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Resource Allocation across Industrial Sectors, Growth, Poverty, and Income Inequality in Ethiopia: A Macro-Micro Approach

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Abstract

Ethiopia has endorsed a Growth and Transformation Plan intended to transform the manufacturing sector through the construction of industrial parks that target priority industries such as textiles and garments, leather and leather products, sugar, cement, metals and engineering, chemicals, pharmaceuticals, and agro-processing. Using the 2010 Social Accounting Matrix (SAM), a dynamic CGE model, and data from the 2009-2010 survey of Household Income and Expenditure, we examined the effect on economic growth, poverty, and income inequality in Ethiopia when resources were allocated to selected industrial activities. We simulated the effect of financing industrial parks through borrowing and then repaying loans through a five-percent tax on non-priority industrial sectors. The results showed that Ethiopia's Gross Domestic Product increased slightly across time. Both production and exports of priority industries operating inside the industrial parks and household income increased while production and exports in similar sectors outside the industrial park decreased. The production of non-priority industrial and service activities showed mixed results, and poverty and income inequality were reduced by a small amount. Transforming the manufacturing sector and stimulating both economic growth and poverty reduction requires attention to attracting direct foreign investment.

JEL classification: O4, 041
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Table of contents

I. Introduction p.1

II. Statement of the Problem p.2

III. Literature Review p.4

IV. Conceptual Framework p.6

V. SAM Documentation and Characterization p.7

4.1. SAM Documentation

4.2. SAM-Based Characterization of the Ethiopian Industrial Sector

VI. Model Development p.9

6.1. Model Closure

6.2. Simulations

VII. Results p.12

VIII. Conclusion p.17

References p.19

Appendix p.22

List of tables

Table 1: Sources of Household Income 9
Table 2: Share of Priority Industries in the Industrial Park 13
Table 3: Growth of Production of Goods by Priority Industries 14
Table 4: Growth of Production by Non-Priority Industries 14
Table 5: Export Performance of Priority Industries Inside and Outside Industrial Parks 15
Table 6: Growth of Production in Service and Agricultural Sectors 15
Table 7: Growth of Household Income 16
Table 8: Percentage Change in the Poverty Line 17
Table 9: Factors of Production (Inside and Outside of the Park) 25
Table 10: Share of Export and Local Supply (Outside of the Park) 25
Table 11: Factors of production (Inside and Outside of the Park) 26
Table 12: Export Performance (Inside and Outside of the Park) 26
Table 13: Price Change in the Most-Consumed Commodities 26
Table 14: Growth of Capital Remuneration to Households 27
Table 15: Growth of Labor Remuneration To Households 27
Table 16: Poverty Index 28
Table 17: Food Items Used for Poverty Lines 29

List of figures

Figure 1: Conceptual Framework 7
Figure 2: Real GDP Growth Rates 13

I. Introduction

An industrial park is a clustering of enterprises that provides a variety of services and facilities to the occupants (UNIDO, 1962; Ramos & Sazanami, 1992). Industrial parks have been widely used in Southeast Asian countries[1] as a means to achieve structural transformation, and their success has driven many developing countries to mimic such industrial-development strategies (UNIDO, 2015). Ethiopia is a case in point. The construction of industrial parks in Ethiopia, most of them state-owned, is a key policy instrument of the Growth and Transformation Plan I (GTP I, 2010-2015) and the second GTP (GTP II, 2016-2020). Industrial-park development targets priority industries—in specific, agro-processing, textile and garment, leather and leather products, sugar, metals and engineering, chemicals, and pharmaceuticals (NPC, 2010). The government has built five industrial parks: Hawassa, Bole Lemi, Mekele, Kombolcha, and Adama. Additional industrial parks are under construction (Dire Dawa, Debre Birhan, Arerti, Kilinto, Jimma, Bahir Dar, and Ayisha).

Industrial parks are strategically located in Ethiopia. Hawassa Industrial Park (HIP), for instance, a textile and garment industrial park and the largest in Africa, is located on the Trans-African Highway, which stretches from Cairo to Cape Town. It benefits from a direct rail line that connects the Port of Djibouti, Addis Ababa, and Modjo. The city also lies in one of the most densely populated regions of Ethiopia[2] where labor is readily available. It is connected to the Modjo-Hawassa expressway that links Addis Ababa with Moyale near Kenya, accentuating its potential as a regional trade hub for the East African Community (UNIDO, 2015). PVH Corp., the world's second largest apparel company, chose HIP when it moved its production to Africa. The factors that influenced the establishment of PVH's African production in Ethiopia included government stability, access to land, port accessibility, cost of and access to electricity and water, labor availability, and competitive wages (Mihretu & Llobet, 2017).

The greatest share of the costs of construction of these parks was financed through loans while nearly a quarter came from the government budget (NPC, 2010). The Ethiopian Industrial Parks Development Corporation (IPDC), a public enterprise established in 2014, has the mandate

1 Taiwan, Malaysia, and China have made extensive use of industrial parks (or SEZs) to attract foreign investment and push industrialization.

2 Hawassa has a population of close to five million within a fifty-kilometer radius.

to develop and administer industrial parks throughout the country. The IPCD, in collaboration with other government institutions, provides one-stop-shop service to investors, including pre- and post-investment servicing, pre-built business spaces (sheds), industrial land, and infrastructure. In order to attract foreign direct investment (FDI) into the strategic manufacturing sectors, the government offers fiscal and non-fiscal incentives. For instance, investors that produce export-oriented goods can import machinery, equipment, construction materials, spare parts, raw materials, and vehicles exempt from duties and other taxes on imports. Enterprises operating in the industrial parks are exempt from income tax for a period of up to ten years. In addition to this, there are export-tax exemptions for targeted goods excepting semi-processed hides and skins. Apart from these, foreign investors can send profit and dividends out of Ethiopia (NPC, 2015). Preferential access of Ethiopian exports to the EU and US markets is another important factor likely to attract FDI.

The unemployment rate in urban Ethiopia is nearly 17.4 % (CSA, 2014), and one of the benefits of industrial parks is that they generate employment opportunities for youth. Industrial parks are expected to create new jobs in manufacturing every year, mostly targeting younger Ethiopians. For instance, Bole Lemi I, which focuses on footwear and apparel, created 13,000 jobs, and the Hawassa industrial park is expected to generate up to 60,000 jobs (Mihretu & Llobet, 2017).

II. Statement of the problem

A series of policies have been introduced since the mid 1950s to promote industrialization, a challenge for the Ethiopian economy. In the mid-1960s, the imperial government especially emphasized agro-processing, mining, and power generation. The manufacturing sector grew at an annual average rate of 16% as a consequence, and the industrial sector's share of the economy grew from 9% in 1963 to 13% in 1967 (UNDP, 2017). Afterwards, the agricultural sector was targeted to bridge the gap in raw materials and domestic demand for industrial outputs. Industrial growth slowed after the downfall of the imperial regime and experienced a negative growth rate averaging 1.4 percent per annum over the seventeen-years of the socialist regime (1973-1974 to 1990-1991).

Agricultural Development Led Industrialization (ADLI) was implemented by the incumbent government in the early 1990s, and it continued through 2010. The share of industry in Ethiopia's GDP remained as low as 12%. The GTP I and GTP II designed for 2010-2015 and 2015-2020, respectively, gave greater attention to industrialization and agricultural development. In the GTP II, the manufacturing industry was envisioned as one of the main drivers of growth and transformation with the construction of industrial parks as a key strategy. Space in industrial parks was to be allotted to selected, labor-intensive industrial sectors (textiles and garments, leather, metal, agro-processing, and chemicals). The plan had a dual purpose. On one hand, the policy projected an increase of industry's share in the GDP to 22%. On the other hand, it aspired to reduce the level of poverty from 23% in 2016 to 16% by 2020 (NPC, 2015).

