Impact of industrial policy on the regional economy in Ethiopia:A computable general equilibrium analysis

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Abstract

This work is to examine the impacts of industrial policy on the regional economy in Ethiopia. This study would support industrial policy as a base for industrialization and economic growth in developing countries if the industries functioned at their full capacity. The paper opines that the laissez-faire industrial policy, which has been advocated by advanced countries as a good policy for economic growth, is not the appropriate strategy for Ethiopia. The computable general equilibrium models results indicate that the industrial policy has a positive impact on the components of the regional economy. In particular, the result indicates that the simulation 2 would have a significant impact on agro-processing industries' demand for agricultural and related commodities, agro-processed commodities, other manufactured and industrial commodities. Capital stock injections into the regional economy significantly enhance the output of other manufacturing and industries by about 63% when they work under capacity. If they worked at their full capacity, industrial policy would significantly raise the output of other manufacturing and industries by about 122%. The study suggests a combination of incentives with disciplines approach to develop industries and enable industries to realize their full capacity.

Keywords: CGE Models; Industrial Policy; Impacts;Regional Economy

1 Introduction

Government intervention has intensively been debated under neo-classical and structuralists schools of thought. The neo-classical economists argue in favor of market mechanism for allocation of resources.Whilethe structuralistssupport government intervention in allocating the resources, which takes into consideration industry in general and manufacturing in particular as a base for economic growth. The structuralists advocate infant industry protection to promoteindustrialization(Meier 1987, Lall 1992, 1994, 2001, Weiss 1990), increasedomestic producers' price;enlargeeconomies of scales and increase the volumeof export (Weiss 1990,Itoh et al. 1991,Todaro 1994). In addition to these, reasons for industrial policy are to create externalities and complementarity, andresolve coordination failures.

All of today's developed countries used tariff protection and subsidies to develop their industries when they were in catching-up positions. Chang (2010) recommends the developing countries to use industrial policy in accordance with their development strategy to promote industrialization and economic growth. Other scholars also recommend government to use industrial policies as a shock to bring about changes in the economic structure (e.g., Ghatak and Roberts 1997, Cohen 2007). On other hand, advanced countries often force developing countries to pursue free trade policy and laissez-faire industrial policy to stimulate economic growth (Chang 2010).

Neo-classical economists believe that East Asian countries have achieved faster economic growth than Latin American countries. The former used market-friendly approach, orthodox adjustment policies, internal and external liberalization and outward orientation strategy. They also adopted neutral incentives between domestic and foreign investors, moderate

interventionand exploitation of static comparative advantage to bring about faster changes in economic growth (Lall 1992, 1994, 2001, Stiglitz 1996).

The later achieved the slower economic growth because they used import-substituting industrialization, quantitative restrictions, debt-driven demand expansion policies and currency overvaluations. In particular, the import substitution strategies are inversely associated with the industrial development and export promotion (Meier 1987).Rodrik (2000) argued that the slower economic growth is associated with poor institutions rather than industrial policy.Industrial policies in developing countries do not work since the governments do not have perfect information to make right decisions, do not have financial capability to provide adequate incentives and do not have abilities to control rent-seeking behaviors (Chang 1994, Lall 1992, 1994, 2001; Itoh et al. 1991, Stiglitz 1996). Therefore, the governments could not achieve their targets and could not pick the winners (Pack andSaggi 2006).

In the case of Africa, industrial policy was not successful (Deepak 1983, Krueger 1993, Robinson 2009) because of the lack of industrial policy formulation and implementation abilities and the lack of willingness of political power (UNCTAD 2007). Following Ghatak and Roberts (1997), Kim and Cho (2006), it is found to be necessary to appraise the direction of the state intervention impact on the regional economy (Leeuw and Vaessen 2009). So far, the impact of manufacturing industry on the economy of a country is estimated by Libanio (2006),Cororaton and Orden (2008) in both advanced and less advanced economies. They measured the impacts of manufacturing industry on the economicdevelopment of a country using Computable General Equilibrium (CGE) models. Similarly, the impact of improved productivity of the manufacturing industry on the Ethiopian economy is studied by

Bethelhem(2012). In particular, there are no empirical studies conducted which uncover the impacts of industrial policy on regional economy.

