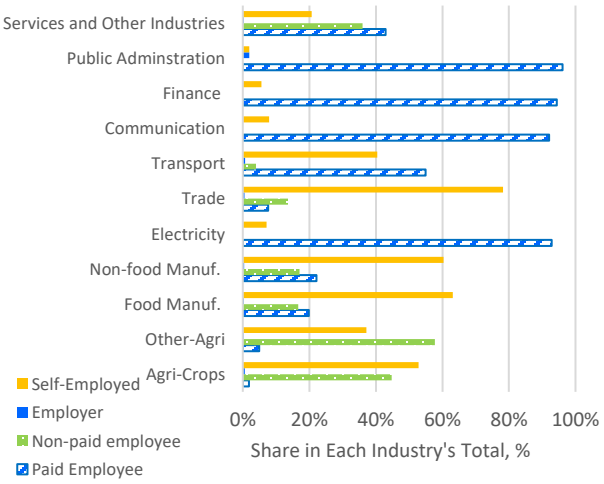
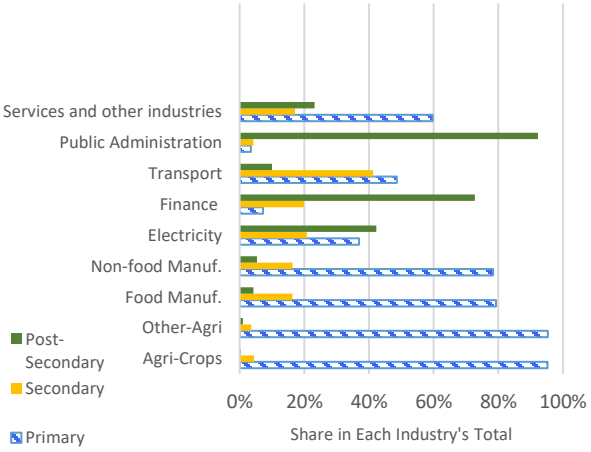


Figure 14: Employment by Education and Industries in 2013 (%)



Source: Authors' calculations using Labor Force Surveys of Ethiopia

In particular, the agricultural workforce predominantly consists of individuals with primary or no education (95%); a similar pattern is observed in food and non-food manufacturing (more than 70%), and trade (77%, Figure 14). On the other hand, public administration, finance, and power tend to hire more

workers with secondary and post-secondary degrees and provide better-paid jobs, but account for only a small share in total employment. The dominance of low educated workers in many sectors is also due to the overall low education profile of the country, where nearly 70 percent of populaton has either primary or no education.

Developing Ethiopia's industrial base has been at the heart of the country's development agenda. Manufacturing activities grew at an annual rate close to 9 percent between 2005 and 2015 (and by 20.3 percent only in 2015). A central element of the GTP is the development of industrial parks, referred to by the Ethiopian Investment Commission (EIC) as "World-class sustainable eco-parks ready for *'plug & play'*". They are dedicated for specific sectors such as textile and apparel; leather and leather products; pharmaceuticals; agro-processing and others, and aimed at "coordinated production along value chains".[23] Industrial parks are backed by strong government support and an industrial policy led by the Ethiopian Investment Board (EIB). Industrial parks are located along key economic corridors and connected to ports. They are surrounded by infrastructure that includes airports, railway lines and dry ports. Both, developers of industrial parks and manufacturers, enjoy tax and financing benefits, and are offered direct, one-step government services within park premises, in addition to having access to essential infrastructure services. There are three industrial parks currently operational: The *Hawassa* Industrial Park, 275 km south of Addis Ababa, and fully occupied by international and domestic manufacturers; the *Bole Lemi I* Industrial Park, located in the south eastern part of Addis Ababa; and the (small) *Addis Industrial Village* that has been operational since the 1980s. Eight other industrial parks have been, or are in the process of being, fully constructed in 2017, and are expected to become operational in the near future.[24] Despite the fast pace of growth of the industrial sector in general, and manufacturing in particular, the sector contributed just 1.3 percentage points to annual growth of total real value added GDP (Table 2 in the appendix), having started at such a low base in terms of value added. The share of industry in total value added GDP has increased from about 10 percent in 2005 up to 12 percent in 2015. Manufacturing activities alone represented about 4 percent of value added in 2015.

In turn, services activities kept pace with overall economic growth. As part of the process of structural transformation, the share of services in total value added increased from 40 percent in 2005 up to 50 percent in 2015. Among services, trade (retail and wholesale) and transport activities contributed the most to changes in real GDP. On the other hand, the lack of dynamism of the financial services sector is striking. Its share in value added generation decreased from nearly 2 percent in 2005 to less than 1 percent in 2015. Obstacles faced by the financial sector to increase intermediation and financial deepening include the persistence of negative real interest rates, lack of competition in the banking sector, high reserve money ratios, the obligation to use a fraction of deposits for purchasing NBE bonds and the existence of low ceiling for bank to bank lending. Providing a more flexible monetary policy framework and undertaking mechanisms for improved financial intermediation (including continued efforts for lowering and stabilizing inflation) are at the center of policy discussions within NBE to help increase savings and ease access to finance.

An expenditure decomposition of GDP changes helps to understand the contribution of aggregate supply and demand elements to economic growth. Growth in domestic absorption (consumption plus investment) has exceeded that of domestic supply, requiring an increase in imports of goods and services (Table 7 in appendix). The household consumption share in total demand has slightly fallen since 2005 but remains

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[23] http://www.investethiopia.gov.et/investment-opportunities/strategic-sectors/industry-zone-development

[24] They are: Dire Dawa (Completely built by June, 2017), Adama (April, 2017), Mekelle (February, 2017), Kombolcha (February, 2017), Kilinto (June, 2017), Bahir Dar (June, 2017), Bole Lemi II (June, 2017), and Jimma (June, 2017). An airlines logistic park in Addis Ababa is scheduled to be completed by 2019.

as the main source of expenditure GDP growth. As reported above, the increase in the share of investment to GDP has enabled it to contribute with a third of total demand growth between 2005 and 2015.

While Ethiopian exports are relatively small (averaging 11.2 percent of GDP in the period 2010-2015) the country possesses a well-diversified export structure. Coffee remains the largest source of foreign exchange (about 25 percent of total exports between 2013 and 2016), but other exports have been developed, including gold, oil seeds, livestock and horticultural products.

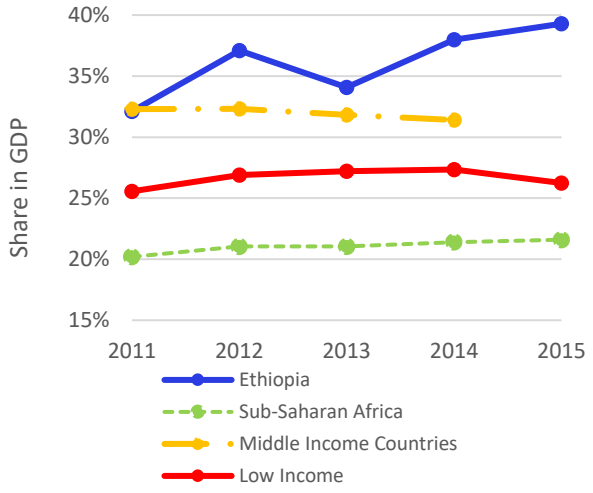
Ethiopia's investment accounted for the highest share in GDP (40% in 2013) among its peers and in the region (Figure 15) and was dominated by public investment: the country the country has at the same time the third highest public investment rate and the sixth lowest private investment rate in the world (World Bank, 2015). These patterns reflect the presence of the state-owned enterprises in several key sectors of the economy and undeveloped private sector due to various growth constraints. Ethiopia ranks relatively low on the Doing Business (focused on regulations) also compared to its regional peers and the Global Competitiveness Index (covering a broader range of business environment dimensions, Figure 16). All this resulted in low entrepreneurship in Ethiopia: the number of newly registered businesses per 1,000 working age population in 2010 (0.03) significantly lagged behind those in Brazil or Malaysia (2.2) (World Bank, 2015).

Given the central role played by capital formation as main engine of economic growth, it is also important to understand the sources of savings in Ethiopia.[25] Gross domestic savings (GDS)[26] is expectedly low given the country's per capita income, representing about 17.4 percent of GDP between 2011 and 2016. This has yielded a resource gap (GDS minus Gross Capital Formation) averaging -18.4 percent of GDP for the period. Some of this gap is shown as a deficit in the current account balance (CAB). It has averaged about -7.3 percent during the period (a deficit in CAB represents positive savings for the rest of the world). Excluding official grants, the CAB averaged -8.9 percent of GDP. Hence, Ethiopia has required additional foreign finance (In excess of what is shown by the CAB net of grants) averaging to an amount equivalent to 9.4 percent of GDP per year since 2011. Official grants and FDI have provided an average of 1.1 and 3.3 percent of GDP for the period, respectively, which means that other sources of foreign financing, in an amount equivalent to 4.5 percent of GDP, have been required. This has come, mainly, as a net increase in government foreign debt.

[25]Table 8 showing the sources of investment can be found in the appendix.

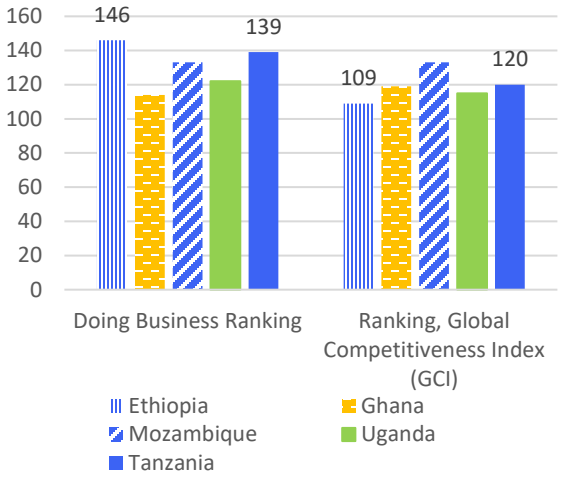
[26] Gross Domestic savings are computed as the difference between GDP and Total Consumption (from both, households and government).

Figure 15: Investment Share in GDP (%)



Source: World Development Indicators, World Bank.

Figure 16: Business Environment Indicators



Source: Doing Business 2015 and GCI 2016-2017.

In 2004, Ethiopia benefited from debt relief under the Highly Indebted Poor Countries (HIPC) initiative. Prior to debt relief, the ratio of public debt to GDP was 87.1 percent. This figure fell, post-debt relief to 35.4 percent of total GDP in 2009 (of which 13.4 percent points were foreign debt). By 2016, and despite high growth in GDP, this ratio had increased to 54.1 percent (30.1 percentage points are foreign debt). Ethiopia possesses a direct tax base that can be regarded as moderately buoyant, considering the increase in the ratio of direct taxes to total GDP, from 2.1 percent in 2005 up to 3.9 percent in 2016. Other revenues, including indirect taxes and non-tax revenue, have also moderately increased with overall economic activity. Hence, the ratio of fiscal revenues to GDP has increased from about 10 percent of GDP in 2005 up to 14.5 percent in 2016. Government expenditures (recurrent and in capital formation) have averaged about 18 percent of GDP between 2010 and 2016. As a result, fiscal accounts have yielded an overall deficit, net of grants, equivalent to about 4 percent of GDP for the period.

GTPII Targets and main Challenges to Economic Development

GTP1 is being followed by a second phase (GTPII) for the period 2015/16- 2019/20. GTPII main goal is attaining lower-middle income country status by 2025,[27] "while at the same time pursuing aggressive measures towards rapid industrialization and structural transformation" (National Planning Commision, 2015). The GTPII has been built around several "pillar strategies", summarized in Box 1. They are important, as they provide relevant context for the EPIQ Ethiopia modeling exercise.

[27] Considering the country's 2016 income level, attaining such goal will require a growth rate in per capita GNI of 4.7 percent per year (7.2 percent total). From data in footnote 1, the required per capita growth rate g is: g=ln(1005/660)/(2025-2016) = 0.0467. Average population growth is estimated at 2.5 percent per year. According to (National Planning Commision, 2015) the aim of GTPII is to achieve an average annual growth rate in real per capita GDP of 11 percent between 2015 and 2025.

Box 1: Growth and Transformation Plan, Phase II. Main Goals

- Sustaining the rapid, broad based and equitable economic growth and development witnessed during the last decade including GTP I;
- Increasing productive capacity and efficiency to reach the economy's productive possibility frontier through rapidly improving quality, productivity and competitiveness of productive sectors (agriculture and manufacturing industries);
- Enhancing the transformation of the domestic private sector to enable them to become a capable development force;
- Building the capacity of the domestic construction industry, bridge critical infrastructure gaps with particular focus on ensuring quality provision of infrastructure services;
- Proactively managing the on-going rapid urbanization to unlock its potential for sustained rapid growth and structural transformation of the economy;
- Accelerating human development and technological capacity building and ensure its sustainability;
- Continuing to build democratic and developmental good governance through enhancing implementation capacity of public institution and actively engaging the citizens;
- Promoting women and youth empowerment, ensure their effective participation in the development and democratization process and enable them to equitably benefit from the outcomes of development;
- Building a climate resilient green economy.

Source: (National Planning Commision, 2015)

More specifically, some of the GTPII economic targets (objectives) through 2020 include: Sustaining a 10 percent growth rate of real GDP; 19.8 percent for industry and 23.6 percent for the manufacturing sector; maintaining investment ratios in excess of 40 percent of GDP; boosting gross domestic savings from about 19.5 percent of GDP in 2014/15 up to 29.6 percent by 2020; increase domestic resource mobilization, mainly from increasing tax revenues from about 12.9 percent in 2014/15 up to 17.2 percent in 2020; boosting exports of agriculture and manufacturing each from 4.4 and 0.9 percent of GDP in 2014/15, up to 6.4 and 3.1 percent of GDP in 2020; and further reducing the poverty headcount ratio down to 16.7 percent of population in 2020.[28]

The maintenance of a stable political environment, a relatively adequate macroeconomic framework, and a well-defined development strategy – initially focused in the buildup of physical and a minimum human capital base, and more recently on the growth and consolidation of industrial parks – have and will continue being key elements for the success of the GTP. However important challenges remain, as evidenced by the economic slowdown in 2016.[29]

[28] Table 5 in the appendix summarizes targets for main macroeconomic variables included in GTPII. They provide inputs but also benchmarks to compare outcomes from EPIQ Ethiopia.

[29] Caused by a major drought, the rate of growth in real GDP fell to 6.5 percent (IMF, 2016), which is significantly below the target lined out in the GTP II.