The flow of foreign direct investment (FDI) and the clustering of activities in industrial parks creates a spillover effect, enhancing total factor productivity and promoting the production and export performance of firms operating in the park. Two examples are provided by China and Chile, where FDI in the manufacturing industries has had a positive effect on the productivity of local firms (Chen, 2014). Other evidence shows that industrial parks also improve social welfare by attracting foreign direct investment and by enhancing export diversification (Jenkins, Esquivel & Larraain, 1998; Miyagiwa, 1986; Wang, 2013). Alder, Shao, and Zilibotti (2016) and Wang (2013) further noted that positive spillover effects from industrial parks can enhance economic productivity, make new technologies available, and improve local social welfare, all of which have effects on the domestic population. This is what has happened in Ethiopia. Siba et al. (2012) found that agglomerated firms in Ethiopia had higher productivity if they produced products identical to other firms in the cluster.

Other findings suggest that industrialization through industrial parks is only possible if the parks are properly utilized. Farole and Gokhan (2011) pointed out that African special economic zones have under-performed relative to expectations. Cognizant of this fact, the Ethiopian government has introduced a credit-allocation scheme that limits the support of banks to priority sectors in order to encourage proper utilization of industrial parks. Accordingly, priority industries operating in industrial parks are able to borrow 70% of their investment from banks (FDRE, 2010). On the other hand, nearly 75% of the resources required to construct the parks come from foreign sources in the form of loans while the remainder is financed domestically. Loans are repaid from

revenue generated through rental of commercial space (pre-built sheds) in industrial parks and from other domestic sources, including taxes on non-priority sectors. This creates pressure on other sectors and could cause a proportional reduction in production in the long run. The problem could be exacerbated if commercial space in industrial parks was not fully occupied. This is because rental income from commercial space as well as from FDI depend upon the rate of utilization of the park.

To our knowledge, little research has been conducted on the impact of industrial policy on the Ethiopian economy using CGE modelling (Berhane, 2013). No research has addressed the possible impact of systemic efforts to allocate investments to priority industries through state-owned industrial parks on growth, poverty, and income inequality in Ethiopia.

This study was designed to address these issues using CGE modelling and to focus on the following research questions: To what extent does allocating resources to industrial parks in order to enhance production by priority activities affect economic growth, poverty, and income inequality? To what extent is production by priority industries within or outside industrial parks affected? To what extent does resource allocation affect the income of households of different socio-economic groups? Our study also applied a new methodology to capture heterogeneities in the growth of income among households in the same group (such as the poor and non-poor household categories) by establishing a relationship between respective growth rates of the average incomes of poor and non-poor households using linear combination.

III. Literature Review

The impetus behind the establishment of industrial parks comes from Alfred Marshal's theory that an agglomeration of small to medium-sized firms speeds up external economies (Belussi & Sedita, 2010). The introduction of industrial parks as a tool to encourage industrialization goes back to 1896 when Trafford Park was built in Manchester, England. Following this, an industrial park was built in Naples in 1904, and Clearing Industrial District followed in Chicago in 1907. Thereafter, the construction of industrial parks began in Asia—mainly in Thailand, Indonesia, Malaysia, and the Philippines. Today, it is estimated that more than 15,000 industrial parks exist in the world (UNIDO, 2012). It was estimated that industrial parks in China accounted for about 22%

of national GDP, 46% of FDI, and 60% of exports and generated in excess of thirty million jobs (Zeng, 2010). In keeping with their particular economic structures, countries have used a variety of incentives and tax holidays to promote their industries and maximize gains from industrial parks and special economic zones, all of which have their own effects on the economy.

Anita (2012) considered four policy shocks on industrialization in New Zealand: a 10% increase in demand for exports; a 10% productivity improvement in large but low-value-added sectors and an identical improvement in small but high-value-added sectors; and a 15% research-and-development tax credit. The result was that increased productivity had a more significant effect when it occurred in larger sectors (agriculture rather than manufacturing), but that the imports used by the sector were as important as the value-added provided by the sector itself. Using CGE modelling, Salarpour and Alijani (2014) explored the economy-wide effect of a reduction in production subsidies in Iran and found that the impact on the mining sector (mineral and oil) was not considerable while the food industry was left vulnerable to shocks and risks. Using a CGE model, Goodman (2003) examined the impact of a one-half-percent increase in the sales tax in Pueblo, Colorado, which was used to create a $1.5 million annual subsidy for capital in the export sector and a land subsidy amounting to $0.5 million. Goodman's results suggest that the regional benefits of such incentives are relatively small; they are largely transferred to new businesses and employees who migrate to the region in response to the incentives. Meanwhile, net benefits to the local population are likely to be negative as is the net impact on the local manufacturing sector. The incentives end up creating a substitution effect because investment is shifted toward the export-oriented manufacturing sectors that are favored for economic development.

Li and Chen (2005) constructed a regional CGE model and applied it to the analysis of the economic impact of the Tainan Science-Based Industrial Park (TSBIP) in Southern Taiwan. Following construction of the park, the power industry and the manufacture of electronics and mechanical equipment had a tremendously positive effect on output, employment, and income. Ziliang, Rod, and Adam (2008) examined productivity spillovers of foreign direct investment using a CGE model and showed that national gross output, value added, and exports increased monotonically following an increase in total factor productivity.

There is, however, limited research on the economy-wide effects—in Africa in general and in Ethiopia in particular—of industrial-resource allocation following the introduction of industrial

parks that attract foreign direct investment and which, in turn, eventually affect total factor productivity.