Therefore, the examination of the impacts of industrial policy on regional economy is necessary for several reasons. The study provides pioneering evidence on the impacts of industrial policy on the regional economy. Regional economic model is developed to examine the industrial policy impacts as well as to provide quantitative information with particular focus on the components of the regional economy such as the outputs, factors of production, household incomes and household consumptions. Laissez-faire industrial policy has been increasingly questioned by heterodox economists. It, therefore, offers evidence on the debate regarding the role of states versus markets in the economy. It is fundamental to industrial policy approach reform in the developing countries.It adds new knowledge to the existing empirical knowledge by analyzing the impacts of industrial policy on the regional economy.

2 Research Methodology

2.1 Source of Data forBuilding SAM and Value Added Estimation Methods

In this study, data from surveys of Central Statistical Agency of Ethiopia (CSA), Ministry of Finance and Economic Development (MoFED),Oromia Finance and Economic Development Bureau (OFEDB) and other institutions in 2010/11 are used to buildOromia regional SAM.

Dataused in this study arethe outputs andpricesof agriculture,the outputs and pricesof industries andtheoutputsand pricesof services. Data also include the intermediate input used in each sector, the quantity of capital and labor supplied to industrial sector,the urban and rural households' income, consumption and expenditure, private and government savings and investment, government revenues and expendituresand the row.

The estimates of GVA are set by following the production approach (i.e. Gross Value Output (GVO) less Intermediate Input Cost (IC)). This approach involvesthe estimation ofthe value of outputs at current prices and the corresponding value of intermediate inputs at purchasers' prices. We use the direct method to measure both value of gross crop outputs and IC of crop production. The gross value of crop outputis equal toaverage price timesquantity of crop outputsold in cash or consumed at home. TheIC is equal to10% of GVO(MoFED 2010).The IC involves the costs of fertilizers, the costs of seeds, the costs of pesticides, the costs of insecticides and other costs (agricultural services, power, utilities, etc.) which are equated to be 10 % ofGVO (MoFED 2010).Gross Value Added (GVA) is equal to the GVO minus IC.Annual per capita consumption of forest products is used to estimate GVO which is (population) * (annual per person quantity consumption). The IC is assumed to be 25% of GVO is applied with the proper approximation (MoFED 2010).

…This study uses the production approach (i.e. the GVO less IC) to estimate GVA. The GVO is measured by multiplying current price times outputwhereasthe value of intermediate inputs is estimated with purchasers' prices. For instance, the direct method is used to estimate the value of gross livestock output. The GVO equals the value of livestock off-take plus value of livestock byproducts plus value of the change in stocksminus the value of imports. The IC is equal tothe value of feed cost plus the value of health cost plus the value of breeding cost plus other costs. Current price estimates (expenditure approach) imputations using annual per capita consumption of fishing products. The IC of fishingis equated to be 17% of GVO (MoFED 2010).

The intermediate inputs used by industries include purchase the value of all items of raw materials, their components, packing materials, fuels, lubricants, electricity, water, etc.

consumed; costs of non-industrial services received from other concerns; the costs of material consumed for repairs and maintenances of fixed assets including the cost of work done by others to the fixed assets. The surveys are also conducted to collect data from each manufacturing sector to estimate the amount and value of each intermediate input used in the production process to produce a unit of product.

In this study, the industrial outputs primarilyinvolve: 1) the value of sales of all products and byproducts,2) the value of industrial and non‐industrial services are given to others,3) value of fixed assets produced by the industries for its own use,4) the net balance of goods sold in the same condition as purchased and 5) the net changes between the beginning and the end of the year of finished products.