Figure 17: Ranking of the Top Business Environment Obstacles for Firms

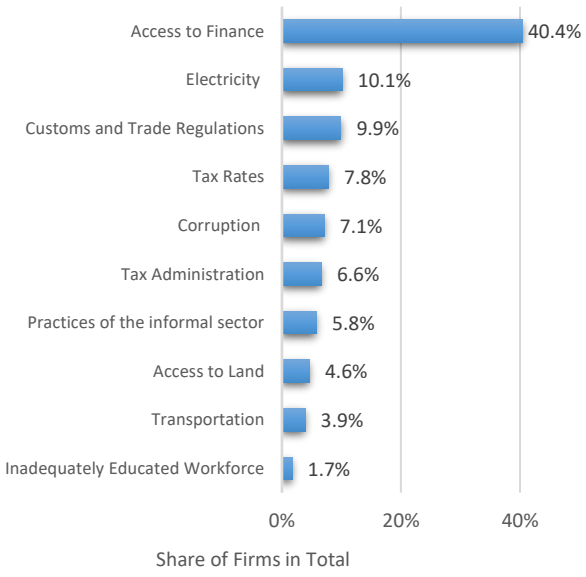
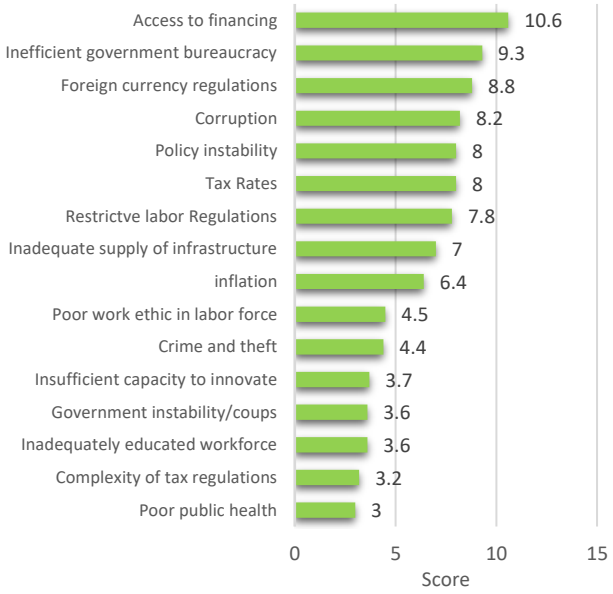


Figure 18: The Most Problematic Factors for Doing Business



Source: Enterprise Surveys, World Bank Group 2014–2016. *Source: Doing Business 2016 and GCI 2015–2016.*

First, Ethiopia remains vulnerable to natural hazards, especially to changes in rainfall (floods and droughts). Since 2000 an average of 2.6 million people every year (about 3 percent of the population) has been affected by natural disasters, decreasing yields and hurting stocks that create food insecurity – even famines – and pose additional challenges for poverty reduction.[30] Between 2015 and 2017, the country was severely hit by the worst drought in 30 years, a phenomenon linked to El Niño. Between 50 and 90 percent of crop production was lost, more than 1.5 million livestock perished, farmers' incomes dwindled and food insecurity soared. The number of people requiring emergency assistance to meet their basic food needs was estimated at 7.8 million by mid-2017 (FAO, 2017). The phenomenon contributed to an overall slowdown in the pace of economic activity.

Furthermore, the country's ability to meet development goals are constrained by its limited access to financing resources relative to needs as highlighted in the World Bank's Systematic Country Diagnostics (World Bank, 2016). Forty percent of firms identified access to finance as a key constraint to firm entry and expansion, as the country has highly regulated financial markets and a low level of financial development affecting mostly SMEs and farmers (Figure 17). Power, customs and trade regulations, and tax rates are also identified as key impediments to private sector growth. Some of these obstacles are also listed among the most problematic factors for doing business reported in the Global Competitiveness Report, with access to financing, inefficient government bureaucracy, foreign currency regulations, and corruption topping the list (Figure 18).

Another key challenge to GoE's ambitious investment plans is the availability of sufficient sources of financing. Domestic savings are low, given the country's very low levels of income per capita. In particular, between 2010 and 2016, the ratio of gross domestic savings to GDP has remained at around 20 percent of

[30] See EMDAT: http://emdat.be/emdat_db/

GDP (of which around 17 percent points are private savings), thus providing just half of the financing of gross investments during the period. About half of the resource gap has been filled with FDI, leaving an outstanding balance (in the vicinity of 10 percent of GDP) that is financed by official development assistance (about 1 percent of GDP) and by a net increase in government debt. By 2004, public debt represented 87 percent of the country's GDP. Under the enhanced Debt Initiative for the Heavily Indebted Poor Countries (HIPC) the country was able to reduce its debt burden (IMF, 2016b). By 2009, the public debt ratio represented 35.4 percent of GDP. By undertaking large-scale investment projects, GoE has incurred in continuous deficit spending, with the overall fiscal deficit averaging 3 percent of GDP since 2010. Most of the deficit has been financed by domestic and foreign public borrowing. As a result, the ratio of public debt to GDP has climbed up to 54.1 percent in 2016 (30.1 percent points corresponding to foreign debt and the remaining 24 percent points to domestic debt). Ethiopia faces challenges to mobilize domestic resources, considering the country's low tax base, which contrast with the resource needs to continuing building the physical and human capital base, and to keep fueling economic growth.

3. EPIQ Ethiopia Model: A Non-Technical Description

The EPIQ Model can be placed under the umbrella of so-called integrated assessments or top-down bottom-up models. It is a dynamic, structural, macro-micro representation at the country level, designed with the goal of providing insights on expected macro and distributional impacts of shocks and policies, mainly related to the implications of private sector interventions, both investments and advisory services, on the World Bank Twin Goals as well as the Sustainable Development Goals.

EPIQ represents the standard structure and mechanics of the economy: during every time period, households (composed by different kinds of individuals) and industry sectors meet and transact in two types of markets (the factor markets and the goods and services markets). In the factor markets, households supply labor and financial capital, where labor is demanded by firms, and savings are transformed into physical capital employed by firms. On the other hand, firms are the suppliers of goods and services that are demanded and consumed together with imports by households, and used as intermediate inputs by other firms. In all these markets, a price is determined following the signals of supply and demand. Unlike other structural macroeconomic models, prices in EPIQ do not clear markets at all times. Prices are sticky, and therefore, might lead to market imbalances, much like in real economies. Once prices are determined, households realize income for the labor and financial capital they supply, which at the same time is a source of expenditures paid by firms. Similarly, firms realize their revenues from selling the goods and services that they produce to households, to other firms or to export markets, which at the same time become the consumption expenses of households and intermediate costs for other firms. Producers can allocate their output either to domestic or foreign markets (exports) based on assessment of relative prices; likewise, consumers can choose from among domestically produced and competing imported goods to define their consumption basket, also based on their appraisal of relative prices. The government collects taxes and other revenues and participates in economic activities by consuming and investing. The EPIQ model represents all these interactions over time and measures different related outcomes, such as total value added (GDP), wages, household income, poverty, and inequality.

The remainder of this section provides a detailed non-technical description of EPIQ and its features. The first subsection describes the behavior of the economic agents, and is followed by a subsection on the model's dynamic mechanisms.

Economic Agents, Markets and Prices

Households and Individuals

To link private sector interventions with the World Bank Group's Twin Goals, EPIQ represents private households in great detail. For instance, EPIQ Ethiopia features 9,600 different household types that vary according to the number of people in the household, the number of working age members per household, the age of the household head, the education level of the household head, and, whether the household is located in an urban or rural area. To provide more granularity for calculating welfare related variables, and acknowledging household heterogeneity regarding sources of income other than that coming from labor, the model splits household types based on whether they receive remittances and/or own financial capital.[31]

[31] Regarding capital ownership, the model introduces 4 categories based on how much financial capital a household owns and a fifth category of households that do not own any financial capital.

The model incorporates an exogenous evolution of demographic variables including population by location (urban or rural) and age group (from UN data) for the estimation period.[32] Changes in the level and structure of the population, by gender and age groups imply a need of reconciling information contained in household surveys that is used in the model. This is a straightforward exercise for the initial period of estimation (2005) as the Ethiopia Household survey for 2005 includes weights for individuals and households that allow reproducing the aggregate level and structure of the Ethiopian population. In addition, EPIQ uses an algorithm to compute a transition matrix, which yields new values of household weights at every point in time. The process of aggregation of re-weighted individuals, by characteristics, yields results that are very close to UN population estimates (by location and age cohorts).[33]

Households in EPIQ spend their disposable income to maximize a 'Stone-Geary' utility function in each period. In other words, households earn income from labor and financial capital, and, receive remittances and government transfers. They pay direct taxes and save a fixed share of their disposable income after spending a fixed amount per capita on a minimal consumption basket. Beyond those basic expenditures, households spend the remainder of their income to maximize their utility.

Industry Sectors and Firm Decisions

Given the industry sector focus of EPIQ, differentiation across and within industries is a central feature of the model that allows for the analysis of key drivers of sectoral and economy-wide growth, and facilitates a holistic approach to assess the overall impact of country-level strategies and investment programs. The current choice of industries for EPIQ Ethiopia is driven by both, their contribution to GDP and employment, and their strategic importance as growth enablers, as defined in Ethiopia's GTP I and GTP II.

The current model includes twelve sectors: crops, rest of agriculture, food and beverage manufacturing, non-food manufacturing, utilities (electricity and water), construction, trade (wholesale and retail), transportation, communication, financial intermediation, government services, and other services. While this aggregation level is tailored to investigate private sector interventions along the line of Ethiopia's GTP, the structure of EPIQ is flexible and modular, which makes it possible to change the sectoral aggregation to address specific questions.

While neoclassical economic models assume that firms can change their production decisions instantaneously to react to changing prices in markets, in reality firms typically make decisions on their production plans ahead of time and thus under uncertainty. Those decisions are made on observed information up to a point in time and applying expectations of future demand and prices. In this regard, production decisions in EPIQ resemble companies' behavior in the real world. In EPIQ, sectors decide on their *target output* for the next period to meet adaptive expectations of future domestic and export demand, considering domestic commodity inventories. Sectors' production functions exhibit fixed expenditure shares for the different labor types and physical capital, and need fixed quantities of intermediate inputs besides value-added.[34] In a second step, firms decide on their physical capital and labor demand such that they minimize costs based on their expectations on future factor prices. As wages and interest rates are sticky, a sector might not be able to acquire all required factors of production, and thus, actual realized production might fall short of the planned target output.

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[32] UN population projections are obtained from: United Nations, Department of Economic and Social Affairs (DESA) Population Division (https://esa.un.org/unpd/wpp/) under a Medium Variant scenario for population growth.

[33] Future model developments could include endogenous structures for demographic variables.

[34] The production function is nested and combines intermediate material inputs with value-added in a Leontief function on the top nest. Value-added is a Cobb-Douglas combination of the three labor skill types and capital.

EPIQ allows for a full bottom up structural representation of key selected economic sectors that are of special interest given their contribution to value added and employment, or their expected leading, catalyzing role to achieve SDGs under GoE's Growth and Transformation Plan. In the case of EPIQ Ethiopia, the model includes a breakdown of economic activities that allows the modeling of shocks and policies in areas of interest under GTPII, including crops, food manufacturing and non-food manufacturing. The current version of EPIQ Ethiopia represents these activities through top-down production functions. Future versions of the model could include bottom-up modules for agriculture and the power sector.[35]

Government Sector

The government sector in EPIQ Ethiopia represents the central government (not including the expanded public sector that contains public enterprises). The government collects direct and indirect taxes and other non-tax revenues, while it pays for exogenously fixed government expenditures for intermediate goods, invests according to an exogenous schedule, and redistributes income (transfers to households). Government deficits (surpluses) accumulate (reduce) public domestic and foreign debt. The model includes alternative closures for government investment, one where the government can undertake any (exogenously defined) government investment path, and another where the government is limited to invest only the amount of revenues that is left after subtracting current government expenditures net of interest payment.[36]

External Sector

EPIQ Ethiopia includes a trade sub-structure which is defined by the producers' ability to allocate their output between the domestic and foreign market (exports), based on the price of domestically produced goods relative to (exogenously defined) export prices; and by consumers' choices between domestically produced goods and imported commodities, based on the price of domestic commodities and (exogenously defined) import prices.[37]

The model allows for different closures for the external sector. The closure applied in the scenarios for this report is that of fixing the Real Exchange Rate (RER) at historically observed levels, so the Current Account Balance (CAB) adjusts in such a way that, for given values of imports, exports, and FDI, inflows and outflows of foreign currency become equal. A second possibility assumes exogenous flows for all components of the CAB (excluding exports and imports), in which case the RER adjusts so the trade balance achieves a value that equilibrates the foreign sector.[38]

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[35] The EPIQ Philippines pilot model includes a bottom-up representation of the power sector.

[36] Under unrestricted government capital expenditures government could see an accumulation in its public debt. The current EPIQ Ethiopia model does not impose a cap in maximum debt, but is amenable to be modified for taking into consideration restrictions imposed by debt sustainability analysis.

[37] This is achieved by introducing a Constant Elasticity of Transformation function for output, and an *Armington* specification for consumer allocation of commodities between domestically produced goods and imports.

[38] With no explicit modeling or introduction of capital account elements, an implicit assumption of EPIQ Ethiopia is that any CAB plus net FDI equals the (negative of the) value of other capital and financial account components, so foreign reserves remain constant. Since there is an explicit modeling of the government fiscal balance, then the difference entre CAB+FDI minus government overall balance equals the private sector balance that affects the stock of private debt.

Labor Market

EPIQ Ethiopia breaks from the neoclassical assumption of perfectly competitive labor markets, where wages equal the marginal product of labor and where there is no unemployment. Instead, the model represents different labor types, based on level of education (primary, secondary and tertiary). The model assumes perfect mobility across the entire geography for workers with tertiary education; in turn, labor markets for workers with primary and secondary education are segmented by geographical area (rural and urban). Furthermore, it is assumed that all rural workers are employed only in agricultural activities. Putting all together this implies that there is a single labor price for all workers with tertiary education (regardless of sector of economic activity and whether workers are in rural or urban areas); and there are different prices of labor by primary and secondary education, and by urban and rural areas.

Supply of labor in each market segment is given by the household structure which in turn is determined exogenously by a demographics module outlined in a subsection below. On the other hand, demand for the different types of labor is determined by sectoral target output and the firms' cost minimization problem based on expectations on relative prices. Labor prices, however, are not necessarily market-clearing for any of the labor market segments. Instead, prices are fixed within each period and change based on current imbalances between demand and supply. If demand for labor is higher than supply, not all of labor demand is satisfied, resulting in lower sector output than anticipated, and an increase in the price of labor in future periods for this market segment. Otherwise, if more labor is supplied than demanded, involuntary unemployment unfolds and the wage rate in the next period decreases.

Capital Market

EPIQ Ethiopia incorporates a simplified structure for capital accumulation. Households own and accumulate financial capital which is received by firms in a competitive market to acquire physical capital assets. The purchasing price of physical capital depends on the prices of the intermediates bought to construct capital goods. The share of intermediate goods needed to produce physical capital is fixed over the model horizon, and, mainly consists of construction and non-food manufacturing. Firms demand physical capital based on their target output and lagged capital prices. As in the case for labor markets, total capital available does not necessarily equal capital demand by firms. A capital satisfaction ratio is introduced, which indicates idle capital if supply exceeds demand (prompting a decrease in future capital prices) or a need to adjust output based on scarce capital (which leads to a future increase in the price of capital).

Commodity Markets

Commodities are bought by households to satisfy their demand, by sectors to serve as intermediate inputs and exported. The supply of goods can either be satisfied by domestic production or by imports. Since domestic production cannot immediately react to changes in supply, and since commodity prices are fixed within any given period, supply and demand do not necessarily need to equal. Supply-demand imbalances will result in the accumulation of inventories or in their depletion. Domestic prices adjust downwards (upwards) if supply-demand imbalances result in stocks that are above (below) desired stock levels.

Model dynamics

Model dynamics are introduced by means of sub-structures for the evolution of demographics, labor endowments, capital formation, total factor productivity, and assumptions on the response of prices to supply-demand imbalances, plus other stock-flow constructions included in the model. The model solves in a recursive dynamic way for the period 2005-2030. Critically, agents do not have perfect foresight. Instead, they observe the values of relevant variables (i.e. prices, income and costs) at every point in time and make decisions (i.e. consumption, output and factor demand) for optimizing their objective functions.

The economy may be out of equilibrium at the end of a given period for as long as there are shocks and policy interventions, due to uncertainty about prices and markets at the time of decision making, delays in price adjustment, delays in the decision-making process, and due to the presence of stocks. Agents revise their decisions at every point in time based on the information at hand.[39]

Demographics

In EPIQ demographics are represented by household types with different characteristics and associated household weights. A full picture of Ethiopian demographics is assembled when households are aggregated using their respective weights. While initial household weights in 2005 can be constructed using disaggregated UN population and Ethiopian census data, a mechanism that determines future weights is required. To this end, EPIQ applies a transition matrix that determines the evolution of individual household weights over the model horizon. The transition matrix is estimated through an algorithm that matches the resulting weights to disaggregated UN population data over the historic period, and to UN estimates for the projection period.