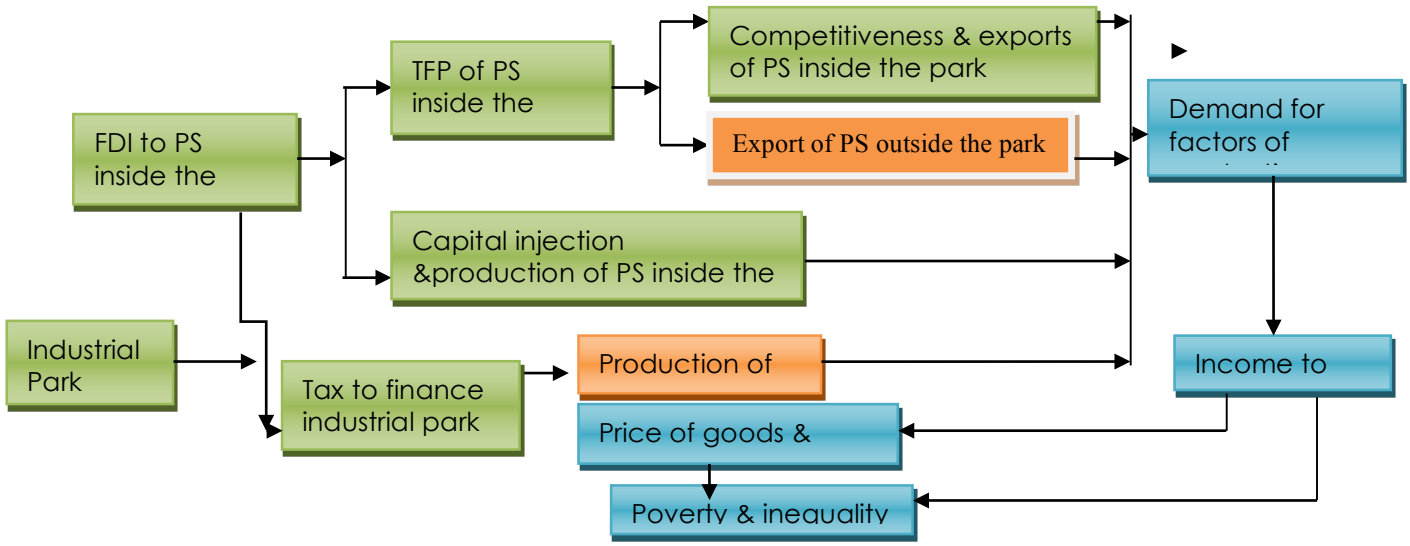
IV. Conceptual Framework

The Ethiopian government has been intensively engaged in the construction of industrial parks whose commercial spaces are mainly rented to foreign investors. The construction of these parks is financed principally through loans. The effect of such investment on the Ethiopian economy is transmitted through two channels. First, the construction of industrial parks attracts foreign direct investment, which injects new capital into priority sectors in the parks and increases their production. FDI is an endogenous variable. The flow of FDI also increases total factor productivity of priority industries operating in the parks, empirical evidence of which is provided by Kokko (1994), Xu (2000), and Yannikkaya (2003). The gain from total factor productivity resulting from FDI enhances the competitiveness of priority industries operating inside the parks compared to those operating outside. This gain in total productivity by "inside" priority sectors reduces both export performance and the production of similar "outside" priority industries, largely because more resources are channeled to "inside" priority sectors than to priority sectors operating outside. The flow of FDI to priority industrial sectors could, therefore, produce a crowding-out effect through reduction of production and exports by "outside" priority industries.

Second, in order to finance the construction of industrial parks that are intended for rental to investors, the government has levied a tax on non-priority sectors in addition to borrowing from the rest of the world. This has increased the price of non-priority industrial goods and ultimately affected production through the reduction of demand. Competitiveness has also decreased in non-priority sectors as compared to priority sectors. The expansion of priority industrial goods has increased the demand for labor and capital. Conversely, the reduction in production by non-priority industries has reduced the demand for a variety of production factors. The cumulative effect of the polarizing influence of industrial parks on production eventually affects overall demand for production factors. The high demand for production factors on the part of priority activities benefits labor-endowed households while the remuneration of priority industries to capital goes to the rest

of the world. Thus, the income effect to households is greater through labor than through capital which, in turn, eventually affects household income. The price effect of taxing non-priority sectors and the income effects of such a shock affect the poverty status of households. The figure below summarizes the idea.

Figure 1: Conceptual Framework



PS: priority sectors; NPS: non-priority sectors; TFP: total factor productivity. Green boxes show an improvement while orange boxes show a reduction. The blue shows mixed (some positive and other negative) effects

V. SAM Documentation and Characterization

5.1. SAM Documentation

The Ethiopian 2010 SAM was adjusted to analyze changes in the economy. The Ethiopian government endorsed a Growth and Transformation Plan that focused on industrial production through the establishment of industrial parks. Seventy-five percent of the cost of creating these parks was to be obtained in the form of loans from the rest of the world while 25% was to come from the government budget (NPC, 2010). The National Planning Commission (NPC) collected information related to the construction costs of and revenues from industrial parks, and industrial-park enterprises were established to construct and monitor industrial parks with the goal of attracting foreign direct investment. To capture this situation, we created a commodity called "industrial park" which is consumed as an intermediate input by priority industries who pay rent to

the industrial-park sector for the use of commercial space. The income collected from the use of commercial space by priority activities (investors) is transferred to the government as income in the form of rent.

In addition, we introduce a special tax to the SAM called the "tax priority," collected from non-priority sectors. This tax is used to finance industrial parks and is thus transferred to government accounts. The revenue from the leasing of commercial spaces (pre-built sheds) in the "industrial parks," which are owned by the state, is transferred to the rest of the world as repayment of loans. The industrial park mainly uses capital goods (the parks with the pre-built sheds), which are subject to annual depreciation.

In addition, the Ethiopian government already allows foreign direct investors to transfer all the profit from their investments to their home economies. The capital account of priority sectors thus pays to the rest of the world rather than to local households or other capital-endowed national economic agents. The account balance is computed after considering the contribution of loans from the rest of the world and the rental income from industrial parks, and the difference is collected from the separate tax account. It is assumed that this tax is levied on non-priority industrial goods because priority industries enjoy a number of incentives, including tax holidays. Hence, the SAM was adjusted to include all these developments as well as production, consumption, and export performance of priority industries within and outside of the parks.

5.2. SAM-Based Characterization of the Ethiopian Industrial Sector

We examined the production characteristics of industrial sectors inside and outside of industrial parks. Indeed, production technology differs slightly between priority sectors inside and outside of industrial parks. Both do share the fact that they intensively use intermediate inputs, however. In relative terms, priority industries outside industrial parks are labor-intensive when compared to priority sectors operating inside. "Inside" priority sectors are relatively more capital-intensive than are similar "outside" sectors (see Table 7). There is also a difference in production characteristics among priority industries. Textile, apparel, and leather are relatively labor-intensive and use more semi-skilled labor. Among the priority sectors, the leather and chemical industries use more capital than do other priority industries (Table 8).

The export intensity of priority industries varies across sectors as well. Ninety-seven percent of food produced is locally supplied while the rest is exported. The leather sector has better export performance than any other; forty-five percent of the sector's total production is exported while the rest is locally supplied. Given that the lion's share of commercial space in industrial parks has been allocated to food processing, textiles, and garment manufacture, the export share of priority industries inside the industrial park has reached as high as 70% for garments and 45% for textiles, though the figures are only 3% and 5%, respectively, for leather and chemicals (Table 10).

The possible impact on household income of industrialization through industrial parks depends upon the sources of income across household categories. Households in Ethiopia receive income from a variety of production factors. From the SAM, the rural non-poor, urban poor, and non-poor households obtained nearly 40% of their income from capital. The rural poor earned only 29% of their income from agricultural labor, 26% from non-agricultural labor, and the rest mainly from land. Urban non-poor households obtained 26% of their income from skilled labor while the figure fell as low as 1% for rural poor and 10% for urban poor. Rural non-poor households obtained 17% of their income from semi-skilled labor.

Table 1: Sources of Household Income

Households	Base value	Agriculture Labor	Skilled labor	Semi skilled	Unskilled Labor	Land	Capital	Govt	Rent
Rural poor	74010.83	0.27	0.01	0.12	0.11	0.19	0.23	0.01	0.05
Rural non-poor	261369.9	0.14	0.04	0.17	0.10	0.10	0.41	0.00	0.04
Urban poor	3829.089	0.00	0.10	0.20	0.23	0.00	0.41	0.00	0.10
Urban non-poor	35554.58	0.00	0.26	0.10	0.10	0.00	0.42	0.00	0.13

Source: The 2015 SAM for Ethiopia.

VI. Model development

We used the PEP 1-t model developed by Decaluwé et al. (2013). This model relies on nested Constant Elasticity of Substitution (CES) production functions and Stone-Geary utility functions. The nested production function is also categorized in two stages: the first applies Leontief technologies to combine intermediate and value added at an aggregate level, and the

second also applies Leontief technologies to combine intermediate inputs with fixed proportion in aggregate intermediate demands. Note that the second stage also uses CES technologies to explain the generation of value added using primary factors of production. The Stone-Geary utility function, on the other hand, considers spending on subsistence consumption. It also imposes a CES function when combining composite commodities from imported and locally produced commodities with the assumption of imperfect substitutability. Moreover, the constant Elasticity of Transformation (CET) function is applied to interactions between local and export demand. As explained in the specifications of the PEP 1-t model, all other behavioral equations are linear (Decaluwé et al., 2013). Given that the construction of industrial parks has its own unique financing characteristics, we included new equations that could capture these features in the model (see Appendix A.).