CSA collects data from 14,038 sample households in 703 enumeration areas in 2010/11 fiscal year. Data on the household income, consumption and expenditure are collected at random from 2,301 urban and rural households in 192 enumeration areas with the help of interview schedules and objective methods. The surveys are carried out from 4 July to 3 August 2010 in the first round and from 4 February to 5 March 2011 in the second round.

The per capita consumption expenditure of household is calculated using household income consumption expenditure of CSA (2010/11). To estimate regional urban and rural household income, consumption and expenditure, we multiply benchmark per-capita income,consumption and expenditure by the total population of Oromia region. An adjustment in market price is made to calculate own consumption. The quantity held on to by the producers for their own consumption is valued at producers'prices,andthe quantity of purchased foods isestimated at the averagerural and urban retail prices.

Gross capital formation is measured by the value of gross fixed capital formation and change

in stocks (inventories) during the accounting year. The various CSA surveys provide capital expenditure by establishments and types of assets for private enterprises construction, large and medium manufacturingand small scale cottage industry surveys.To estimate gross capital formation, wedirectly use the public and private actual expenditures aremade on the purchase of machineryand equipment. Thegross capital formation equalsthe total costs of construction (construction GVO) plusthe costs of machinery and equipment plus the costs of transport equipment.

Service data on the hotel, education, health, transport, distributive servicesand others are gathered from CSA and OFEDB database. The method of estimation of the gross value added of the health sector and the government schools is the same as the public administration.The non-governmental school gross value added is derived as the respective number of students multiplied by the annual average tuition fee minus intermediate input. Estimation of gross value added of all banks and micro finance institutions and credit associations at the national level at current prices. Based on the profit and loss statements of all banks, calculate the actual service charges i.e. exchange commission, other commission, service charge/other income and the imputed service charge.

The same procedure has been followed to estimate micro finance and credit cooperatives. Then from the gross value output minus the cost of intermediate input(general expenses of all the banks minus depreciation and other expenses, which are not directly related with the current year service of the bank) to arrive at the gross value added of the bank and micro finance institutions at current prices.

Data on government revenues and expenditures are obtained from MoFED andOFEDB database. The capital budget and the recurrent budget are used to estimate government

expenditure. The final consumption expenditure of the government is computed as the sum of all expenditures on the outputs (consumption goods and services) of non-market and market producers, less any receipts from sales of goods and services. Government final consumption expenditure equals total government output less goods and services sold on the market less own-account capital formation plus goods and services purchased to be provided for free to the population. The national import per capitais used to estimate the total regional imported goods since the import data at the regional level is not completely available. The national imported goods per capita is estimated by dividing total national import by the total Ethiopian population and multiplying national imported goods per capita by the total population of Oromia region to estimate total Oromia region imported goods. As well, the study applies the residual approach to calculate the quantity of exported goods from the Oromiaregion to the rest of the world. In this approach, export equals GDP plus import minus consumption minus government expenditure minus investment.

Table 1Thelist of collected data to build SAM

N	**Production activities**	**Commodities**	**Price**
1	Cereals production	Agriculture commodities	»
2	Other crops and livestock production	Agro-processed commodities	»
3	Industries production	Industrial commodities	»
4	Services production	Services commodities	
	Factors of production		
1	Labor for each production	1 Private	
2	Capital for each production	2 Government	
	Households' income and consumption	**Rest of the world**	
1	Rural households' income	1 Import	
2	Urban households' income	2 Export	
3	Rural households' consumption of commodities		
4	Urban households' consumption of commodities		
	Government's consumption		
1	Consumption of each commodities		
	Government revenues		
1	Direct taxes		
2	Indirect taxes		

2.2 Methodology for Developing the SAM

We designed the accounts for our SAM on the basis of the accounts of the SAM developed by the International Food Policy Research Institute (IFPRI). The regional economic interactions are built on the basis of the accounts such as production, commodity, productionfactors, institutional agents, savings-investment and the rest of the world. CGE models feature four activities including agriculture sector and non-agricultural sector (three activities), two factors of production (labor, capital), two groups of households (urban, rural), government taxes (direct, indirect taxes), savings-investment and the rest of the world (import, export).