Migration

While the transition matrix results in exogenous demographic trends that UN estimates, EPIQ does not assume that all demographic trends are completely independent of economic impacts. Urbanization depends on economic pressure -or the lack of- to move to a different area to improve economic wellbeing. In EPIQ, urbanization increases if urban sectors are exhibiting faster economic growth than rural areas. The function governing urbanization is calibrated such that UN urbanization trends are realized along a baseline, but deviations from that baseline result in a faster or slower pace of urbanization depending on economic growth in the respective areas. The sensitivity of urbanization to regional GDP is estimated using time series data from Ethiopia and compared to other sub-Saharan African countries.

Economic Growth

Economic growth in EPIQ results from different sources. On the one hand, population grows exogenously in line with UN estimates, and so does labor supply, and, on the other hand, total factor productivity increases, and capital is accumulated. The evolution of total factor productivity in each sector is calibrated over the historical period to replicate historically observed adjustments of value-added to output. Financial capital is accumulated through private savings, government investments and foreign direct investment. In the scenarios presented in this report, private savings are endogenous and depend on the income of the private households together with an exogenously fixed marginal propensity to save. Government investments are exogenous and follow historical data and grow in line with GDP over the projection horizon. Foreign direct investment endogenously balances the current account balance along the baseline, but additional foreign investments are realized in the stimulus counterfactuals.

Poverty and Distributional Impacts

Poverty and inequality measures are an endogenous result in EPIQ Ethiopia, thanks to the high resolution used to represent the Ethiopian population in the model. Given EPIQ's integrated macro-micro structure, the computation of welfare outcomes becomes a relatively straightforward exercise, as the model keeps track of household characteristics, household and individual income and consumption as well as household

[39] In EPIQ, in the absence of shocks, values of endogenous variables from the model converge to steady state equilibrium values in the long term.

and individual weights. They all emerge from the feedback model dynamics, including the optimizing decisions of households and firms and the abiding to model closures and constraints.

Both income and consumption per capita data are available at every point in time, so all *Foster-Greer-Thorbecke* poverty metrics (The poverty headcount ratio, the poverty gap and the squared poverty gap) can be computed. Inequality metrics such as the Gini Coefficient and Theil Index can also be generated, as well as inputs for plotting distributional graphs such as the growth incidence curve. For the case of Ethiopia, as in most SSA countries, consumption data is preferred as a welfare proxy.

The heterogeneity in household structure defined by household and individual characteristics, regions and sectors of economic activity allows for computing welfare and distributional metrics for both, total population and by selected groups and cohorts, including urban vs rural, by gender of household head, by sectors of economic activity, labor status, education, and others, which are relevant for assessing impacts of polices and shocks for selected groups.

4. Calibration issues

The process of calibration can be broken down into three separate components:

i. Solving a standard static CGE model to estimate initial unobserved parameters that define the structure of the economy (household preferences, firms' technologies, and relative prices, among others), to make the model representative of Ethiopia for the initial historical year (2005).[40]
ii. A numerical estimation of a demographic transition matrix that resembles the evolution of the distribution of household types and population growth. This calculation uses available household survey micro data during the defined historical period (2005, 2008, 20011 and 2015).[41]
iii. A dynamic structural model that resembles the behavior of the economy over time for the historical (2005-2015) period. The dynamic model component follows a similar underlying economic structure as i), but includes features that relax the inherent static assumptions to represent the dynamics of the economy over time in more realistic way.[42]

Calibration for the initial period

A first step in the calibration process involves producing a balanced SAM that aggregates activities into selected sectors and commodities. The process of aggregation is guided by needs of GoE and of IFC to quantify impacts of policies and interventions that target specific sectors, including, for instance, crops, food manufacturing, non-food manufacturing, and others. The SAM is also defined for selected factors of production included in EPIQ Ethiopia (labor and capital) and selected agents: a government sector, a foreign sector and households.

Given the introduction of heterogeneous households (by types) the process of initial calibration also entails reconciling macro data with aggregated micro information from the Household Survey for the same year in which the SAM is available. For instance, the SAM includes data on total private consumption by commodity and on household savings; such data needs to be consistent with aggregate household consumption and savings that emerge from summing and weighting information across the many household types defined in the model.

The variables generated by the static CGE model are used to initialize the dynamic model component. Similarly, the model parameters from the static model become time invariant parameters for the dynamic model. They include: technology parameters from the production function; shares and elasticity from consumption and utility specifications; intermediate consumption, and capital and labor (by education) demands for all industry sectors; investment and savings for all household types; an estimated distribution of capital by household type consistent with observed macro variables from the SAM and data on consumption distribution; equilibrium prices for all goods and services, capital, and wages by labor (education), among others.

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[40] This component is solved in GAMS (General Algebraic Modeling System) a high-level modeling system for mathematical programming problems.

[41] Solved also in GAMS.

[42] Solved in VENSIM (http://www.vensim.com) a System Dynamics based software. System dynamics is both an analytical framework and mathematical modeling technique useful for understanding and discussing complex issues and problems. See: http://www.systemdynamics.org

Demographic Transition Matrix

The demographic transition matrix is estimated to match the observed population data by area (rural/urban) as closely as possible, as well as the household types distribution observed in the nationally representative household-level FIES survey data available for the historical period (2005, 2008, 2011 and 2015).[43] This is achieved by changing the values of the weights for each household type relative to the initial weights defined in the initial household survey. Figure 19 and Figure 20 show the observed and estimated population, total and by area (urban/rural) for years 2005-2015.

Figure 19: Total Population

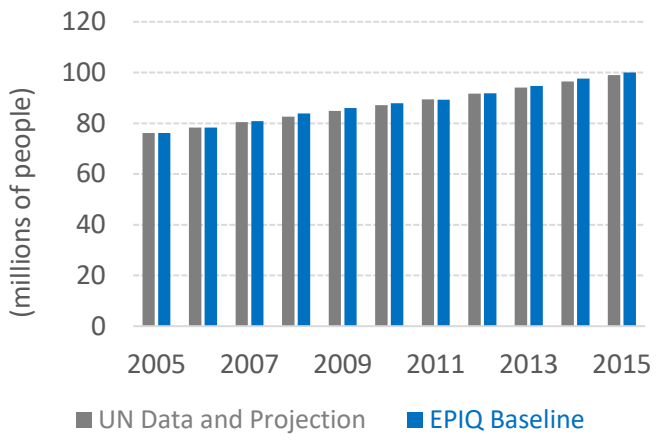
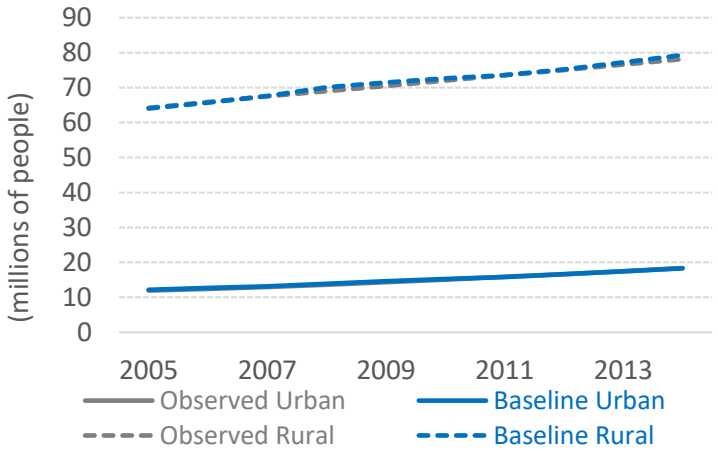


Figure 20: Urban and Rural Population



Calibration of the Dynamic Model Component for the historical period

The process of calibrating EPIQ Ethiopia for the rest of the historical period (2005-2015) involves the following steps:

i. Bringing into the model historical data for exogenous variables, such as import and export prices and FDI.

ii. Introducing an exogenous path for the historical period for some of the model variables that are otherwise endogenous in the projection period from 2016 to 2030. These are, in general, variables that have been directly affected by discretionary measures and are hard to capture by the model structure. They include: gross capital formation, government debt ratios and debt service (amortization and interest), government import tariff and non-tax revenues, government transfers to households, and government consumption. This partial exogenous definition for the historical period of some of the endogenous variables allows for assessing the extent to which the majority of variables that remain endogenous are able to replicate their actual, historical values between 2005 and 2015. The approach of converting some endogenous variables into exogenous data (using observed information) for the historical period acknowledges that EPIQ (and for that matter, any structural model, regardless of its level of sophistication) cannot precisely replicate all endogenous variables whenever discretionary measures and shocks play a role in driving model dynamics.

[43] The weighted sum of household sizes (from household level data) yields total population (in line with UN estimates).

Moreover, one could argue in favor of such an approach whenever the model generates values for endogenous variables over the historical period, which closely keep track of observed values, especially because it allows to calibrate other time-variant parameters for which only initial values are known.[44]

iii. Defining a model closure for the computation of endogenous variables for the historical period. Regarding the balance of savings and investment, the model uses exogenous historical values for capital formation, so MPS is endogenously estimated. In addition, foreign savings are also introduced exogenously at historical levels, therefore the RER is endogenous during the historical period.

In what follows, a comparison of key, selected, endogenously generated macro and micro variables with observed values is presented for the historical period.

Calibrating Macroeconomic Variables.

As explained above, EPIQ Ethiopia computes endogenous values for many macro variables that are typically included in a CGE model. In what follows a comparison is presented for historic versus baseline endogenous values for selected variables, including real value added GDP, expenditure GDP categories, the real exchange rate, and others. As will be shown, the model provides sensible endogenous estimation of key economic aggregates, which enhances confidence in outcomes. EPIQ Ethiopia allows for computing GDP based on alternative approaches: expenditure based, value added based and income based.[45] As explained above, a Cobb-Douglas production function is used to compute value added GDP. Thus, levels and changes in GDP are obtained as a function of levels and changes in labor and capital, as well as on the model calibrated TFP. Figure 21 compares observed and baseline values for total real value added GDP. In turn, Figure 22 presents the evolution of the investment ratio to GDP.

Figure 21: Total GDP

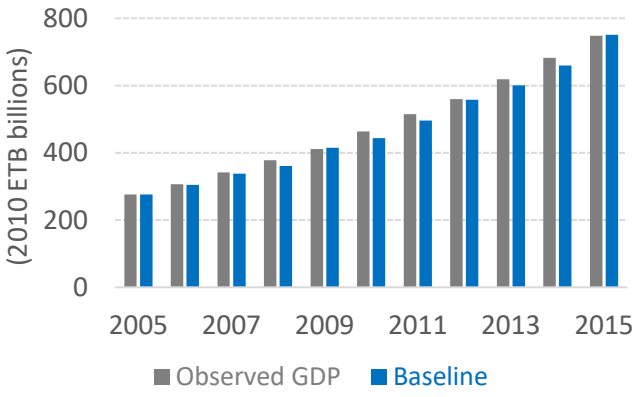
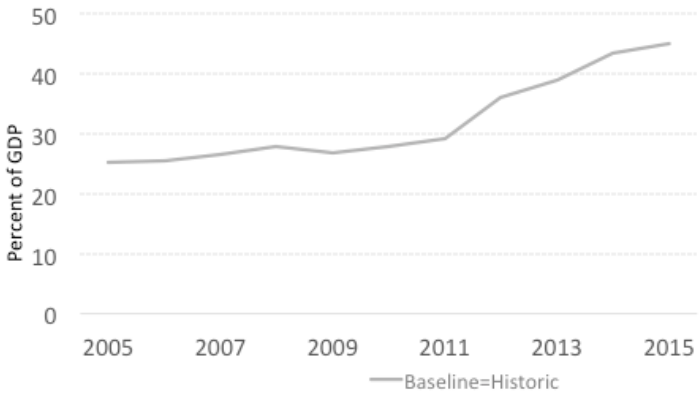


Figure 22: Investment to GDP Ratio (%)



[44] These include, for instance, the average sales tax rate, average direct tax rate, and the marginal propensity to save for households.

[45] By aggregating expenditure categories: Household and government consumption, capital formation, and the trade balance one obtains total expenditure GDP. By aggregating value added by sector, one computes total value added GDP; by adding net taxes and subsidies to the latter one gets total expenditure GDP. Finally, GDP can be obtained by summing across payments to factors of production plus the consumption of fixed capital

The next four figures present a comparison between the historical evolution of GDP expenditure categories with model estimates. EPIQ Ethiopia is able to keep track of dynamic behavior for many variables that are endogenous in the calibration period under a consistent macro-micro framework. The aggregate value for total private consumption emerges from the (weighted) aggregation of household consumption decisions, which try to optimize the allocation of household income (from labor, capital and other sources) among commodities (and savings) given the evolution of relative prices. Real government consumption is calibrated for the initial year (2005) based on SAM values and takes into consideration both historical data on current government consumption from IMF and endogenously generated prices. Real exports are endogenously computed based on a constant elasticity of transformation function that allocates domestic production between local and foreign markets, taking into consideration, among other things, relative domestic versus international prices, and the evolution of the real exchange rate. Real imports are computed from an Armington specification that allocates consumption decisions between locally produced and foreign products, also taking into consideration relative local versus foreign prices and the RER.

Figure 23: Private Consumption

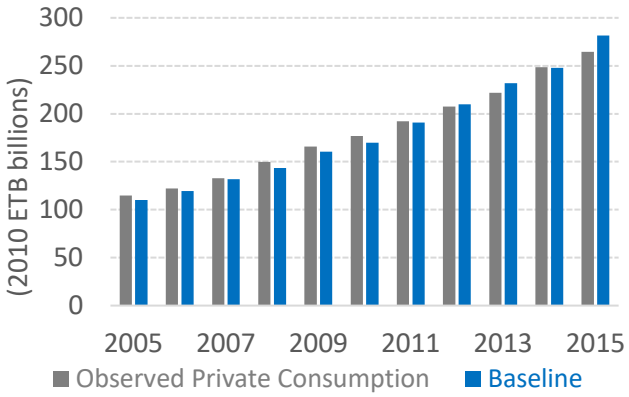


Figure 24: Government Expenditures (2010 ETB billion)

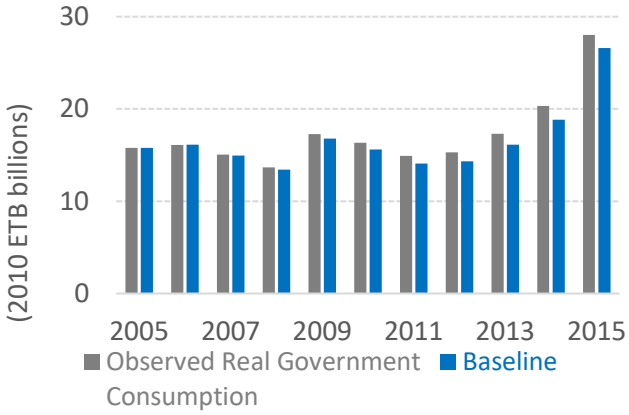


Figure 25: Exports (2010 ETB billion)

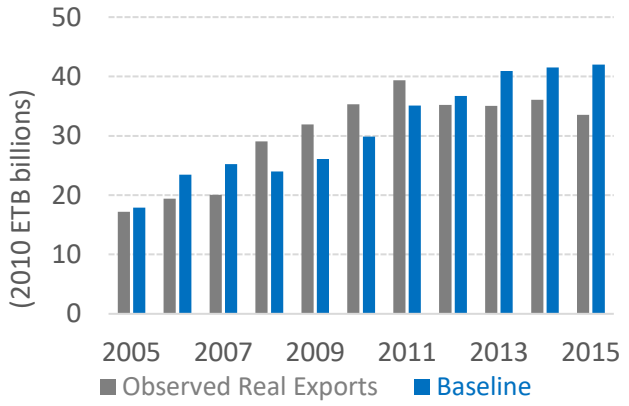
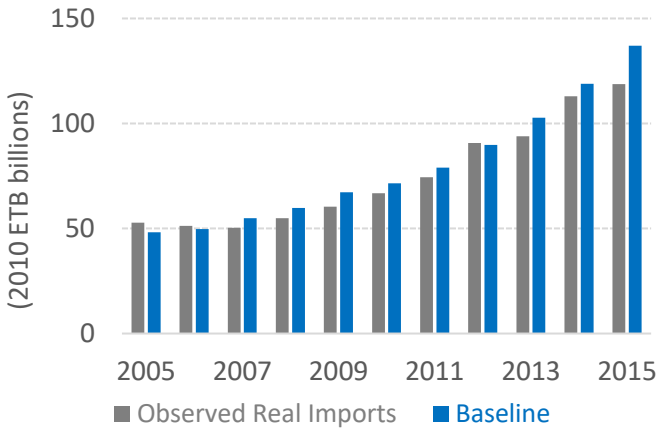


Figure 26: Imports (2010 ETB billion)



As explained above, the model includes alternative closures to ensure that basic macroeconomic identities are respected. One such closure refers to the savings-investment balance. For any structural model to be economically consistent – and regardless of equilibrium conditions - it must be the case that the difference

between savings (that is, gross national savings) and capital formation equals the - negative of - the current account balance. EPIQ Ethiopia is solved for the historical period using exogenous values for investment and also exogenous variables for the CAB, which means that household savings need to adjust (via a variable marginal propensity to save). Similarly, inflows and outflows of foreign exchange must be equal, so given the exogenous values of CAB components other than exports and imports of goods and services, exogenous FDI, and exogenous prices of exports and imports, the RER has to achieve external balance. In Figure 10, a comparison between the historical RER (from IMF) and the endogenously computed RER is presented. The model is able to pick up the appreciating trend of the Birr for the period 2005-2015. Figure 28 presents the ratio of CAB to real GDP. A negative CAB reflects the need to tap in foreign savings to finance high, growing investment.