Commercial space in the parks is intended for foreign investors in priority industries. FDI is thus endogenous to the system (Appendix A) because the amount of foreign investment attracted to the domestic economy depends upon the capacity utilization of the parks, the number of industrial parks constructed, and the extent of occupancy by foreign firms. This is because commercial space in industrial parks may not be rented at full capacity, particularly during early phases. The rate of utilization of the park is expected to increase over time. The rationale for such an assertion is that, as time goes by, more foreign-owned firms will come to the park. Trends in Ethiopia confirm this assumption: rental of pre-built sheds in industrial parks has increased over time. In addition to the rate of capacity utilization, FDI in specific priority activities further depends upon how much of the park is allocated to each industry and the amount each activity pays into the capital account. In addition, FDI has its own indirect effect: more FDI increases total factor productivity of priority activities (see Appendix A).

The model is also designed to examine the poverty implications of policy interventions in which an endogenous poverty line, determined by basic consumer needs, is introduced (see Ravallion & Bidani, 1994). The basic-needs basket is presumed to be universal across all four household types in the SAM and comprises the food items described in Table 17. These items were identified by Dercon and Krishnan (1998) based on the Ethiopian rural household survey. They are the most-consumed foods in Ethiopia, provide a 2,300-calorie intake, and have been used in poverty analyses in Ethiopia since 1998 (see the list in the Appendix).

Thus, the poverty status of households was measured using the methodology of Foster, Greer, and Thorbecke (1984), which may be written, quite generally, as follows.

$$P_{\alpha} = \frac{1}{N}\sum_{i=1}^{N}\left(\frac{G_i}{z}\right)^{\alpha} \qquad G_i = z - x_i \text{(with Gi = 0 when Xi > z).}$$

where α refers to a sensitivity index to poverty and z is designated as the poverty line, Xi represents the per capita expenditure in the i^{th} person's household, and z is the poverty gap for individual i. Note that, if α is zero, P0 simply measures the headcount index. If α is one, the poverty gap index is P1 and, when α is 2, P2 is the poverty severity index.

The shocks not only affect the level of poverty but also the distribution of income. Different approaches have been used to examine the impact of policy shocks on the income distribution of households in a CGE. The model also applies the approach of Stifel and Thorbecke (2003) and imposes an assumption of neutrality in the distribution of income. This means that intra-group income distributions vary proportionately to the variation in the mean income of the respective groups. That is, if the mean income of group j increases by j percent, then the income of each household in group j increases by j percent. There is, however, heterogeneity across individual households found in the same group in the SAM. For instance, the income of those who are near the poverty line may change more than does the income of households far from the poverty line. To address this issue, Tsehay (2015) used a linear combination and arithmetic approach so that household incomes within the same group changed differently (see Appendix B). We also assumed that the income of each member of the household in each group of households would change by the same rate as did the group's income.

6.1 Model Closure

Considering the economic realities of Ethiopia, the model considers the following closures. Because Ethiopia is a small country, it cannot affect prices on the world market. World prices (both import and export) were therefore fixed in the model. The exchange rate was used as a numeraire (the basis on which relative prices were computed). The current account balance was fixed as well.

Tax rates in Ethiopia are not flexible and are not prone to frequent change. Government spending and tax rates were assumed to be fixed in the model. Because urban unemployment is high in Ethiopia, a 10% unemployment rate was assumed for skilled and semi-skilled labor while full employment was assumed in agricultural labor. Both labor and capital were assumed to be mobile across sectors.

6.2 Simulations

Given the industrial-park trend in Ethiopia, a total of 650 million Birr in loans would need to be borrowed each year to construct the remainder of the planned parks. As previously mentioned, a separate tax on non-priority commodities was created to finance both loans and construction, and the government would need to increase the tax rate by nearly 5%. The following simulations have therefore been considered.

1. Loans for construction of industrial parks totaling 650 million Birr annually for ten years;
2. The tax on non-priority industrial good increases by 5% annually for ten years.

VII. Results

Within existing industrial parks, nearly 60% of space has been allocated to textile production; apparel manufacture, which accounts for 27%, follows. The remainder has been allocated to leather (6%) and chemical production (1%). The textile and garment sectors are more heavily emphasized in the Growth and Transformation Plan, largely because these sectors are labor-intensive and are believed to generate more foreign exchange and employment opportunities for the semi-skilled labor force.

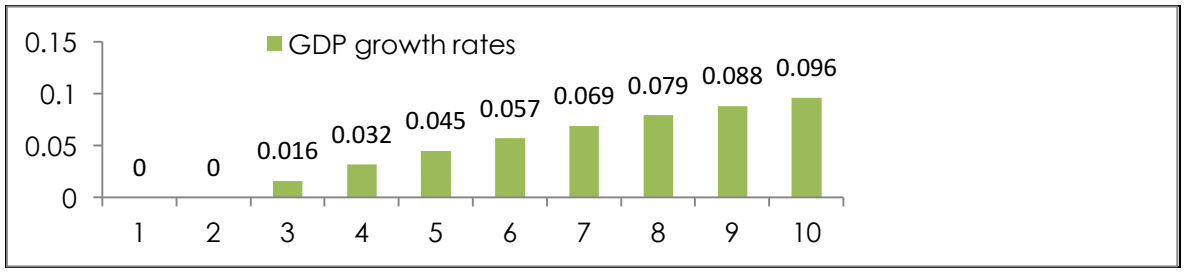
Table 2: Share of Priority Industries in the Industrial Park

Sectors	Share in total
Food processing	0.07
Textiles	0.59
Apparel	0.27
Leather	0.06
Chemicals	0.01

Source: Authors' calculations.

The construction of industrial parks in Ethiopia has had a positive impact on the growth of the economy. As indicated above, industrial parks attract foreign direct investment to selected export-oriented industrial sectors, and this systemic injection of resources into the economy increases production of priority industrial goods and promotes additional exports, leading to economic growth over time. Though growth rates seem small in comparison to Ethiopia's 10% average rate of growth over the last decade, the economic growth brought about by the industrial-parks policy has trended steadily upward and may equal the Ethiopian average growth rate in the next ten years.

Figure 2: Real GDP Growth Rates



Source: Authors' calculations.

Our model took into consideration the fact that, as previously mentioned, occupancy rates in industrial park would initially be low. In response, Ethiopia constructed additional parks so that the growth of industrial parks reached as high as 40.35% in the tenth year. The flow of FDI to priority industrial sectors grew following the opening of more parks and increasing occupancy rates. This ultimately increased production by priority activities, indicating a strong likelihood that production by priority industries would grow steadily over the coming ten years.

Table 3: Growth of Production of Goods by Priority Industries

	BASE	2	3	4	5	6	7	8	9	10
Food processing	(0.00)	(0.53)	3.63	7.51	11.00	14.24	17.27	20.11	22.81	25.37
Textile	0.00	(0.68)	3.04	7.53	10.60	13.40	15.99	18.43	20.74	22.95
Apparel	(0.00)	(1.21)	0.90	3.29	4.95	6.46	7.85	9.16	10.38	11.56
Leather	0.00	13.45	51.25	104.16	139.03	177.50	218.02	258.92	299.16	339.71
Chemicals	(0.00)	(10.47)	26.97	71.54	114.39	159.01	203.96	247.26	287.73	324.34
Industrial park	0.00	(0.01)	5.81	11.43	16.80	21.95	26.87	31.57	36.06	40.35

Source: Authors' calculations.