The production account is disaggregated into agriculture activities, agro-processing activities,other manufacturing and industry activitiesand service activities (Table 2). We disaggregate the commodity account into agricultural commodities, agro-processed commodities, other manufactured and industrial commodities and service commodities. We disaggregate factors of production into labor and capital, and households into urban and rural households. The government accountis disaggregated into direct and indirect tax account (Table 2).

Table 2 2010 SAM for economy of Oromia region with 4 sectors (in Billions of Ethiopia Birr)

Accounts		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
AGRA	1																	
AGROA	2																	
OMIA	3																	

SA	4																	
AGRC	5																	
AGROC	6																	
OMIC	7																	
SC	8																	
LAB	9																	
CAP	10																	
RHH	11																	
UHH	12																	
Dtax	13																	
Idtax	14																	
S-I	15																	
Row	16																	
Total	17																	

Note: AGRA= Agricultural activities, AGROA= Agro-processing activities, OMIA= Manufacturing and other industry activities, SA=Service activities, AGRC = Agricultural commodities, AGROC = Agro-processed commodities, OMIC = Other manufactured and industrial commodities, SC = Service commodities, LAB= Labor, CAP =Capital, Dtax= Direct tax, Idtax = Indirect tax, S-I= Savings-investment, Row= Rest of the World, Total = Column and row total.

2.3 Computable general equilibrium (CGE) Models

This study used Oromia regional SAM as a basis for calibration of CGE models (Pyatt and Round 1979). Following Ghatakand Roberts (1997), CGE modelsare the best suited to

estimate the impacts of industrial policy on the regional economy. It symbolizes an example of the modern the best technique to estimate economy-wide impacts of policy changes within the economy. As well, CGE analysis is extensively employed to estimate the impacts of policy shocks on economy in the theoretically consistent way. CGE models overcome shortcomings of the SAM-based model's assumptions such as fixed prices, linear relationships and unitary elasticities.

CGE models'arguments are on the basis of standard general equilibrium assumptions for a developing country (Dervis et al. 1989). On the supply side, each activity uses a combination of fixed capital with labor factor to maximize its profit. The distributions of incomes across different agents are associated with their initial factor endowments. On the demand side, each agent maximizes its utility on the basis of current product prices.

The inputs to calibration procedure are the SAM database, which reports an initial equilibrium in the regional economy. The CGE models convert all initial quantities and prices into one unit currency by normalizing (Burfisher 2011). Measurement units for all factors are determined by setting up all factor prices equal to one. Likewise, the prices of domestic goods and imports, the world price of exports and the exchange rate are all set equal to one in the base year.

The CGE models illustrate only relative price, which is homogeneous of degree zero in all prices. This price serves a model's a numeraire, a benchmark value which is chosen by fixing an aggregate price equals to one. The weights of such aggregate price can be the initial values of production in each sector. The numeraire is treated as the Consumer Price Index (CPI), which is a fixed variable. It is calculated as the weighted sum of initial consumer prices, where weights are each goods base budget share in the consumption basket. Producer Price Index (DPI) can also be used as an alternative for the numeraire. Either the CPI or DPI is equal to the

numeraire since the model is homogenous of degree zero in all prices (Burfisher 2011). A doubling of the value of the numeraire would double all prices, but it leaves all real quantities unchanged. As a remark, all simulated price and income changes should be interpreted as changes in relation to the numeraire price index (Lofgren et al. 2002).Regional CGE models used in this study is based on IFPRI standard model of Lofgen et al. (2002).