Figure 27: Real Exchange Rate (2005=1)

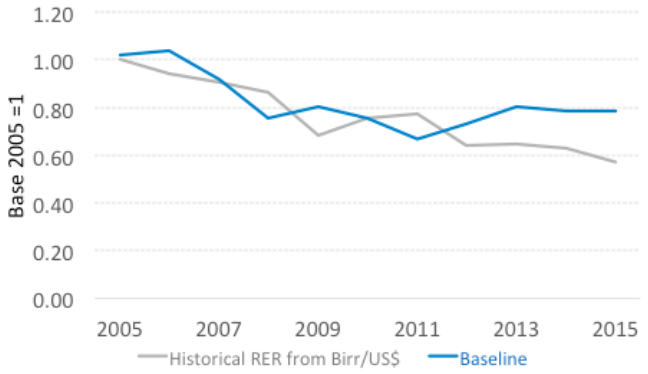
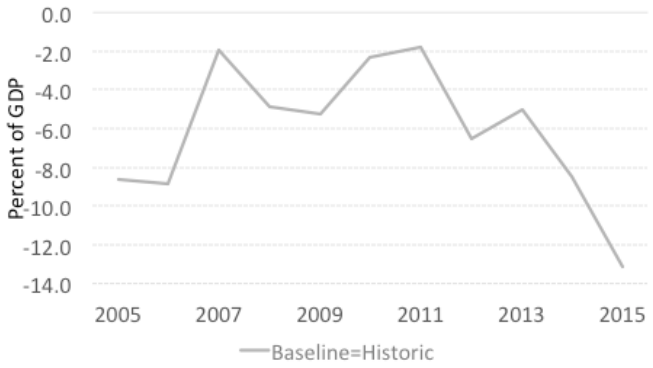


Figure 28: Current Account Balance Ratio (%)



Importantly, the process of calibration also allows for a sensible estimation of several time-varying parameters. As explained above, some parameters, such as the export and import price index are known and introduced exogenously. In some other cases, values of parameters are known only for the initial period (such as the effective direct tax rate, effective sales tax rate, and the shares of factors of production on value added GDP). Values over time for these parameters can be retrieved from the model and then used as basis for computing other endogenous variables for the forecasted period. Implicit effective tax rates (such as the effective direct tax rate in Figure 29) are used for computing government revenues for the period 2016-2030. Shares of capital and labor (Figure 30) are also retrieved from model outcomes.

Figure 29: Effective Direct Tax Rate

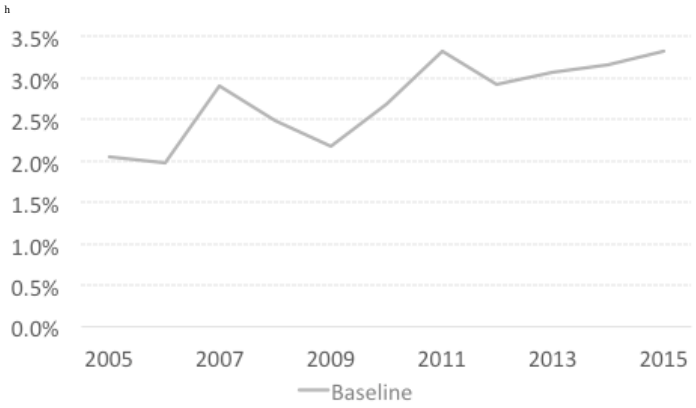
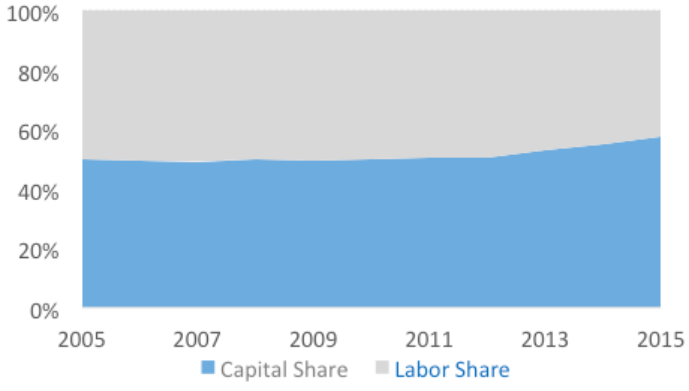


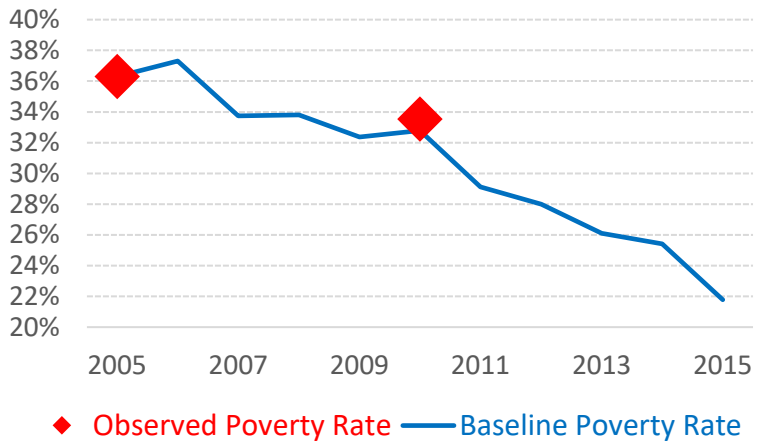
Figure 30: Capital and Labor Share (%)



Poverty

The poverty line is calibrated to match the poverty rate as of the initial year 2005. For years 2006 onwards, the poverty rate is a fully endogenous calculation that compares the poverty line each period with per-capita household consumption, which, in turn, is a function of household incomes and relative prices. It is important to note that household income in the model varies across household types by the number of adult workers along with their education, age, and location (urban/rural); and within household types by the fractions of households that: i) own or do not own financial capital, and ii) receive or do not receive remittances. Figure 31 shows the estimated poverty rate over time relative to the observed poverty rate measured through household survey data every five years. The results show that the model is capable of reproducing the fall in the poverty headcount for years 2005 and 2010. The model predicts a further fall in the headcount ratio down to about 24 percent in 2015.

Figure 31: Poverty Rate (%)



Baseline for the projection period

The following are the main assumptions that define the baseline scenario for the projection period (2016 – 2030):

1. *Population growth follows the mid-variant case projection of the 2012 United Nations World Population Prospects.*[46]

This is done by setting total population targets by 2030 in the estimation procedure of the demographic transition matrix, affecting most of the implicit fertility rates across household types. All other features defining the household structure as well as those related to life-cycle individual labor productivity profiles remain unchanged from those used in the historical period. Figure 32 shows total population from both UN and the baseline case. The demographic transition matrix keeps track of total population as well as its structure by age groups and location (urban/rural). Figure 33 compares estimated population from UN by urban and rural areas to the baseline estimates.

[46] Data and assumptions in: https://esa.un.org/unpd/wpp/

Figure 32: Total Population

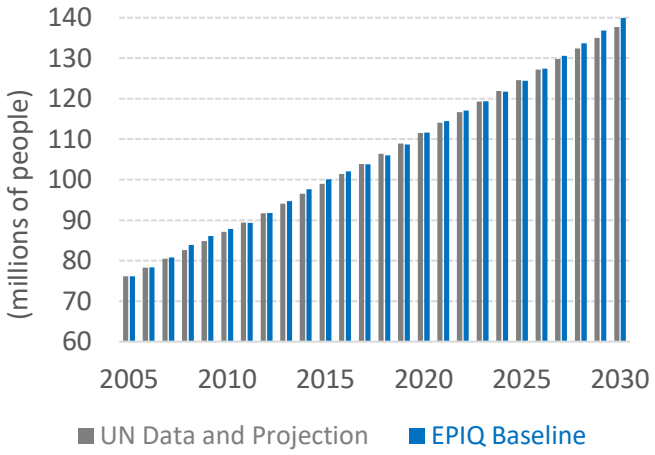
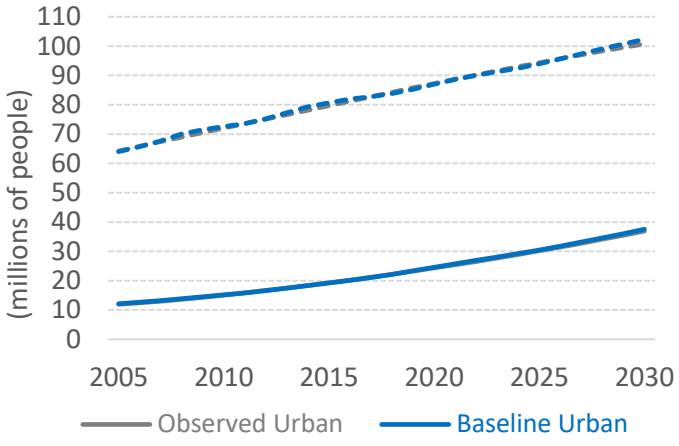


Figure 33: Urban and Rural Population



2. *Model closures include: An exogenous path for government investment in line with what is historically observed and according to overall investment targets from the GTP. The marginal propensity to save is exogenous, and, as a result, total investments become endogenous in the model. In addition, the model fixes the RER at the value observed in last year of historical calibration (2005), so the CAB becomes endogenous. Furthermore, the model allows government to continue borrowing to finance its current expenditure and expenditures (which means that it can incur deficits), but it imposes a cap in the maximum debt it can incur. In the event the cap is reached, the model imposes a limit on total capital expenditures from public sector so debt cannot keep accumulating.*

3. Values for exogenous variables included in the model are informed by IMF projections through 2020 and used as reference historical values for model parameters and endogenous results from the calibration period. TFP enters exogenously in the model based on historical values and trends. This yields a growth rate in total real GDP of 6.9 percent for the period 2016-2030, or 4.8 percent in per capita terms.

A standard growth accounting decomposition can be used to understand sources of past and estimated growth based on results from EPIQ Ethiopia. Under this decomposition, the following identity is used:

$$\frac{RGDP}{POP} \equiv \frac{RGDP}{EMPL} \times \frac{EMPL}{LFORCE} \times \frac{LFORCE}{WAP} \times \frac{WAP}{POP} \qquad \text{Equation 1}$$

On the left-hand side of Equation 1, Real GDP (RGDP) is divided by population (POP) to get per capita real GDP. It equals the value of GDP per unit of worker (EMPL), that is, average product of labor, times the ratio of employment to labor force (LFORCE), the employment ratio; times the ratio of labor force to working age population (WAP), the participation rate; times the ratio of working age population to total population which is an indicator of the age dependency ratio. For developing countries that are undergoing a demographic transition, it is important to observe both changes in real GDP per capita and real GDP per worker, given the significant changes in demographics and labor that occur along the process; including changes in fertility and mortality that affect the age structure of population (and hence the dependency ratio) as well as changes in individuals' decisions to participate in the labor force, associated for instance to changes in return to education, expectations of being employed or finding a better paid job, the ability of female and of individuals in general to become part of the labor force as fertility rates increase and health status improve, respectively.

Furthermore, a Cobb-Douglas specification is used for overall real value added GDP to proxy for the contribution of effective labor and capital to growth. The contribution of effective labor emerges from both

changes in employment and in the human capital embedded in labor force, as proxied by changes in education. Thus, the contribution of capital formation per unit of labor, of human capital and demographic elements can be ascertained.

This is shown in Table 2. The model allows for an investment path that is aligned with goals for capital formation set forth in the GTP, so capital stock per unit of labor remains as the main source of proximate economic growth. It contributes with about 3.5 points from the 4.8 percent growth in per capita GDP. The model incorporates conservative assumptions for the growth of TFP as well as for the contribution of human capital (in line with past trends). All demographic and labor force elements (changes in the age dependency ratio, in participation rates and employment from Equation 1) plus changes in human capital per unit of labor contribute with 1.3 percent of the 4.8 percent growth in per capita GDP in the forecasted period.

Table 2: Extended Growth Accounting Decomposition. Baseline

	Annual growth rates				Avg Investment to GDP ratio
Period	**Real GDP per capita**	**Capital Stock per unit of labor**	**TFP, Demographics, and Labor**	**Real total GDP**	
2005-2016	7.61	4.03	3.59	10.28	31.17
2016-2030	4.80	3.51	1.29	7.05	47.54

4. The model endogenously represents changes in the economy that occur due to structural transformation.

A feature of EPIQ Ethiopia is that it does not impose any exogenous assumption on the dynamics and allocation of factors of production across economic activities or regarding the allocation of consumption across commodities. Instead, such dynamics emerge endogenously from the economically consistent model structure. It is thus interesting to observe that the model is capable to adequately picture patterns of economic growth that are in line with what is predicted by stylized facts regarding structural transformation. In particular, EPIQ Ethiopia yields the following results: i) a shift on the composition of GDP away from traditional primary activities and into secondary and tertiary sectors (Figure 34); ii) a shift in labor employment away from primary activities and into secondary and tertiary activities (Figure 35); iii) a reduction in the share of food consumption (linked to crops, rest of agriculture and food and beverage industries) relative to total household consumption; and iv) a reduction in the age dependency ratio, which, other things equal, leads to an increase in the ratio of working age population to total population.