Because non-priority sectors cannot rent commercial space in industrial parks, their production depends upon the extent to which priority sectors employ their products as intermediate inputs. As a result, growth of production by priority industries could cause an increase in the production of non-priority industrial. Indeed, most of the production of non-priority industrial goods increased although the growth rates in non-priority sectors were extremely small when compared to those of priority industries. Production also decreased in some sectors. Those sectors that have encountered reduction in production are not intensively used as an intermediate input by the priority sectors but do pay taxes (Table 4).

Table 4: Growth of Production by Non-Priority Industries

	Base	2	3	4	5	6	7	8	9	10
Non metal	0.000	0.003	0.029	0.060	0.083	0.103	0.120	0.136	0.150	0.163
Metal	0.000	0.006	0.034	0.068	0.090	0.111	0.130	0.148	0.164	0.178
Machinery	0.000	0.001	0.023	0.050	0.069	0.087	0.105	0.121	0.137	0.151
Vehicles	0.000	0.003	0.019	0.038	0.050	0.061	0.071	0.080	0.089	0.096
Electronics	0.000	0.006	0.027	0.052	0.071	0.089	0.106	0.122	0.137	0.151
Other manuf.	0.000	-0.004	-0.012	-0.018	-0.026	-0.033	-0.040	-0.047	-0.054	-0.060

The effect of investing in industrial parks and renting commercial space to priority industries has had an additional impact on the activities of priority industries. Priority industries may operate both inside and outside industrial parks, but "inside" and "outside" production are treated as different activities in the SAM. Our findings reveal that production by priority sectors inside industrial parks grew more in comparison to similar production outside the parks; in fact, production in similar sectors operating outside the parks decreased. This is because we assumed that the total factor productivity (TFP) of priority industrial goods produced "inside" would be higher than the TFP of priority sectors operating "outside." This result is more or less in line with the findings of Ziliang, Rod, and Adam (2008).

Because production by priority industries is destined for export, the export performance of those industries has increased. What is interesting is that the export performance of similar priority industries operating outside the parks has decreased, indicating that the expansion of industrial parks puts pressure on both the production and exports of "outside" operators and creates a crowding-out effect on domestic firms that operate outside of industrial parks. This effect is associated with higher total factor productivity gains from foreign direct investment in "inside" priority industries whose strong export orientation provides a comparative advantage over similar sectors operating outside the park.

Table 5: Export Performance of Priority Industries Inside and Outside Industrial Parks

	1	2	3	4	5	6	7	8	9	10
Food processing	0.0	(1.45)	(2.02)	(2.69)	(3.30)	(3.88)	(4.41)	(4.92)	(5.40)	(5.84)
Food processing park	0.0	(0.53)	3.63	7.51	11.00	14.24	17.27	20.11	22.81	25.37
Textile	0.0	(1.32)	(2.10)	(3.31)	(4.08)	(4.80)	(5.48)	(6.13)	(6.75)	(7.33)
Textile park	0.0	(0.68)	3.04	7.53	10.60	13.40	15.99	18.43	20.74	22.95
Apparel	0.0	(0.94)	(1.85)	(3.10)	(3.92)	(4.68)	(5.38)	(6.04)	(6.66)	(7.24)
Apparel park	0.0	(1.21)	0.90	3.29	4.95	6.46	7.85	9.16	10.38	11.56
Leather	0.0	(1.87)	(2.78)	(3.43)	(4.51)	(5.57)	(6.58)	(7.56)	(8.51)	(9.39)
Leather park	0.0	13.45	51.25	104.16	139.03	177.50	218.02	258.92	299.16	339.71
Chemical	0.0	(0.60)	(0.89)	(1.33)	(1.94)	(2.63)	(3.37)	(4.13)	(4.88)	(5.60)
Chemical park	0.0	(10.47)	26.97	71.54	114.39	159.01	203.96	247.26	287.73	324.34

Source: Authors' calculations.

An increase in the production of export-oriented priority industrial goods has its own impact on the service and agricultural sectors (Table 6). Production by service and agriculture sectors that are used an intermediate inputs by exporting firms increased, while the production of those not used as inputs decreased. This is because these sectors are taxed to finance the construction of industrial park.

Table 6: Growth of Production in Service and Agricultural Sectors

	1	2	3	4	5	6	7	8	9	10
Main Agriculture crops										
Teff	0	0.002	-0.003	-0.006	-0.008	-0.01	-0.012	-0.014	-0.017	-0.019
Barely		-0.002	-0.005	-0.009	-0.012	-0.016	-0.019	-0.022	-0.026	-0.029
Wheat	0	0.002	0.017	0.029	0.041	0.051	0.06	0.067	0.074	0.08
Maize	0	-0.002	-0.004	-0.008	-0.011	-0.014	-0.017	-0.021	-0.024	-0.028
Sorghum	0	-0.001	-0.003	-0.007	-0.009	-0.012	-0.015	-0.018	-0.021	-0.024
Service										
Water		-0.003	-0.012	-0.019	-0.028	-0.037	-0.045	-0.054	-0.062	-0.070
Trade	0	-0.002	-0.005	-0.005	-0.009	-0.013	-0.017	-0.021	-0.025	-0.029
Hotel	0	-0.002	-0.006	-0.008	-0.013	-0.017	-0.022	-0.027	-0.033	-0.038

Transport	0	0.007	0.029	0.058	0.079	0.098	0.117	0.135	0.152	0.169
Communication	0	0.003	0.016	0.033	0.043	0.053	0.061	0.069	0.076	0.082
Business service	0	0.014	0.05	0.088	0.117	0.145	0.17	0.193	0.214	0.234
Real estate	0	-0.002	-0.009	-0.016	-0.023	-0.031	-0.038	-0.046	-0.053	-0.06
Other service	0	-0.001	-0.007	-0.012	-0.017	-0.022	-0.027	-0.032	-0.037	-0.041

Source: Authors' calculations.

As indicated above, the construction of industrial parks through loans and the taxation of non-priority sectors has had a mixed effect on production across sectors and, in turn, has affected factor remuneration. In particular, the production of non-priority industrial goods has decreased. The remuneration of production factors thus depends upon the combined impact of these two effects. Cumulatively, factor remuneration from both capital and labor to households has increased (Table 12 and Table 13). This means that the increase in production factors from priority activities is greater than the loss from non-priority activities.

Unemployment has been assumed in skilled and semi-skilled labor while full employment has been assumed for rural households. Because the largest share of household income comes from production factors, household income has increased in response to an increase in production by priority industries. The income of rural households has increased more than has the income of urban households, and the income of poor households has increased more than has the income of non-poor households in both rural and urban areas. The industrial-park policy would seem to be pro-poor.

Table 7: Growth of Household Income

	1	2	3	4	5	6	7	8	9	10
Rural poor	(0.00)	1.40	1.14	1.03	0.94	0.86	0.78	0.71	0.65	0.57
Rural non- poor Poor	0.00	1.25	1.01	0.91	0.82	0.74	0.67	0.60	0.54	0.47
Urban poor	0.00	1.15	0.92	0.83	0.74	0.67	0.60	0.54	0.48	0.42
Urban non- poor	0.00	0.99	0.80	0.72	0.65	0.59	0.54	0.49	0.45	0.40

Source: Authors' calculations.