3. Results

3.1 Model Based Scenarios of Alternative Industrial Policy

This study takes into account capital stocks as a proxy variable for industrial policy in order to evaluate its impact on the regional economy. However, the injected capital stocks into the regional economy are working under capacity.We developed two scenarios. The first scenario assumesthat the injected capital stocks into the regional economy are working under capacity. The second scenario assumes that the injected capital stocks into the regional economy are working at their full capacity. In order to assess the impacts of industrial policy on the regional economy, the consequences of two alternative scenarios are compared against the base scenario. These scenarios are alternative counterfactual simulations, which are developed on the basis of CSA and OFEDB database in which 2010 is chosen as the base year. The injected capital stocks into the regional economy have been working under capacity from 2010 to 2016. Therefore, the counterfactual simulations are alternative realities, which have been happening (shock) and yielding positive or negative outcomes to the components of the regional economy. The study compares the counterfactual scenarios with the baseline scenario. The outcomes of scenarios indicate that simulation 2 would have a significant impact on demand of agro-processing industries for agricultural and related commodities, agro-processed commodities, other manufactured and industrial commodities (Table 3). This implies that

industrial policy has relatively the highest positive impact on backward linkages of this sector with other sectors (Table 3). For instance, simulation 1 increases the demand of agro-processing activities for agricultural and related commodities (about 33%),while simulation 2 significantly raises the same sector's demand for the same commodities (about 54%) (Table 3).

Table 3The impact of industrial policy on intermediate input use

Intermediate input demand by activities	The capital stock injections into the regional economy				
	Without IP	ACU	FCU	Increase over base (%)	
	Base	SIM1	SIM2	SIM1%	SIM2%
AGRA for AGRC	5.14	5.50	5.70^{ns}	7.00	10.89
AGROA for AGRC	5.11	6.79	7.86**	32.87	53.82
SA for AGRC	3.90	4.59	5.10^{ns}	17.69	30.77
AGRA for AGROC	1.30	1.37	1.41^{ns}	5.38	8.46
AGROA for AGROC	3.55	4.85	5.70**	36.62	60.56
SA for AGROC	3.63	4.27	4.74^{ns}	17.63	30.58
AGRA for OMIC	1.54	1.63	1.68^{ns}	5.84	9.09
AGROA for OMIC	1.08	1.46	1.70**	35.19	57.41
OMIA for OMIC	5.49	8.95	12.21**	63.02	122.40
SA for OMIC	3.27	3.84	4.27^{ns}	17.43	30.58
AGRA for SC	2.47	2.64	2.72^{ns}	6.88	10.12
AGROA for SC	4.59	6.24	7.35**	35.95	60.13
OMIA for SC	3.75	6.12	8.34**	63.20	122.40
SA for SC	12.36	14.54	16.12^{ns}	17.64	30.42

Source: Own computation result based on Oromia regional SAM.

Note: ** is statistically significant at 5% level, ns=non significant at 5% level. IP=Industrial Policy, Base=Benchmark (without industrial policy), ACU= Actual Capacity Utilization, FCU= Full Capacity Utilization, SIM1= Simulation 1, SIM2= Simulation 2, SIM1% stands for 52% of a quantity of capital stock injections into the regional economy, SIM2% stands for 94% of the quantity of capital stock injections into the regional economy. AGRA= Agricultural activities, AGROA= Agro-processing activities, OMIA= Manufacturing and other industry activities, SA=Service activities, AGRC = Agricultural and related commodities, AGROC = Agro-processed commodities, OMIC = Other manufactured and industrial commodities, SC = Service commodities.

The industrial policy would increase the output of agricultural and related sectors by about 10% if the capital stocks functioned at their full capacity (Table 4). Capital stock injections into the regional economy significantly enhance the output of other manufacturing and industries by about 63% when they work under capacity. If they worked at their full capacity, industrial policy would also significantly raise the output of other manufacturing and industries by 122%, which has the greatest impact on the output of this sector as compared with other sectors.