Figure 34: Sectoral GDP Share (%)

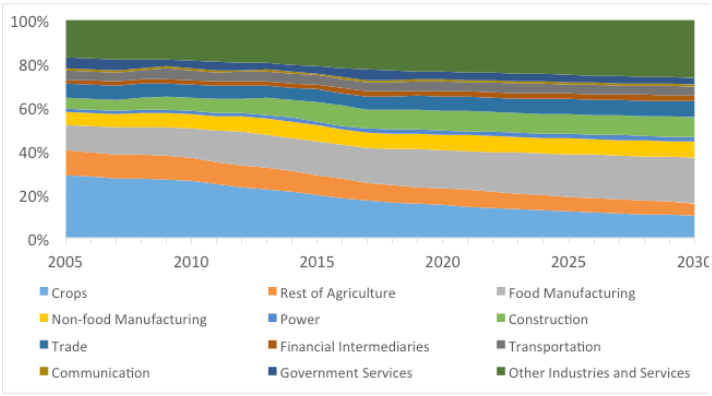
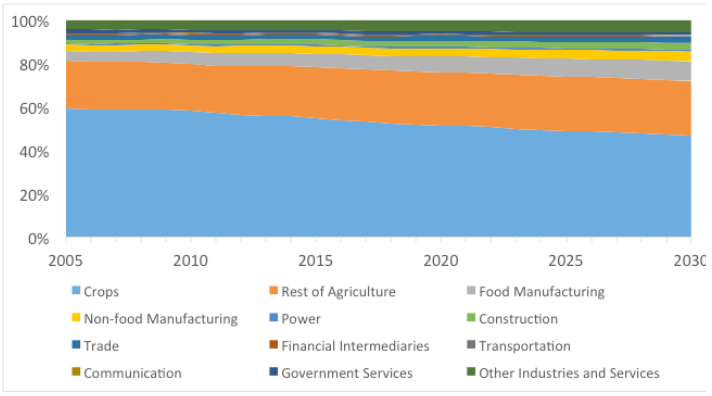


Figure 35: Sectoral Share in Employment (%)



It becomes critical to understand the forces of structural transformation that drive economic outcomes of the model. EPIQ Ethiopia yields average rates of economic growth for the period 2016-2030 that are below historical outcomes, despite assumptions of increases in the ratio of investment to GDP. Such results are in line, for instance, with IMF forecasts, but may be a bit of a surprise, especially given the expectations regarding the future contribution of manufacturing activities to economic growth. Table 3 shows results for real value added GDP growth for the period 2016-2030 using EPIQ Ethiopia outcomes. As can be observed, manufacturing activities grow at average annual rates near 9 percent over the period under baseline assumptions. However, given a share on total value added GDP of about 22 percent in 2016 (and a share of 25 percent for 2016-2030), these sectors' contribution to total growth remains at about 2.4 percentage points. On the other hand, tertiary activities, with a slightly lower growth rate, but higher share, contribute by almost half the growth in real value added GDP.

Table 3: Real Value Added, Growth and Contribution, by Activities. 2016 – 2030.

	2016 (Bill. Birr of 2010)	2030 (Bill. Birr of 2010)	Avg. Annual Growth (percent)	Avg Share in VA GDP (percent)	Contrib. to GDP growth (% point)	Share in 2000	Share in 2016	Share in 2030
PRIMARY	**165.3**	**292.7**	**4.1**	**21.5**	**0.9**	**50.3**	**27.1**	**16.0**
-Crops	112.1	185.0	3.6	14.2	0.5	34.6	18.3	10.1
-Rest of Agriculture	53.2	107.7	5.0	7.3	0.4	15.7	8.7	5.9
SECONDARY	**204.8**	**721.7**	**9.0**	**36.5**	**3.3**	**10.7**	**33.5**	**39.4**
-Food and Beverage Manufacturi	94.9	381.5	9.9	18.2	1.8	2.6	15.5	20.8
-Non Food Manufacturing	43.7	134.5	8.0	7.3	0.6	2.5	7.2	7.3
-Electricity and Water	10.5	38.9	9.3	1.9	0.2	2.0	1.7	2.1
-Construction	55.6	166.8	7.8	9.1	0.7	3.6	9.1	9.1
TERTIARY	**240.9**	**817.1**	**8.7**	**42.0**	**3.7**	**39.0**	**39.4**	**44.6**
-Trade	35.6	130.8	9.3	6.5	0.6	10.9	5.8	7.1
-Financial Services	13.6	49.0	9.1	2.5	0.2	1.6	2.2	2.7
-Transport	26.4	75.8	7.5	4.2	0.3	3.8	4.3	4.1
-Communication	5.5	18.5	8.7	1.0	0.1	0.7	0.9	1.0
-Government Services	25.5	55.8	5.6	3.6	0.2	6.3	4.2	3.0
-Other Services	134.3	487.2	9.2	24.3	2.2	15.6	22.0	26.6
TOTAL REAL VALUE ADDED	**610.9**	**1,831.5**	**7.8**	**100**	**7.8**	**100.0**	**100.0**	**100.0**

Table 4, in turn, shows results of a so-called Shapley decomposition. It shows the contributions to changes in average product of labor (real GDP per worker) by activity that are driven by: a change in the level of employment in each sector of economic activity; a change in the output per worker by sector; and a shift on employment across sectors. The Shapley decomposition is a counter-factual exercise, so, for instance, the contribution of changes in output per worker (column 1) is computed under the assumption that no changes in the ratio or composition of employment occur. Similarly, the contribution of the changes on the employment ratio (column 2) assumes that no changes in output per worker or shifts in employment take place. Finally, the contribution of shifts in employment across sectors (column 3) assumes that no changes in employment ratio or output per worker take place. For columns 1 and 2, increases in output per worker and in the employment ratio contribute positively to changes in real GDP per worker. For column 3, positive contributions occur whenever employment moves away from low productive activities (i.e. crops and rest of agriculture) or when it moves towards high productive activities (i.e. Food and Beverage Manufacturing and Non-Food Manufacturing).

In this regard, it can be observed that EPIQ Ethiopia yields a growth rate in value added GDP per worker of 6.1 percent (higher than the 4.8 percent increase in real expenditure GDP per capita), which is mostly explained by the contribution of changes in productivity (4.8 percent, Column 1). The model does not yield substantive changes in the overall employment level, so its contribution remains at 0.2 percent points of the total change in value added GDP per capita. Ethiopia is a country that exhibits a low rate of unemployment, which is typical of many developing SSA countries. For most working age Ethiopians in the labor force it is simply not possible to become idle when they do not find good paying jobs, so their only feasible choice is to engage in low productive, subsistence activities in agriculture and informal services. However, the model shows that a reduction in the ratio of employment in agriculture does occur (with a contribution of -0.5 percent points to changes in real value added GDP per worker), which is more than compensated by the absorption of a larger share of workers in secondary and tertiary activities.

Table 4: Decomposition of Changes in Per Capita GDP in components: Average Product of Labor, Employment Ratios and Employment Shifts across sectors (Percentage Points per Year). 2016 - 2030

	Contributions from changes in:			
	Output per worker (1)	Level Employment (2)	Sectoral composition of employment (3)	Total (4)
Sectoral Contribution	**4.8**	**0.2**	**1.1**	**6.1**
Crops	0.3	-0.5	0.4	0.2
Rest of Agriculture	0.2	0.1	-0.1	0.2
Food and Beverage Manufacturing	1.0	0.2	0.3	1.5
Non Food Manufacturing	0.3	0.1	0.1	0.4
Electricity and Water	0.1	0.0	0.0	0.1
Construction	0.5	0.0	0.1	0.5
Trade	0.3	0.1	0.1	0.5
Financial Services	0.2	0.2	0.0	0.4
Transport	0.3	0.0	0.0	0.2
Communication	0.1	0.0	0.0	0.1
Government Services	0.2	0.0	0.0	0.1
Other Services	1.4	0.1	0.3	1.8

Despite relatively modest contribution from changes in the employment ratio alone, one needs to take into consideration the role played by a relocation of employment away from primary activities and into secondary and tertiary activities. This yields an additional 1.1 percent to the growth in real value added GDP per worker. For instance, the reduction in the employment ratio in agriculture (Colum 2) is partially offset by the fact that agriculture is a low value added sector, so moving away from the activity adds 0.4 percent points to economic growth (Column 3). Similarly, the increase in the ratio of employment in food and beverage manufacturing and in non-food manufacturing contribute both with 0.2 and 0.1 percent points to growth, respectively; since they are sectors of high value added per worker relative to the rest of the economy, the shift of employment towards these activities contribute each an additional 0.3 and 0.1 percent of economic growth. So overall, labor changes in manufacturing contribute 0.7 percent to changes in value added GDP per worker. When one also considers changes in average productivity, manufacturing adds 1.9 percent points to economic growth.

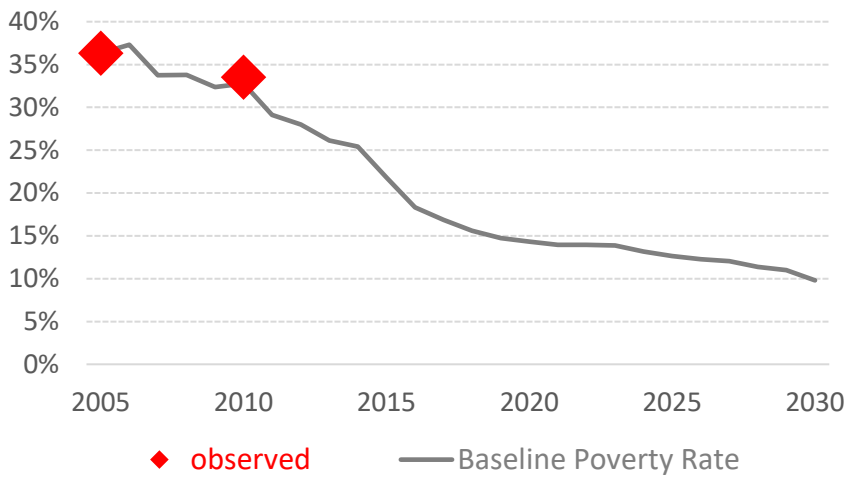
5. Given the baseline results of lower (relative to historic values) but still sizable growth rates, poverty is estimated to continue decreasing over the period 2016-2030, while inequality (measured by the share on income of the bottom 40 percent of households) tends to increase

Further gains in poverty reduction are direct result of economic growth in Ethiopia, which increases averages incomes and consumption across all income percentiles. The baseline poverty headcount falls to

close to 10 percent by 2030. However, it must be noted that many households remain vulnerable to shocks (for instance from natural hazards such as floods and droughts) as their levels remain just slightly above the poverty line.

Furthermore, model outcomes imply a reduction in the share in incomes for the households in the bottom 40 percent from 20.6 percent in 2005, slightly down to 20.5 percent in 2015, and further down to 17.6 percent in 2030. Such results are not at odds with what is observed across countries, as they move towards higher levels of income, a phenomenon that is often represented for the so-called Kuznet curve, which plots levels of inequality by income level.

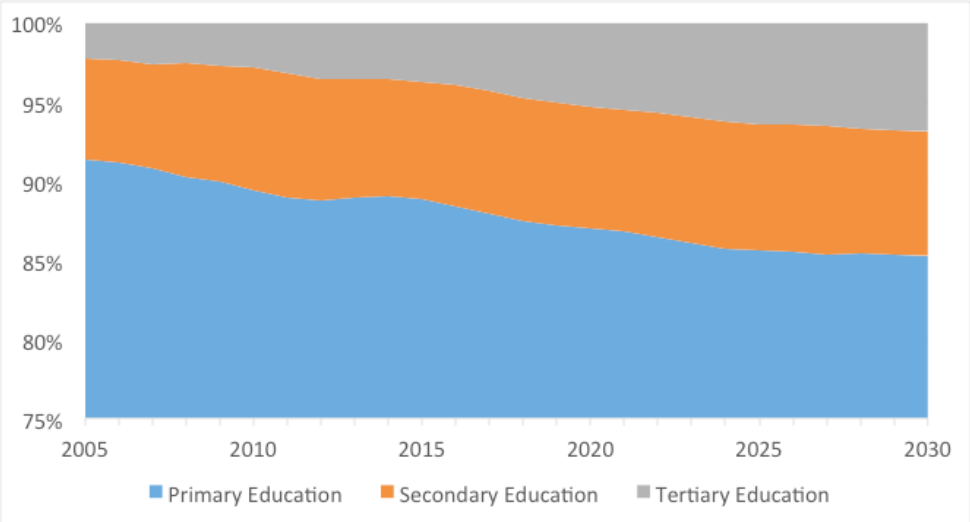
Figure 36: Poverty Rate (%)



6. In relative terms, Ethiopia makes significant gains in terms of the education of its labor force, as well as in yielding higher real wages for all education types. Labor demand increases for all types of labor, more for those with tertiary education, however, given the sheer growth in labor force, the economy cannot provide good paying jobs even for a scenario of high growth, hence, many individuals and entrants in the labor market will remain employed in low pay primary activities.

As shown in Figure 37, Ethiopia continues to slowly build its human capital base, with gains in the share of workers with secondary and tertiary education. However, by 2030 the economy remains with a high share of primary educated labor (over 85 percent). These model results are consistent with what has been historically observed in Ethiopia. Since 2000 it has been possible to provide basic education to the large and growing labor force, but it remains a huge challenge to advance levels of education beyond this threshold. Under the baseline case, Ethiopia will find itself struggling trying to strike a balance in financing ambitious investment programs in infrastructure and building its manufacturing base given financing constraints, and yet having to find resources to continue building its human capital base.

Figure 37: Employment Shares by Education (%)



Furthermore, model results indicate gains in wages for all education types and in both rural and urban areas (Figure 38). Between 2016 and 2030, average wages increase about 4.4 percent per year for workers with primary education (both rural and urban), 6.7 percent for secondary educated labor in rural areas, 7.8 percent for secondary educated labor in urban areas, and about 2.8 percent for tertiary educated labor. In turn, labor demand increases in the period more for labor force with tertiary education at 5.9 percent per year, and at rates of 1.7 percent and 2.1 percent for primary and secondary educated, respectively. The lowest growth in tertiary wages for tertiary educated people indicates a faster growth in the supply of this type of labor relative to the growth in demand. Putting all together, considering its low stating base in terms of the number of good paying jobs relative to the country's high and still rapidly growing labor force, and in terms of their average, Ethiopia will continue facing tremendous challenges to make its growth process extended to a large fraction of individuals. Advances in education, wages and in the pace of good job creation are good in relative terms, but fall quite short in reaching a large fraction of population.

Figure 38: Real Wages by Education Attainment and Rural / Urban (2010 ETB thousands)

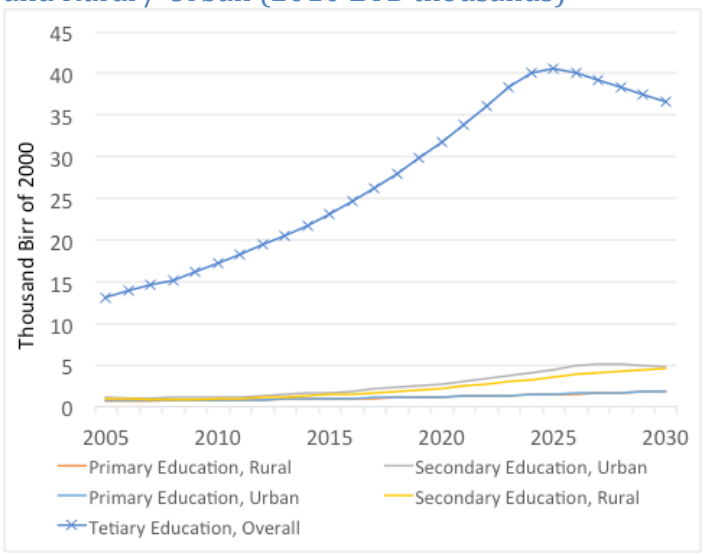
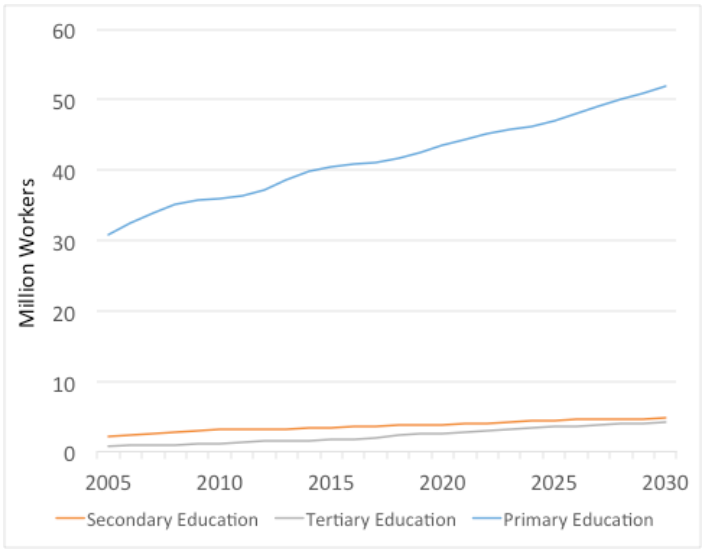


Figure 39: Labor Demand by Education (million)



5. Scenarios

Scenario description

The structure of EPIQ Ethiopia allows for a broad variety of scenarios that can be evaluated. Potential counterfactual scenario analysis can include evaluating the effects of investment growth in particular sectors, policy changes such as direct and indirect tax rate changes for different income brackets, different governmental transfer policies as means of redistribution of income and wealth, the study of different exogenous structural characteristics of the economy, such as the impact of accelerated TFP growth and a change in the behavior of economic agents (on individual family and labor decisions) among others. To highlight the insight EPIQ can deliver regarding the impact of private investments in the economy, this report discusses three different counterfactuals regarding additional FDI investment in different sectors of the Ethiopian economy. The choice of these scenarios is driven by the nature of IFC and other private investors potential interventions on the one hand, while highlighting the different channels over which different sectors affect other sectors of the economy and private households alike. The following analysis describes the effects of different investment strategies by comparing the outcomes of the counterfactuals to each other as well as to the baseline discussed in the previous section.