The effect that the construction of industrial parks has on poverty depends also upon the impact that production in industrial parks has on the prices of goods and services. Our results reveal that the prices of basic cereals and the most consumed commodities increased, which ultimately increased poverty. Household incomes increased, which produced an increased demand for commodities and a corresponding increase in prices. Of all commodities, the price of the two most

consumed cereals (teff and wheat) increased most markedly (Table 12).

The poverty line is computed as the sum of expenditures made on the most consumed food items that provide a 2,300-calorie daily diet. Prices of most-consumed commodities increased in the simulation, thereby raising the poverty line because the quantities of these commodities were assumed to remain the same, and any change in commodity prices was accompanied by a step-up in the poverty line (Table 8).

Table 8: Percentage Change in the Poverty Line

Percentage change in the poverty line from base values										
		Percentage change								
Poverty lines	BASE 3630	2 1.06	3 0.90	4 0.86	5 0.82	6 0.78	7 0.75	8 0.73	9 0.71	10 0.68

Source: Authors' calculations.

The effect that the construction of industrial parks has on poverty levels depends upon its impact on the poverty line as well as its effect on household income. Our results show that the effect of the increase in the poverty line was offset by an increase in household income that ultimately reduced poverty levels by a minute figure. The depth and severity of poverty decreased by a small amount as well. Both findings result from the fact that production in industrial parks increased the income of poor households more than it did the income of non-poor households, decreasing the country's income inequality by a very small amount. It is quite possible to conclude that the effect that the industrial-parks policy has on the reduction of poverty is not strong; indeed, it only reduced poverty by 1% over ten years (Tables 15 and 16).

VIII. Conclusion

Our study examined the impact of the construction of industrial parks on growth, poverty, and income inequality in Ethiopia. Commercial space in industrial parks is earmarked for selected industrial activities such as textiles, agro-processing, leather, chemicals, and others, and is mainly intended to attract foreign direct investors. Ethiopia's 2010 SAM was updated to include information related to industrial parks. We employed the PEP dynamic CGE model as well as a new

function that captured the flow of foreign direct investment into selected industrial sectors, which is an endogenous account. In addition, we introduced a rate of capital utilization coupled with a function that endogenized total factor productivity.

Our results reveal that production by priority industries outside industrial parks decreased while production by priority industries inside parks increased significantly. In the meantime, production by service and agricultural sectors that were used by export-oriented priority industries increased while others decreased. The net effect did induce economic growth in the Ethiopian economy because of the inflows of FDI that followed the creation of more industrial parks. The positive effects of the industrial-parks policy will be secured if commercial space in the industrial parks is rented fully. Otherwise, the parks cannot attract FDI. If commercial space in industrial parks is not fully rented out, that missing rental income exerts pressure to increase taxes in order to pay down loans, exacerbating poverty in the long run by making goods and services more expensive but having little impact on household income. The industrial-parks policy produced crowding-out effects as it reduced production by similar industrial activities outside the park. A strategy to allow knowledge to flow from priority "inside" industries to similar "outside" activities should be launched.

Our results further indicate that remuneration to production factors increased as did income in all household income categories. The increase in the income of poor households was higher than the increase in non-poor households, ultimately reducing poverty in both rural and urban areas. The severity of poverty and poverty gaps did decrease, but they did so by very little. Income inequality also decreased by a negligible amount. When the policy is gauged from the point of view of its impact on poverty and income inequality, it is not a major success: it was estimated to reduce poverty by less than 0.5% over the coming ten years.

References

Alder, S., Shao, L., and Zilibotti, F. (2016). Economic Reforms and Industrial Policy in a Panel of Chinese cities. Journal of Economic Growth, 21(4): 305-349.

Anita, K. (2012). Economy-Wide Impacts of Industry Policy. New Zealand Treasury Working Paper 12/05.

Belussi, F. and Sedita, S. R. (2010) Localized and Distance Learning in Industrial Districts. In: Belussi, F. and Sammarra, A., Eds., Business Networks in Clusters and Industrial Districts: The Governance of the Global Value Chain. New York: Routledge, 27.

Berhane, B. (2013). The Effect of Improved Productivity of the Manufacturing Industries on the Ethiopian Economy: A Computable General Equilibrium (CGE) Analysis, Ethiopian Journal of Economics Vol. XXII No 1, April 2013

Chen, Chunlai (2014). The Impact of FDI on China's Economic Growth. In L. Song, R. Garnaut, and C. Fang, Eds., Deepening Reform for China's Long-Term Growth and Development. Canberra, Australia: ANU (Australian National University) Press.

CSA (Central Statistics Authority) (2014). Key Findings on the 2014 Urban Employment Unemployment Survey. Addis Ababa, Ethiopia.

Decaluwé, B., Lemelin, A., Robichaud, V., and Maisonnave, H. (2013). PEP 1-t the PEP standard single-country, recursive dynamic CGE model, Partnership for Economic Policy (PEP)

Decaluwé, B., Savard, L., and Thorbecke, E. (2005). General Equilibrium Approach for Poverty Analysis: With an Application to Cameroon. African Development Review, 17(2), 213-243.

Dercon, S. and Krishnan, T. (1998), Changes in Poverty in Rural Ethiopia 1989-1995: Measurement, Robustness Test and Decomposition. Working Paper Series 98-7. Oxford, England: Centre for the Study of African Economies.

Farole, Thomas and Gokhan, Akinci (2011). Special Economic Zones, Progress, Emerging Challenges and Future Directions. Washington, DC: The World Bank.

FDRE (2010). Growth and transformation plan of Ethiopia. Ministry of Finance and Economic Development, Addis Ababa, Ethiopia.

Foster, J., Greer, J., and Thorbecke, E. (1984). A Class of Decomposable Poverty Measures. Econometrica 52(3), 761-65.

Goodman, D. J. (2003). Are Economic Development Incentives Worth it? A Computable General Equilibrium Analysis of Pueblo, Colorado's Efforts to Attract Business. The Journal of Regional Analysis and Policy, 33, 43-56

Jenkins, M., Esquivel, G. and Larraain, B. (1998). Export processing zones in Central America. Harvard Institute for International Development, Development Discussion paper No. 646. Cambridge: MA: Harvard Institute of International Development.

Kokko, A. (1994). Technology, market characteristics, and spillovers. Journal of Development Economics, 43(2), 279-293.

Li, Chun-Chu and Chen, Chia-Yon (2005). The Development of a Computable General Equilibrium Model of the Economic Impact of a Science-Based Industrial Park in Taiwan. International

Journal of Management, 22(4), 677.

Mihretu, Mamo Esmelealem and Llobet, Gabriela (2017). Looking Beyond the Horizon: A case study of PVH's commitment to Ethiopia's Hawassa industrial park. Washington, DC: World Bank Group. Retrieved from http://documents.worldbank.org/curated/en/163511499673766520/A-case-study-of-PVH-s-commitment-to-Ethiopia-s-Hawassa-industrial-park.

Miyagiwa, J. (1986). A reconsideration of the welfare economics of a free-trade zone, Journal of International Economics, Volume 21, Issues 3-4, November 1986, Pages 337-350

NPC (National Plan Commission of Ethiopia) (2015). Growth and transformation plan of Ethiopia II. Addis Ababa, Ethiopia.

Puga, D. (2010). The Magnitude and Causes of Agglomeration Economies. Journal of Regional Science 50(1), 203-219.

Ramos, J. M. and Sazanami, H. (1991). Industrial Estates and Regional Development in Selected Asian Countries. Nagoya: Japan: United Nations Centre for Regional Development and NIDA Publications..