Table 4|The impact of industrial policy on the regional output

Regional output	The capital stock injections into the regional economy				
	Without IP	ACU	FCU	Increase over base (%)	
	Base	SIM1	SIM2	SIM1%	SIM2%
AGRC	102.29	108.38	112.38^{ns}	6.46	9.86
AGROC	21.90	29.54	34.55**	34.89	57.76
OMIC	15.99	26.08**	35.56**	63.10	122.39
SC	54.33	63.89	71.01^{ns}	17.60	30.70

Source: Own computation result based on Oromia regional SAM.

Note: ** is statistically significant at 5% level, ns=non significant at 5% level.

The difference in various sectors' domestic outputs due to simulation 1 and 2 reflect the existence of higher capital-output ratio. This implies that capital accumulation by itself may not be a basis for a higher economic growth. This result supports the notion that if capital accumulation is associated with optimal productivity that will serve as a basis for economic growth in line with what had been recommended by Solow (1956). However, the capital formation may be very difficult under *laissez-faire* industrial policy in the developing countries because investors could not direct their cash flow into various manufacturing sectors. East Asian countries adopted both incentives and disciplines at a time which were the base for a higher economic growth rate as compared with Oromia region like Latin American countries which used incentives alone to promote economic growth as observed by Amsden (2001), Hausmann and Rodrick (2003).

The CGE models results portray that both simulations do slightly decrease agricultural and related and service sectors' labor demand which is negatively associated with the industrial policy because injected capital stocks into agricultural sector substitutes for labor, as well as agricultural labor moves from agricultural sector to non-agricultural sector. However, these simulations increase the remaining sectors' labor demand (Table 5). For instance, change in the capital stocks would cause labor demand of agro-processing industries to grow up by 6%. Industrial policy raises the other manufacturing and industries oflabor demand by 33%(Table 5). As well, the factories construction phase enhances the real return for unskilled labor in the region. During the industrial policy operation, the real return of unskilled labor increases in the region.

Table5The impact of industrial policy on the production factor demand

Production factor	The capital stock injections into the regional economy				
	Without IP	ACU	FCU	Increase over base (%)	
Labor demand by activity	Base	SIM1	SIM2	SIM1%	SIM2%
AGRA	77.21	76.85	76.41^{ns}	-0.47	-1.03
AGROA	2.16	2.26	2.29^{ns}	4.46	6.02
OMIA	1.03	1.21	1.37^{ns}	17.47	33.01
SA	15.93	15.63	15.70^{ns}	-1.88	-1.44

Source: Own computation result based on Oromia regional SAM.

Note: ** is statistically significant at 5% level, ns=non significant at 5% level. Negative signal stands for negative impact on labor demand, AGRA= Agricultural and related activities, AGROA= Agro-processing industry activities, OMIA= Other manufacturing and industry activities and SA=Services activities.

With higher benefits in terms of job creation, both simulations would have the positive impact on the rural and urban households' incomes. For example, an increase in the capital stocks makes both rural and urban households' labor and capital incomes to increase by 17% and 23%(Table 6).

Table6The impacts of industrial policy on households' incomes

Households' incomes from factors	The capital stock injections into the regional economy				
	Without IP	ACU	FCU	Increase over base	
	Base	SIM1	SIM2	SIM1%	SIM2%

Rural households' income from labor	82.67	91.56	96.96 ns	10.75	17.29
Rural households' income from capital	13.99	15.83	17.14 ns	13.15	22.52
Urban households' income from labor	14.89	16.49	17.46 ns	10.74	17.26
Urban households' income from capital	24.16	27.36	29.61 ns	13.25	22.56
Rural households' income	100.60	111.30	118.00 ns	10.64	17.40
Urban households' income	46.84	51.58	54.74 ns	10.12	17.63

Source: Own computation result based on Oromia regional SAM.

Note: ** is statistically significant at 5% level, ns=non significant at 5% level.