All scenarios are characterized by additional FDI flowing into specific sectors of the economy. While (cross-sectoral) FDI inflows in the baseline scenario are maintained, additional investments will occur between 2016 and 2020 in either agriculture (*Agricultural Stimulus*), manufacturing (*Manufacturing Stimulus*) or services (*Service Stimulus*). It is assumed that the additional annual capital flows during this period will equal 1.0 percent of GDP which roughly compares to about 7.0 percent of additional FDI inflows above baseline levels. While additional capital formation in specific sectors will boost production and labor productivity in these sectors, hence leading to higher income for the government and households, the additional FDI inflows will increase the country's foreign liabilities and hence total debt.

Scenario results

Growth and fiscal effect of additional Investments

Additional FDI investments will help to grow the capital stock, the inflow of knowledge and technology and, hence, the growth of the economy. Figure 40 shows historical and projected GNI per capita. Over the historical period before 2015, the baseline scenario follows official IMF numbers closely. The model results indicate that Ethiopia is on the way to reach middle income country status by 2026 along the baseline. Additional investments as laid out in the stimulus scenarios will not be enough to achieve middle income status much earlier than 2025.

Figure 40: GNI per Capita

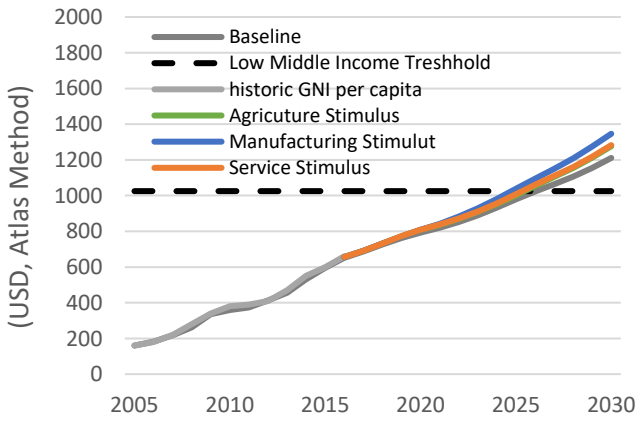


Figure 41: Real GDP Growth

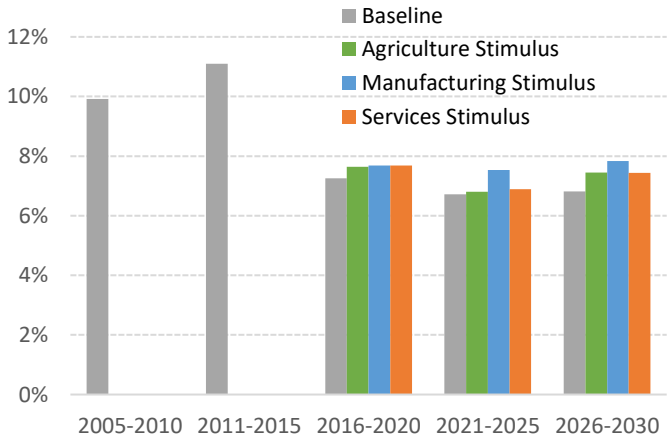
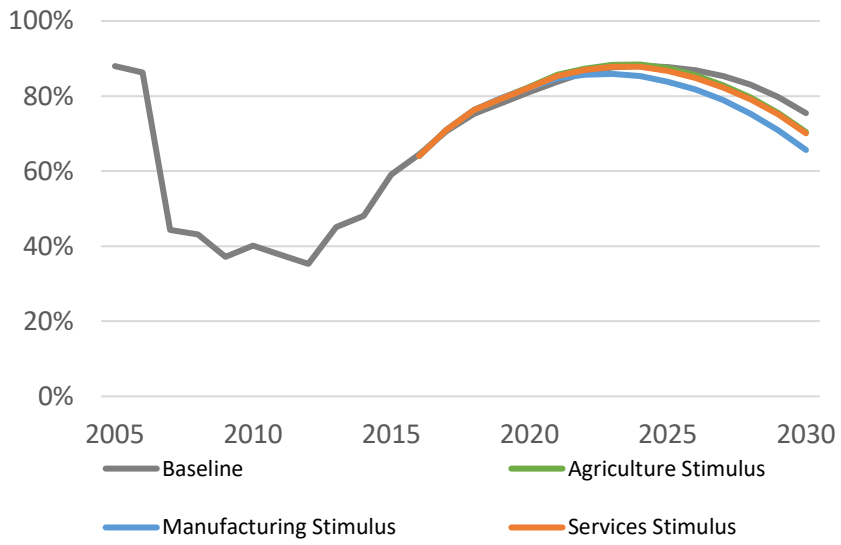


Figure 41 provides a closer look at GDP growth rates. EPIQ Ethiopia indicates that the policies and investment schedules along all counterfactuals are not enough to maintain a 10 percent growth rate of GDP until 2030. While GDP grew by an average of 10.5 percent per annum over the historical period, GDP growth will decline to 6.9 percent over the forecasting period in the baseline. However, additional FDI investment will lead to an increase in GDP growth. The strongest effect on GDP growth comes from a stimulus package that favors food and non-food manufacturing. GDP growth rates would be as high as 7.6 percent over the projection period. The agricultural and service stimulus fare slightly worse, increasing GDP growth to 7.1 percent and 7.2 percent, respectively. Noteworthy, additional FDI inflows over 4 years, from 2016 to 2020, have a lasting effect on GDP growth reaching beyond the stimulus period.

Figure 42 shows total Ethiopian debt as a percent of GDP. Historically, the debt relief after the 2004 enhanced Debt Initiative for the Heavily Indebted Poor Countries (HIPC) can be observed in Figure 42, as Ethiopia's debt burden decreased significantly before 2007. Model results imply, in line with data, that while debt was kept under control until the early 2010s, it has been on the rise again as large scale investment programs made it necessary for additional funding to enter the country. EPIQ simulations show that debt as a percentage of GDP will keep on rising until the early 2020s when finally, the high growth rate of GDP will outperform increases in debt.

Figure 42: Debt to GDP Ratio (%)



Under the additional stimulus programs debt will increase slightly quicker during the initial investment period, but boosted GDP growth will help to decrease the debt burden quicker after the turn around happened. The results highlighted in Figure 42 show the importance of tax revenue increases targeted by GTPII. The GoE targets to increase tax revenues by 4 percent of GDP by 2020, which will help to keep debt at bay and signal to potential creditors and investors, alike, that GoE takes sustainable finances seriously.

Labor market effects

In addition to aggregate effects on household income, EPIQ allows to take a closer look at growth contributions. Table 5 shows the per capita growth decomposition for capital and labor for the manufacturing stimulus. While real GDP per capita under the baseline is 4.8 percent per annum over the projection period (see Table 2), per capita GDP grows at 5.5 percent under the manufacturing stimulus over the same period. While the initial shock happens on the capital side, only an additional growth increment of 0.2 percentage points can be attributed to the increase of capital per unit of labor. At the same

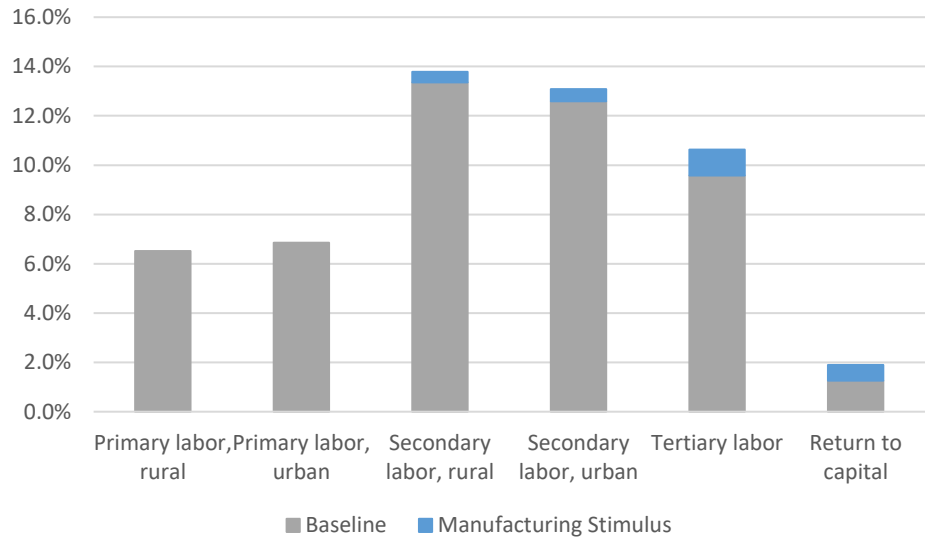
time, the contribution of labor and factor productivity (over the shift from labor into more productive sectors) increases from 1.3 percent to 1.8 percent.

Table 5: Extended Growth Accounting Decomposition. Manufacturing Stimulus.

	Annual growth rates				Avg Investment to GDP ratio
Period	Real GDP per capita	Capital Stock per unit of labor	TFP, Demographics, and Labor	Real total GDP	
2005-2016	7.68	4.03	3.65	10.34	31.21
2016-2030	5.45	3.67	1.79	7.70	47.08

Figure 43 compares wage rate increases over the model horizon for the baseline case and the manufacturing stimulus. With the structural change from the primary sector of the economy to manufacturing, present in the baseline, and accelerated under the manufacturing stimulus, primary labor wage rates tend to increase at a lower rate than secondary and tertiary wage rates. This is driven by a larger demand for higher skilled labor in manufacturing, and an abundance of primary educated labor. The main beneficiaries of a manufacturing stimulus are urban workers, whose wages increase faster relative to the baseline.

Figure 43: Factor Price Increases (%)



Poverty and shared prosperity

As mentioned before, the WBG twin goals aim at reducing the population living under extreme poverty below 3.0 percent of total global population by 2030 while sharing prosperity more equally. Income increases and poverty reduction can happen through different channels represented in EPIQ. Investing in the real sectors of the economy will create formal, better-paid jobs for people formerly living on wages from poorly-paid jobs or subsistence farming in rural areas, and will also increase productivity, and, hence, wages for already employed individuals. In addition, investing into manufacturing and services fosters increased urbanization as people move from subsistence farming in rural areas to wage earning occupations in more urbanized areas; which helps to urbanize areas that were formerly considered rural.

EPIQ features endogenous urbanization driven by GDP growth differences between rural and urban areas. Figure 44 shows the change to urbanization assumed along the baseline driven by differences in urban and rural GDP growth. While investment in agriculture tends to benefit large portions of the rural focused Ethiopian work force, investments in rural areas will decrease the gap between rural and urban GDP growth, and, hence, lead to a slowdown in urbanization. If additional FDI inflows are targeted towards manufacturing or service sectors, the additional GDP growth will be higher in urban areas and hence more people will move from rural to urban ones. However, the overall effect (of up to 350,000 people migrating) in the stimulus programs simulated are small compared to the overall population. While the urban population grows on average by 4.5 percent annually under baseline assumptions and over the projection period, the urban population growth rate only increases by 0.07 percentage points under the manufacturing stimulus, while the rural population growth rate decreases by 0.04 percent during the same period from roughly 1.7 percent in the baseline scenario.

Figure 44: Migration (Additional Urbanization, thousands)

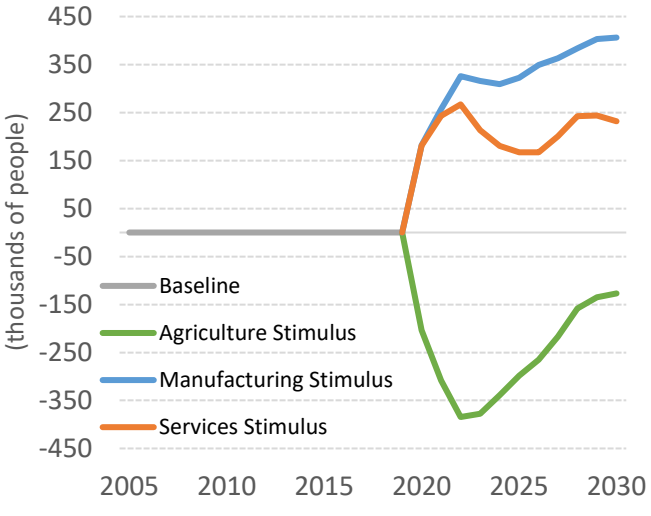


Figure 45: Poverty Rate (%)

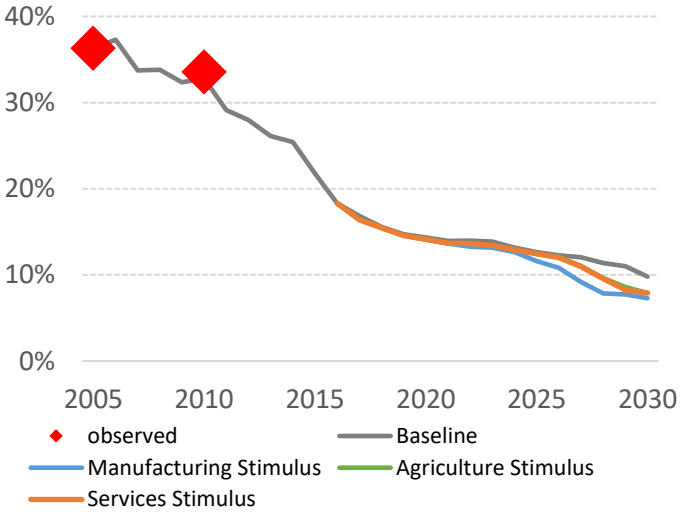


Figure 45 reports the poverty rate as computed in EPIQ Ethiopia. The model applies World Bank poverty definition defined as living below 1.90 US dollars per day (and per capita). While the model replicates closely the historical observations on poverty (36 percent in 2005 and 33 percent in 2010), the simulated results indicate that poverty has continued falling further. By 2015 the poverty rate is estimated to reach 22 percent, while by 2030 10 percent of population would still live under extreme poverty. The investment stimuli across the simulated scenarios would reduce poverty even further. Under a manufacturing stimulus program the poverty rate in 2030 would decline further to roughly 7 percent (2-3 percentage points below the baseline). Interestingly, the service sector stimulus and the agricultural stimulus would lead to similar reductions of around 1 percentage points below the baseline.

While historically the GoE has relied on programs boosting agricultural productivity to fight poverty, in the decades to come investing into manufacturing might be a more effective strategy to reduce poverty. There are three reasons behind this finding. First, boosting manufacturing has a larger positive overall effect on GDP, allowing for larger value added to be distributed. Second, investing in manufacturing leads to urbanization and hence to high-quality job creation. And finally, urban poverty in Ethiopia is also high, leaving room for urban poverty rates to decrease and having an impact on country-wide poverty measures.