Ravallion, M. and Bidani, B. (1994). How Robust Is a Poverty Profile? The World Bank Economic Review, 8(1), 75-102.

Salarpour, M. and Alijani, F. (2014) Production Subsidies Elimination on Iranian Economy (Applying CGE Model). Iranian Economic Review, 18(1), 65-80.

Siba, E., Söderbom, M., Bigsten, A., and Gebreeyesus, M. (2012). Enterprise Agglomeration, Output Prices and Physical Productivity: Firm level Evidence from Ethiopia. Unpublished manuscript: University of Gothenburg.

Stifel, D. and Thorbecke. E. (2003). A dual-dual CGE model of an archetype African economy: trade reform, migration and poverty. Journal of Policy Modeling 25, 207-235.

Tsehay, Solomon (2015). Effect of Trade Liberalization on Poverty, Income Inequality and the Ethiopian Economy: A CGE Modelling Approach. Weikersheim, Germany: Margraf Publisher.

UNDP (United Nations Development Programme) (2017). Growing Manufacturing Industry in Ethiopia: Case Study. Available at http://www.et.undp.org/content/dam/ethiopia/docs/Understanding%20African%20experiences%20in%20formulating%20and%20implementing%20plans%20for%20emergence%20Growing%20Manufacturing%20Industry.pdf.

UNIDO (United Nations Industrial Development Organization) (1962). The Physical Planning of Industrial Estates. Department of Economics and Social Affairs. New York, NY.

UNIDO (United Nations Industrial Development Organization) (2012). Europe and Central Asia Regional Conference on Industrial Parks as a tool to foster local industrial development. Baku, Azerbaijan.

UNIDO (United Nations Industrial Development Organization) (2015). Economic Zones in the ASEAN: Industrial Parks, Special Economic Zones, Eco Industrial Parks, Innovation Districts As Strategies for Industrial Competitiveness. UNIDO Country Office in Vietnam. Hanoi,

Vietnam. Available from https://www.unido.org/sites/default/files/2015-08/UCO_Viet_Nam_Study_FINAL_0.pdf.

Wang, J. (2013). The Economic Impact of Special Economic Zones: Evidence from Chinese Municipalities. Journal of Development Economics, 101, 133-47.

Xu, B. (2000). Multinational enterprises, technology diffusion, and host country productivity growth. Journal of Development Economics, 62(2), 77-493.

Yannikkaya, H. (2003). Trade openness and economic growth: A cross-country empirical investigation. Journal of Development Economics, 72(1), 57-89.

Zeng, D. (2010). Building Engines for Growth and Competitiveness in China: Experience with Special Economic Zones & Industrial Clusters. Washington, DC: World Bank.

Ziliang, D., Rod, F., and Adam, B. (2008). Productivity spillover of foreign direct investment: A computational general equilibrium model. Paper Presented at the 7th GEP Post Graduate Conference, Leverhulme Center for Research on Globalisation and Economic Policy, Nottingham, United Kingdom.

Appendices

1. The Capital Equation

As mentioned, the amount of capital injected into industrial parks increased according to the amount of loan debt they took on each year. This was made possible by increasing the capital stock of the activities in industrial parks. The capital equation of industrial parks is presented as follows:

$$KD_{k,j3,t} = KD_{k,j3,t-1}(1 - \delta_{K,j3}) + IND_{k,j3,t} + \left(\frac{CapIP_{k,j3,t}}{PK\_pri_t}\right)$$

where J3 stands for industrial-park activity and CapIP refers to the capital injected into industrial parks from the amount of loan debt they take on each year.

A logistic function of time that lies between 0 and 1 could capture capital underutilization of the industrial park, $CapUt_t$. The function is given a value of 1 over time so that a full rate of capital utilization is ensured and gives a value of 0.5 at the start of operations. This is borne out in the Ethiopian context in which parks are nearly 50% occupied at the start of operation. The logistic specification of capacity utilization is given below, with time as a variable:

$$CapUt_t = \frac{e^{u_t}}{e^{u_t} + 1}$$

The flow of foreign direct investment is based on the following rationalization. The space available in a park is distributed to foreign direct investors who invest in production in priority industries according to the share of each priority industry in total Ethiopian industrial parks in operation, θ_{j2}. The flow of FDI also depends upon the occupation rate of the industrial park, which is the rate of capital utilization of the park, $CapUt_t$. The type of capital that is affected by FDI is the capital employed in the priority industries, which is designated as "capitalprio" in the model. The initial capital output ratio, φ_{j2}, of the priority industry is another factor determining FDI.

$$FDI_{k,j2,t} = CapUt_t \varphi_{j2} \theta_{j2}$$

where J2 stands for priority industries and $\varphi_{j2} = \frac{KD0_{capitalprio,j2}}{XST0_{j2}}$.

It is clear that activity in industrial parks increases FDI, and capital in the motion equation of capital of the priority activity will increase by the amount of FDI that the sector attracts. The capital-motion equation of priority industries is thus given by the following expression:

$$KD_{k,j2,t} = KD_{k,j2,t-1}(1 - \delta_{K,j2}) + IND_{k,j2,t} + \left(\frac{FDI_{k,j2,t}}{PK\_pri_t}\right)$$

To capture the effect of FDI on the growth of total factor productivity of priority industries, we assumed that the growth of foreign direct investment guided the growth of total factor productivity. Puga (2010) explained that geographic proximity played a key role in skills acquisition, noting that one of the benefits of clustering was that it facilitated learning and thereby increased total factor productivity. In the case of Ethiopia, firms in industrial parks are clustered so that they can share with and learn from each other. We assumed that this phenomenon would tend to increase total factor productivity as per the growth of FDI.

$$GTFP_{j3,t} = TFP_{t-1}\left[\frac{FDI_{k,t}}{FDI_{k,t-1}}\right]^{\eta}$$

with η representing the elasticity of TFP to FDI set at 0.02.

2. Micro-Simulation

The poverty line tends to change with changes in the endogenously determined prices of goods. Consequently, the poverty line is defined as follows:

z ● $\sum P_i X_i$

where z_i is the poverty line and X_i is the bundles of goods indicated in Table 1. Given that the number of bundles of goods and services remains the same in future years, the poverty line changes only because of changes in the prices of the basic bundles of goods. In addition, changes in nominal income are compared to changes in the nominal value of the poverty line.

The extended approach treated the effects of heterogeneities on the household income of the same group by defining a relationship between the growth rates in average income of poor and non-poor households. In the 2010 SAM, both rural and urban households were classified as poor and non-poor.[3] Thus, the growth rate from the CGE models showed the growth rate of

[3] For household details, see Section 1.4.

average income (the fifth quintile), provided that the incomes of both poor and non-poor households were assumed to be normally distributed across their respective means. In order to link the effect of policy shocks to the microdata, the microdata of poor and non-poor households were divided into ten parts. By assuming a linear combination of the average growth rates in the income of poor and non-poor households in each group, the growth rate of the income equivalent of the poverty line was computed. The weights of the linear combination were computed from the respective distances from the poverty line of the mean income of the poor $(ympi)$ and non-poor households $(ymnpi)$. The relative distance from the poverty line of the respective poor and non-poor households was used as a weight to compute the growth rate of the poverty line.