Ethiopia has a remarkable track record of preserving higher equality among its population. The GINI coefficient hovered between 30 and 33 since 2000 and EPIQ Ethiopia estimates show that this coefficient has been maintained until 2015. However, model results indicate that this is likely to change in the coming decades. Moving the focus of GTPI from development in the agricultural sector to boosting manufacturing to keep economic growth high, is likely to create winners and losers of such a shift in policy. The income share of the poorest 40 percent of the Ethiopian population (measured using consumption data and results) has remained around 20 percent over the historical period (See Figure 46). However, the baseline simulation results imply that the share of total consumption enjoyed by the poorest 40 percent will decrease steadily to 17.6 percent until 2030. Additional investment in the stimulus scenarios does not help to alleviate this trend. On the contrary, by 2030 the income share of the bottom 40 percent might decrease by another 0.4 percentage points under a manufacturing stimulus program.

Figure 46: Shared Prosperity (Income Share, %)

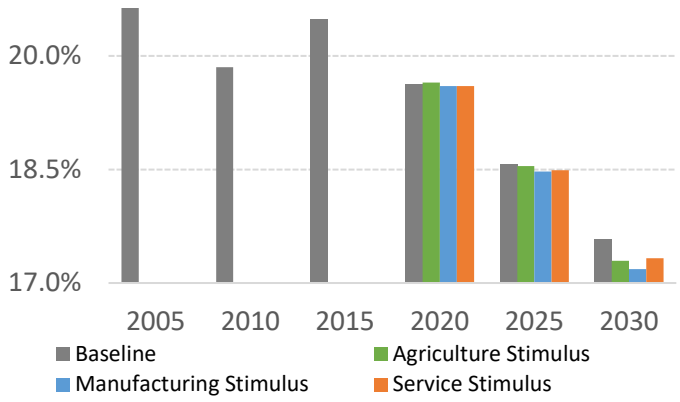
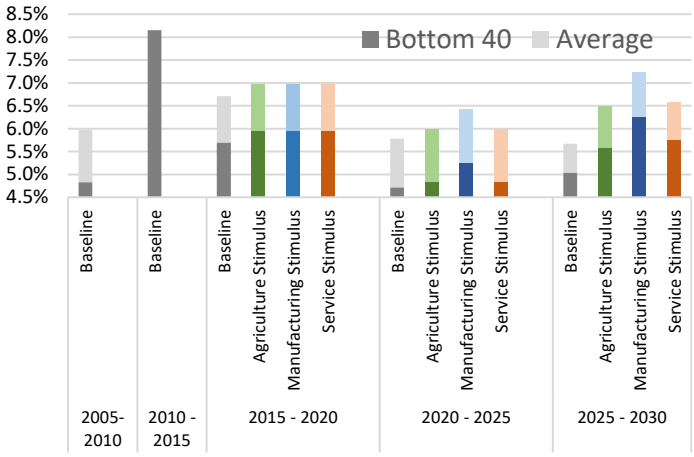


Figure 47: Growth Incidence (Income growth, %)



Similar to what poverty numbers suggest, Figure 47 confirms that both the average income and that of the bottom 40 are growing across all scenarios; and grow at a faster pace with additional FDI. However, with the exception of the period between 2010 and 2015, average income grows faster than the income of the poorest 40 percent of the population. Furthermore, the difference is even larger in the stimulus counterfactual, and highest under a manufacturing stimulus. While the average income over the projection period grow by 6.1 percent, the income of the bottom 40 percent only grows by 5.1 percent. Under a manufacturing stimulus, while the average income grows 0.83 percent faster, the income of the bottom 40 percent grows 0.67 percent faster.

In sum, while additional FDI inflows benefit all groups of the population and help to decrease poverty to some extent, trickle-down economics will not help to alleviate inequality. The results from the EPIQ model suggest that additional transfers or tax policy might be required to maintain current levels of equality.

Conclusions

This report introduces the Economy-wide Impact Quantification model for Ethiopia (EPIQ Ethiopia). EPIQ Ethiopia is a multisectoral structural dynamic economic model of the Ethiopian economy that helps to link IFC's private sector investments to the WBG twin goals. It represents the Ethiopian economy disaggregated into 12 sectors using intermediate inputs, capital, and labor to produce final and intermediate goods. Labor markets are segregated into three different skill levels as well as urban and rural markets. Distinguishing labor based on education and location is important, since these factors determine salary levels to the largest extent, and hence, influence income distribution and poverty rates. The model incorporates 9,600 different household groups. Each group differs in their labor and capital endowments, remittances and government transfers received, household size, number of working individuals, age of household head, education obtained, and location. These distinctions are important to endogenously compute distributional impacts such as changes in the income of the bottom 40 percent and poverty rates.

EPIQ represents the Ethiopian economy in a recursive dynamic setup. The model's horizon stretches from 2005 to 2030 and is solved in annual time steps. It incorporates population growth and decomposition by applying an exogenously estimated transition matrix that updates the number of households of each type between periods. The periods are further linked through investment decisions and capital stock evolution. Households save a fixed amount of their disposable income after minimum life essentials have been bought and taxes have been paid.

EPIQ is built in a modular way. Therefore, sectoral aggregation of the economy can easily be adapted to investigate specific scenarios. In addition, modeling sectors with greater detail can be accommodated as well. While the current Ethiopian model does not include any such extensions, a detailed electricity module has been included in EPIQ Philippines and a regulated electricity market model could be implemented in a later version of EPIQ Ethiopia. This electricity module will need to take into account the highly-regulated nature of the Ethiopian power market, its extensive reliance on the country's hydro potential for supply and, linked to the fast expansion of the production potential, the expansion of residential power access and electricity trade with neighboring countries. Another potential extension includes a more detailed agricultural sector module that would enable a more detailed analysis of the impact of specific improvements in agricultural productivity (e.g. irrigation and inputs quality), detailed effects of agricultural policies that take include seasonal patterns, as well as climate shocks (e.g. droughts).

This report presents three different counterfactuals beside a baseline scenario that showcase the abilities of EPIQ to link investment in specific sectors to the World Bank twin goals and selected SDGs. We show that pushing manufacturing and propelling structural change can play an important role in fighting poverty but has limited impact on closing income gaps. In addition, we shed light on how investments in different sectors such as agriculture, manufacturing, and services filter through economic feedback mechanisms.

An investment through an additional inflow of FDI as large as 1 percent of GDP between 2016 and 2020 can increase average GDP growth rates from 6.9 percent to up to 7.7 percent between 2016 and 2030 if the investment targets manufacturing. Together with larger GDP effects when investments target manufacturing, the poverty rate declines more as well. This result is driven by faster GDP growth, leading to larger value added in the economy to be redistributed. The manufacturing sector is more interlinked with other sectors of the economy through its supply chain, leading to growth both in manufacturing and non-manufacturing sectors. Therefore, investing into manufacturing might tackle urban as well as rural poverty. Second, urban poverty in Ethiopia is high; thus, improving incomes in urban areas can lead to substantial decreases in urban and total poverty in the country. Finally, boosting manufacturing leads to an acceleration in urbanization with positive effects on income levels. Former subsistence farmers become wage earners for the first time, enabling them to escape extreme poverty.

Finally, shared prosperity is relatively unaffected by investments alone. Under no further structural changes in the functioning of the economy, a larger fraction of the benefits of an increase in FDI are reaped by the society's income elite. These individuals tend to earn higher returns on capital as an increasing share of subsistence farmers provide a larger employee pool, preventing wages for lower skilled workers to rise as quick as economic growth accelerates. Therefore, while private sector investment increases economic growth, and thus, generates the necessary wealth to improve the life of most people in Ethiopia, social policies appear to be necessary for any successful strategy aiming at improving upon both World Bank Group twin goals of reducing poverty while at the same time increasing shared prosperity.

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Appendix 1: Areas of Investment Restricted to Government, Nationals of Ethiopia and Domestic Companies.

Areas Reserved Exclusively to Government Only:

- Postal services with the exception of courier service;
- Transmission and supply of electrical energy through the integrated national grid system; and
- Passenger air transport services using aircraft with seating capacity of more than 20 passengers.

Areas Reserved to Ethiopian Nationals Only:

- Banking, insurance and micro credit and saving services;
- Travel and shipping agency services;
- Broadcasting services; and
- Air transport services using aircraft with a seating capacity of up to 20 passengers.

Areas Reserved to Domestic Investors Only:

- Retail trade and brokerage;
- Wholesale trade (Excluding supply of petroleum and its by –products locally Produced);
- Import trade (Excluding Liquefied Petroleum Gas, bitumen and up on the approval of the Council of ministers materials used as inputs for export products);
- Export trade of raw coffee, chat, oil seeds, pulses, hides and skins bought from the market ad live sheep, goats and cattle not raised and fattened by the investor;
- Construction companies excluding those designated as grade 1:
- Tanning of hides and skins up to crust level;
- Hotels other than those star-designated, motels, pensions, tea rooms, coffee shops, bars, night clubs and restaurants excluding international and specialized restaurants;
- Travel agency, trade auxiliary and ticket selling services;
- Car-hire and taxi-cabs transport services;
- Commercial road transport and inland water transport a services;
- Bakery products and pastries for the domestic market;
- Grinding mills;
- Bakery products and pastries for the domestic market;
- Barber shops, beauty salons, and provision of smith workshops and tailoring series except garment factory;
- Building maintenance and repair and maintenance of vehicles;
- Saw milling and timber making products;
- Customs clearance services;
- Museums theaters and cinema hall operations;
- Printing industries.

Appendix 2: EPIQ Model Structure differences between Philippines and Ethiopia Pilots

	Ethiopia	Philippines
Time Unit	Time unit: Year	Time unit: Month
Period of analysis	2005 – 2030	2000-2030
Calibration	Some endogenous variables are made exogenous for the period 2006-2015. These are in general variables directly affected by discretionary measures that are hard to capture in the model structure	Productivity is calibrated to get endogenous values of sectors GDP growth. Bounds imposed to growth rate of selected endogenous variables.
Household structure	HH types by HH head gender and education level, urban/rural and household type. Further HH classification by income received from transfers (Government & Remittances) and capital	Similar to ETH. Further HH classification by Received Remittances (binary); formal / informal; and, capital ownership
Government sector	Fully specified with Revenues, Expenditures and Debt Structure	In simple form (as percent of GDP)
Available Model Closures	Savings – Investment; Foreign Savings – Real Exchange Rate; Government Deficit Bound – Government Deficit Unbound	Savings – Investment
External Sector	Constant Elasticity of Transformation for Domestic Output allocation between domestic markets and exports; and Armington Specification for allocation of consumption between domestically produced products and imports	Assumes perfect transformation between domestically produced goods and exported goods. Imports are residual of total demand and supply
Aggregate Investment	Leontief or as a function of marginal propensity price and price of capital, depending on closures	As a function of marginal propensity price and price of capital
Number of sectors	12	10
Closures	For government investment (unlimited vs capped at available government savings); for savings investment balance (Exogenous private investment path vs endogenous MPS; or fixed MPS with endogenous private investment); and for the external sector (fixed RER vs Endogenous Foreign Savings; or Fixed foreign savings vs variable RER)	Savings-Investment
Detailed sectors	None	Power, Informal, Tourism

Appendix 3: Tables

Table 6 : Ethiopia Sector Value Added Growth Decomposition. 2005-2015

	2005 (Bill. Birr of 2000)	2015 (Bill. Birr of 2000)	Avg. Annual Growth (percent)	Avg Share in VA GDP (percent)	Contrib. to GDP growth (% point)
PRIMARY	**58.8**	**126.6**	**7.7**	**43.1**	**3.3**
-Crops	35.4	92.2	9.6	28.3	2.7
-Rest of Agriculture	23.4	34.4	3.9	14.8	0.6
SECONDARY	**13.2**	**39.9**	**11.1**	**11.4**	**1.3**
-Food and Beverage Manufacturing	2.8	6.9	9.0	2.2	0.2
-Non Food Manufacturing	2.8	6.6	8.7	2.1	0.2
-Electricity and Water	2.3	2.3	-0.1	1.3	0.0
-Construction	5.3	24.2	15.1	5.8	0.9
TERTIARY	**49.2**	**169.4**	**12.4**	**45.5**	**5.6**
-Trade	13.8	42.3	11.2	12.0	1.3
-Financial Services	2.3	2.7	1.5	1.3	0.0
-Transport	5.3	42.7	20.8	8.6	1.8
-Communication	1.0	3.7	12.9	1.0	0.1
-Government Services	6.0	13.0	7.8	4.4	0.3
-Other Services	20.8	65.2	11.4	18.3	2.1
TOTAL REAL VALUE ADDED	**121.2**	**336.0**	**10.2**	**100**	**10.2**

Source: Authors' calculations based on GoE official data.

Table 7 : Ethiopia Real GDP Expenditure Growth Decomposition. 2005-2015

	2005 (Bill. Birr of 2000)	2015 (Bill. Birr of 2000)	Avg. Annual Growth (percent)	Avg Share in VA GDP (percent)	Contrib. to GDP growth (% point)
Private Consumption	113.6	312.9	10.1	60.3	6.1
Government Consumption	15.9	36.5	8.3	7.4	0.6
Gross Capital formation	32.0	143.3	15.0	24.8	3.7
Exports G&S	16.8	35.7	7.6	7.4	0.6
Aggregate Demand	**178.3**	**528.4**	**10.9**	**100.0**	**10.9**
Imports G&S	47.0	163.7	12.5	29.8	3.7
Total GDP at Market prices	131.3	364.7	10.2	70.2	7.2
Aggregate Supply	**178.3**	**528.4**	**10.9**	**100.0**	**10.9**

Source: Authors' calculations based on GoE official data for total Real GDP, IMF and UN data.

Table 8 : Sources of Investment Financing in Ethiopia. 2011-2016 (As percent of GDP)

	Gross Capital Formation - GCF	Gross Domestic Savings - GDS	Resource Gap: (GDS-GCF)	Current Account Balance - CAB	CAB Excluding Grants	Total Extra Foreign Financing	Officlal Grants	Net Foreign Direct Investment	Other Extra Foreign Financing, Net
2011	27.2	12.8	-14.4	-0.7	-4.0	10.4	3.3	4.0	3.1
2012	34.6	15.0	-19.6	-6.5	-8.2	11.4	1.7	2.5	7.2
2013	35.8	16.0	-19.8	-6.0	-7.5	12.3	1.5	2.5	8.3
2014	38.0	20.5	-17.5	-7.9	-9.0	8.5	1.1	2.6	4.8
2015	39.3	21.8	-17.5	-12.0	-13.1	4.4	1.1	3.6	-0.3
2016	39.7	18.4	-21.3	-10.7	-11.7	9.6	1.0	4.6	4.0
Avg. 2011-2016	**35.8**	**17.4**	**-18.4**	**-7.3**	**-8.9**	**9.4**	**1.6**	**3.3**	**4.5**

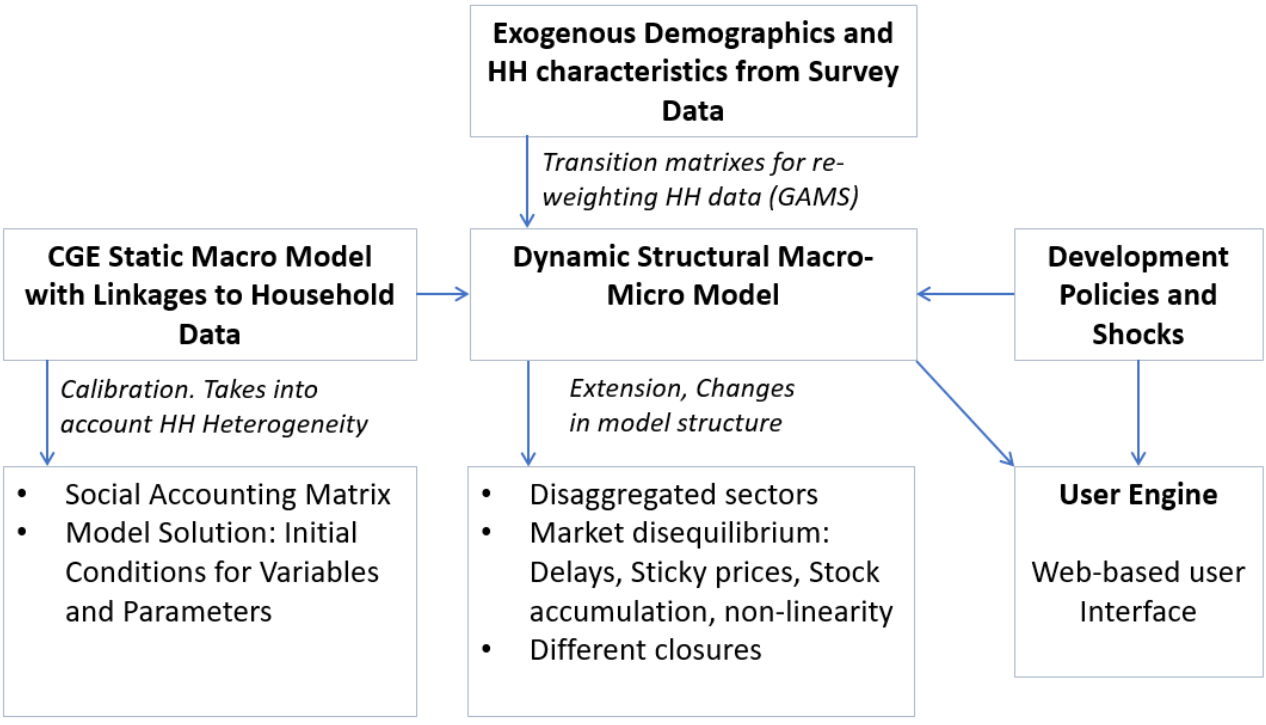
Source: Authors' calculations based on GoE official data for total Real GDP, IMF and UN data.

Table 9 : Summary of Main Macro Targets under GTPII

Indicator	Unit	Baseline (2014/15)	GTPII Targets (2019/20)
A.- The Macro Economy			
Real GDP Growth Rate	annual %	11.4	10.0
Primary Activities Growth rate	annual %	9.6	8.0
Industry Growth rate	annual %	13.7	19.8
(of which) Manufacturing Growth rate	annual %	9.5	23.9
Services Growth rate	annual %	10.3	10.1
Primary Activities Share	% of GDP	41.1	35.6
Industry Share	% of GDP	15.6	22.8
(of which) Manufacturing Share	% of GDP	4.6	8.0
Services Share	% of GDP	43.3	41.6
Gross Domestic Investment share	% of GDP	36.3	41.3
Gross Domestic Saving share	% of GDP	19.5	29.6
Export of Goods and Services share	% of GDP	12.8	20.6
Import of Goods and Services share	% of GDP	29.6	32.3
B.- Public Finances			
Domestic Revenue	% of GDP	14.4	18.8
Tax Revenue	% of GDP	12.9	17.2
Total Expenditure	% of GDP	18.7	22.6
Capital Expenditure	% of GDP	10.1	14.4
Recurrent Expenditure	% of GDP	8.6	8.2
Total Poverty-oriented Expenditure	% of GDP	11.7	14.6
Budget Deficit	% of GDP	-2.9	-3.1
C.- Poverty and Welfare			
Total Poverty Headcount	% of Pop.	33.5 *	16.7
D.- Exports			
Manufacturing Export Revenue	% of GDP	0.9	3.1
Agricultural Export Revenue	% of GDP	4.4	6.5
Manufacturing Exports	% Goods Exports	13.4	25.9
Goods Exports	% of GDP	6.4	11.8
Manufacturing Exports	% Goods Exports	13.4	25.9

Source: National Planning Commission (2015) *(*) By 2010*

Figure 48: EPIQ Modules and Structure



Appendix 4: Short Data description

The modeling approach used in EPIQ requires that the following information is made available:

- At the macro level, a social accounting matrix (SAM) for the initial year of calibration
- Times series macroeconomic data for the historical period, plus assumptions for macro exogenous variables for the estimation period
- At micro level, individual and household characteristics from survey data is incorporated in the analysis for welfare and distributional analysis.

EPIQ Ethiopia uses an aggregated SAM for 12 activities and commodities, that is, in turn, derived from a regionalized one produced by (Hashim, et al., 2010) that includes up to 47 activities and commodities. The SAM is balanced, so total values of income categories (rows of the SAM) equal corresponding total value of expenditure categories (columns in the SAM). This guarantees that an initial equilibrium solution is found that replicates values of variables included in the SAM, as will be explained in the next section.

In turn, the macroeconomic times series data used in EPIQ refers to that typically found in a country's System of National Accounts (SNA). It includes information on GDP by alternative classifications (Value added by sectors of economic activity, expenditure GDP and payments to factor inputs); national income, gross domestic and national savings; an economic classification of Central Government's revenues and expenditures; government debt stock and debt service; data on components of the balance of payments; basic prices (consumer, producers, interest rates and exchange rates). Whenever available, data from GoE, Central Statistic Authority is used. Alternatively, data from IMF and the World Bank's World Development Indicators is employed. Whenever necessary, both data in real and nominal prices is used. This is the case, for instance, of total GDP and expenditure categories. Real variables are introduced in the model Birr, at constant prices of 2000 (same as in the SAM), but then re-expressed in real values of 2011 so as to be able to compare model outcomes with historical data produced by Ethiopia's Central Statistical Authority.

Other macro data refers to demographics, labor force and employment variables. Data on population, total, by location, and by age cohorts, both historical and forecasted, is obtained from the UN Population Program. In particular, population projections correspond to the medium variant scenario, which incorporate medium assumptions for fertility, normal mortality and normal migration patterns[47].

Regarding employment, total and by main sectors of economic activity (as defined by the activity and commodity break down from the SAM), the main source of information is ILO and available labor force surveys.

The main sources of micro data for welfare and distributional analyses are the Family Income and Expenditure Survey (FIES, 2005) and the Labor Force Surveys. The former allows for identifying individual and household characteristics, welfare indicators (income and consumptions) as well as weights useful to reconcile macro and micro variables. The latter enables the computation of proxies for human capital and effectiveness of labor, labor status and sectors of employment.

[47] The medium fertility scenario is one that assumes that total fertility in all countries will eventually converge toward a level of 1.85 children per woman. Mortality is projected on the basis of models of change of life expectancy produced by the United Nations Population Division. The selection of a model for each country is based on recent trends in life expectancy by sex. The normal migration assumption is one where the future path of international migration is set on the basis of past international migration estimates and consideration of the policy stance of each country with regard to future international migration flows.

Appendix 5: EPIQ's User Interface

EPIQ Ethiopia is, by nature, a large and complex model. Model complexity emerges from what is referred to as detail complexity and dynamic complexity. Detail complexity results from the large number of variables in the model at both, macro and micro levels. Dynamic complexity emerges from feedback interactions, non-linearity, stock-flow structures and delays, all together with the integrated nature of the model where macro policies and shocks affect and are affected by emergent behaviors at the micro level. In addition to the model's inherent complexity, a user, interested in simulating specific investment alternatives, also faces a steep learning curve to master the software in which EPIQ Ethiopia is implemented. The combination of these issues requires for individuals to invest a substantial amount of time for building up the necessary skills.

In practice, for many policy makers interested in using EPIQ Ethiopia, it may not be practical to work independently to analyze expected impacts of specific policies and shocks. They will need to rely on support from modelers sufficiently acquainted with EPIQ Ethiopia.

In order to tackle the model's potential inaccessibility, we are piloting a front-end user interface aimed at facilitating access to EPIQ Ethiopia as a tool for policy analysis. This interface is being built in a platform called Epicenter. Epicenter is a computational platform for hosting server-side models, creating interactive web and mobile applications, and sharing insights. Specifically, Epicenter is able to host and provide access to highly complex models (such as EPIQ Ethiopia), enabling users to run simulations for selected model parameters and observing their impact on selected model outputs.[48] No specific software will be necessary for a user to access EPIQ over the interface. The only prerequisites being an internet connection together with an internet browser and access rights granted by the project team.

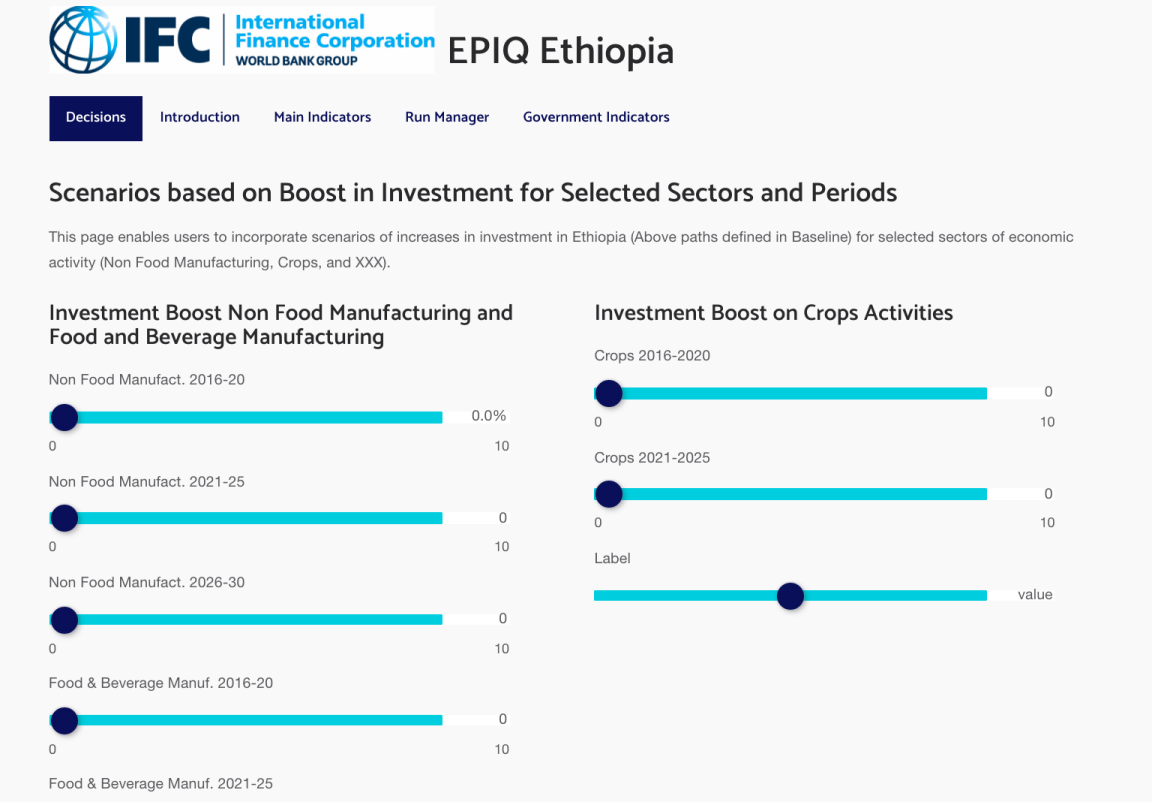
Figure 49 presents the entry page of the alpha version of the EPIQ interface on Epicenter. The introductory page provides the user with an overview, important background information and instructions. Furthermore, this interface allows for easily browsing and navigating the different input and output pages.

Figure 49: Entry and Introduction Page

[48] Epicenter has been created by FORIO. More general information is available at https://forio.com/products/epicenter/

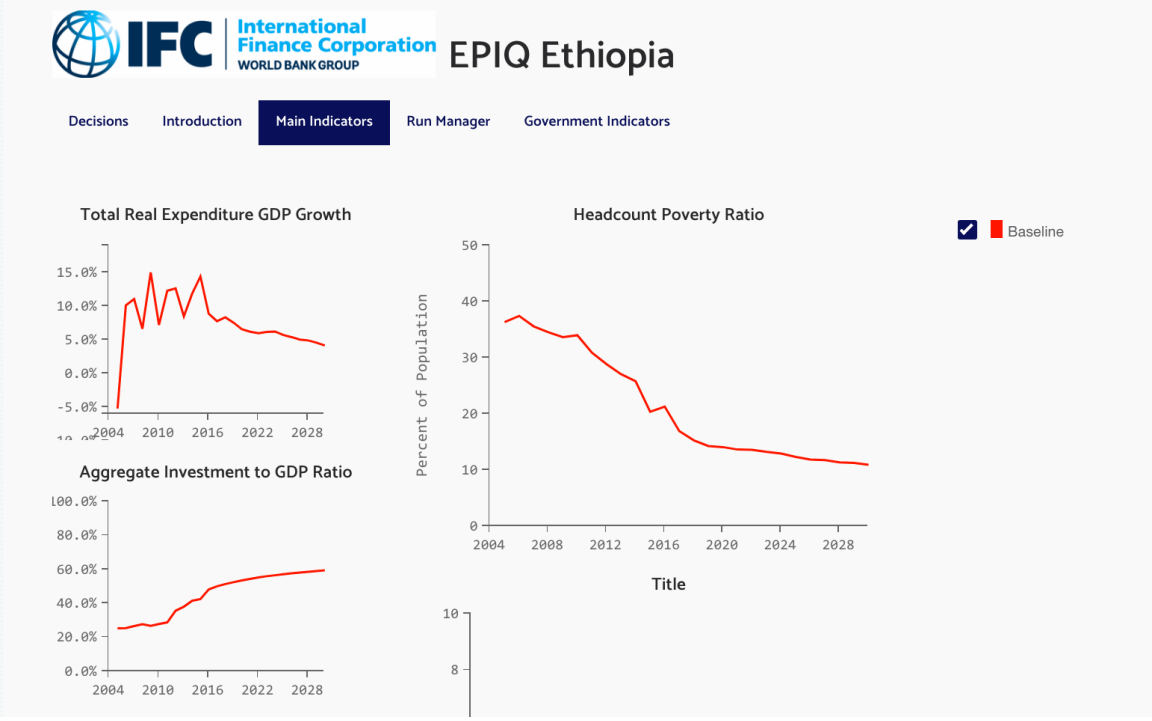
The EPIQ interface allows users to design their own scenarios, based on choosing values for predetermined input parameters. Figure 50 displays one of several pages that allow the user to change input parameters and design their own customized scenarios. Specifically, the interface will allow the user to design investment scenarios along the lines of the ones presented in this report by deciding the size, the timing and the sectors for additional FDI inflows. Further, the user can change assumptions on technological advancement via sectoral TFP growth rates and the sensitivity of urbanization towards urban GDP growth, among others. Other parameter choices, such as price stickiness, Armington elasticities, households' marginal propensity to save, government expenditures and investment, direct and indirect tax rates, and a choice of the various model closures could be added to serve the interests and needs of the users.

Figure 50: Sample Inputs



Once the inputs are specified, the scenario can be computed and the results of the customized scenario become available. Figure 51 shows a sample output page which displays a selection of results of a model run. Several pages contain different groups of results, presenting them in simple to understand graphs. The interface allows the user to store scenario results and to compare them. While the choice of results that are shown is predetermined, new variables of interest can easily be added upon requests from users.

Figure 51: Sample Results



While the above figure shows real GDP growth, the poverty rate and an investment to GDP ratio, the interface can display a wide variety of results of interest, grouped into thematic topics. Namely, macroeconomic variables, such as real GDP, GDP per capita, total consumption, government expenditure, total investment, and net exports, total exports, total imports, and government debt; labor market details, such as a factor growth decomposition (as shown in Tables 2 and 5), sectoral employment numbers per education level, unemployment rates and wage rates for the 5 labor market segments; and Population variables, such as poverty rates and migration numbers; and last but not least, sectoral details, such as sectoral output, value-added, a sectoral growth decomposition (as shown in Table 4), commodity prices, and commodity-specific imports and exports.