$$g_{zi} = \frac{(z_i - y_{mp})}{(y_{mnpi} - y_{mpi})} g_{ypi} + \frac{(y_{mnpi} - z_i)}{(y_{mnpi} - y_{mpi})} g_{npyi}$$

where gzi was the growth rate of the poverty line while $gypi$ and $gnypi$ were the growth rates of poor and non-poor households in each household group as defined in the 2010 Ethiopian SAM, where gzi was the growth rate of the poverty line, $s1$ was the difference between the mean income of the poor households and the poverty line, and $s2$ was the difference between the mean income of the non-poor household and the poverty line. S represented the sum of s1 and s2. In terms of quintiles, the growth rate in the poverty line shows the growth rates of the ten quintiles of poor households and the growth rate of the first quintile for non-poor households. As growth rates across quintiles increased or decreased arithmetically, the difference in growth rates among consecutive quintiles remained the same. This suggests that the growth rate across quintiles follows a pattern of arithmetic progression. Therefore, the difference in each series of the progressions could be computed by simultaneously solving the arithmetic progression of the fifth and tenth quintile of non-poor households, and the fifth quintile and the tenth quintile of poor households. The difference in the growth rate in each consecutive series of poor and non-poor households was thus given by

$$d_p = \frac{(g_z - g_{yp})}{5}$$

$$d_{np} = \frac{(g_{npy5} - g_z)}{5}$$

These two values allowed us to compute the growth rates of income in each quintile of both

the poor and non-poor households using arithmetic progression, presented as follows:

$g_i \bullet g_o$ [illegible] id_p

where d shows the values computed above and i indicates the quintile. Based on this system, income inequality is computed using a Gini Coefficient and the level of poverty is computed using FGT.

Table 9: Factors of Production (Inside and Outside of the Park)

	Inside the Park	Outside the Park
Labor	0.066	0.191
Capital	0.386	0.081
Intermediate input	0.547	0.728
Total value (base)	2,333	18278.86

Table 10: Share of Export and Local Supply (Outside of the Park)

	Food	Textile	Apparel	Leather	Chemical
Export	0.03	0.21	0.15	0.45	0.20
Local supply	0.97	0.79	0.85	0.55	0.80
Base value	6664.7	4605	1169.35	2696.948	3143.35

Table 11: Factors of production (Inside and Outside of the Park)

Description	Food	Food (OT)	Textiles	Textiles (OT)	Clothe	Clothe (OT)	Leather	Leather (OT)	Chemicals	Chemicals (OT)	Industrial park
Skilled labor	0.00	0.01	0.004	0.004	0.003	0.003	0.012	0.012	0.000	0.039	0.102
Semi labor	0.54	0.54	0.74	0.74	0.831	0.831	0.535	0.535	0.329	0.316	0.000
Unskilled	0.10	0.01	0.011	0.011	0.025	0.025	0.029	0.029	0.212	0.204	0.000
Capital	0.36	0.35	0.250	0.25	0.14	0.14	0.43	0.43	0.46	0.441	0.90
Base value	2.7	1472.61	44.89	2113	21.20	557.33	0.352	467.137	0.237	355.76	987.09

Table 12: Export Performance (Inside and Outside of the Park)

	Base value	Inside the Park	Outside the Park
Food	276.94	0.35	0.65
Textile	1741.8	0.45	0.55
Cloth	582.04	0.70	0.30
Leather	1281.8	0.05	0.95
Chemical	657.7	0.03	0.97

Table 13: Price Change in the Most-Consumed Commodities

Year	2	3	4	5	6	7	8	9	10
Teff	2.42	1.98	1.82	1.67	1.53	1.40	1.29	1.18	1.05
Barley	1.71	1.39	1.27	1.16	1.05	0.96	0.88	0.80	0.70
Wheat	1.02	0.83	0.76	0.69	0.63	0.58	0.52	0.48	0.42
Maize	1.71	1.39	1.26	1.14	1.04	0.94	0.86	0.77	0.68
Sorghum	1.73	1.40	1.27	1.15	1.04	0.94	0.85	0.77	0.67
Pulse	1.56	1.27	1.16	1.05	0.96	0.87	0.80	0.72	0.64
Milk	1.69	1.31	1.14	0.99	0.86	0.75	0.65	0.56	0.46
Coffee	1.44	1.18	1.08	0.99	0.91	0.83	0.76	0.69	0.61

Sugar	1.51	1.23	1.13	1.03	0.95	0.86	0.79	0.72	0.63
Vegetables	1.73	1.41	1.28	1.16	1.05	0.95	0.87	0.78	0.69
Enset	1.66	1.34	1.21	1.10	1.00	0.90	0.81	0.73	0.64
Food processing	0.97	0.79	0.72	0.66	0.60	0.55	0.50	0.45	0.40

Table 14: Growth of Capital Remuneration to Households

	1	2	3	4	5	6	7	8	9	10
Rural poor	0.00	1.28	1.04	0.94	0.86	0.78	0.71	0.65	0.59	0.52
Rural non-poor	0.00	1.19	0.95	0.86	0.77	0.69	0.62	0.56	0.50	0.44
Urban poor	0.00	1.12	0.89	0.79	0.70	0.63	0.56	0.49	0.44	0.37
Urban non-poor	0.00	1.12	0.89	0.79	0.70	0.63	0.56	0.49	0.44	0.37

Table 15: Growth of Labor Remuneration To Households

	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Rural poor	(0.00)	1.53	1.25	1.14	1.04	0.95	0.86	0.79	0.72	0.63
Rural non-poor	0.00	1.33	1.08	0.98	0.89	0.80	0.73	0.66	0.60	0.52
Urban poor	0.00	1.19	0.96	0.87	0.78	0.71	0.64	0.58	0.52	0.46
Urban non-poor	0.00	0.84	0.70	0.65	0.60	0.56	0.52	0.49	0.46	0.42

Table 16: Poverty Index

	YEAR	2	3	4	5	6	7	8	9	10
Poverty head count (*P0*)	BASE									
Urban	0.26	0.25801	0.25773	0.25653	0.25210	0.25150	0.25142	0.25062	0.25051	0.25041
Rural	0.33	0.32972	0.32890	0.32651	0.32430	0.32113	0.32091	0.32073	0.32062	0.320691
Depth (P1)										
Urban	0.07340	0.07242	0.07241	0.07234	0.07231	0.07229	0.07227	0.07224	0.07221	0.072190
Rural	0.08936	0.08858	0.08857	0.08841	0.08810	0.08810	0.08809	0.08803	0.08802	0.088011
Severity (P2)										
Urban	0.03	0.02925	0.02917	0.02915	0.02912	0.02907	0.02905	0.02903	0.02901	0.029008
Rural	0.0363	0.03586	0.03560	0.03525	0.03521	0.03515	0.03514	0.03513	0.03510	0.035010

Source: Authors' calculations.

Table 17: GINI Index

	YEAR BASE	2	3	4	5	6	7	8	9	10
Urban	0.39896	0.39532	0.39322	0.39115	0.39078	0.38738	0.38540	0.38342	0.38244	0.38146
Rural	0.28667	0.28428	0.28331	0.28312	0.28033	0.27834	0.27635	0.27536	0.27437	0.27408

Source: Authors' calculations.

Table 17: Food Items Used for Poverty Lines

Food items	Amount	Unit
Teff	1.70	kg
Barley	4.85	kg
Wheat	3.15	kg
Maize	4.48	kg
Sorghum	2.67	kg
Horse beans	1.29	kg
Cow peas	0.23	Kg
Chickpeas	0.69	Kg
Milk	0.55	liters
Coffee	0.10	Kg
Sugar	0.10	Kg
Salt	0.70	Kg
Oil	0.15	Kg
Potatoes	1.51	Kg
Enset	0.19	Kg
Onions	0.20	Kg
Cabbage	0.38	Kg

Source: Dercon and Krishnan (1998). Diet of 2300 Kcal per day per adult, using diet of the poorer half of the sample.