The region enjoys a great improvement in household consumption expenditures of commodities due to the industrial policy. The increased consumption expenditures in the region significantly improve production of different sectors because more consumption requires more production. In general, a change in capital stocks increases rural and urban households' consumption of various commodities. The study found that simulation 1 and 2 have more impact on urban households' consumption of all commodities as compared with rural households' consumption of the same commodities. In particular, the industrial policy operation enhances rural households' consumption of agro-processed commodities by about 34% and significantly increases urban households' consumption of agro-processed commodities by 62% (Table 7). In terms of percentage increment as compared with the base scenario, urban households' consumption of agro-processed commodities is the highest among other commodities due to implementation of the industrial policy (Table 7).

Table 7The impact of industrial policy on household consumption of commodities

Households' consumption of commodities	The capital stock injections into the regional economy				
	Without IP	ACU	FCU	Increase over base (%)	
	Base	SIM1	SIM2	SIM1%	SIM2%
RHHs' consumption of AGRC	55.14	58.28	60.04 ns	5.62	8.89
UHHs' consumption of AGRC	8.76	10.58	11.65 ns	20.78	32.99
RHHs' consumption of AGROC	7.50	9.05	10.03 ns	20.78	33.73
UHHs' consumption of AGROC	3.45	4.73	5.590**	37.10	62.03
RHHs' consumption of OMIC	24.42	28.21	30.99 ns	15.52	26.90
UHHs' consumption of OMIC	7.17	9.43	11.04**	31.52	53.97
RHHs' consumption of SC	9.84	11.60	12.73 ns	17.89	29.37
UHH's consumption of SC	4.17	5.60	6.55**	34.29	57.07

Source: Own computation result based on Oromia regional SAM.

Note: ** is statistically significant at 5% level, ns=Non significant at 5% level.

Note: RHH= Rural household, UHH= Urban household.

The result indicates that both simulations have positive impact on all export commodities except agricultural export commodities. The simulation results reveal that agricultural export commodities, which consist of mainly primary commodities, decrease by about 8% whereas the processed wheat export increases by 63% due to an increase in capital stock (Table 8). The shocks would have the highest impact on export of other manufacturing and industrial products among all export commodities. These shocks appear to decrease the quantity of export commodities in the agricultural sector.

Table8The impact of industrial policy on export commodities

Export commodities	The capital stock injections into the regional economy				
	Without IP	ACU	FCU	Increase over base (%)	
	Base	SIM1	SIM2	SIM1%	SIM2%
AGRC	22.84	22.06	21.08 ^{ns}	-3.42	-7.71
WC	1.79	2.01	2.08 ^{ns}	12.29	16.20
AGROC	4.73	7.48	9.29**	58.14	96.40
WPIC	0.59	0.83	0.96**	40.68	62.71
OMIC	4.32	8.87	13.49**	105.32	212.27

Source: Own computation result based on Oromia regional SAM.

Note: ** is statistically significant at 5% level, ns= Non significant at 5% level. Negative sign indicates negative impact on agricultural commodity export.

3.2 Sensitivity Analysis

Chebyshev's theorem is used to calculate confidence intervals which are used to test the sensitivity of the CGE models results of each variable. Since Chebyshev's theorem does not need the assumptionsabout the shape of probability distribution of the results of each variable. Systematic sensitivity analysis is used to test the sensitivity of each variable to changes in capital stocks. The 95% confidence level around the estimated model results are derived following the procedure outlined by Burfisher (2011). The significant changes at 5% level of significance were observed between the base scenario and scenario 2 for some components of the regional economy such as demand of agro-processing industries for the agricultural and related commodities, the agro-processed commodities (Table 3). The outputs of the agro-

processing industries and other manufacturing and industries significantly reacted to change in capital stock at 5% level of significance (Table 4). The result indicates that urban households' consumption of the agro-processed commodities, other manufactured and industrial commodities and services commodities significantly responded to change in capital stock at 5% level of significance (Table 7). It is possible to surmise that shocks yield robust model results.

Table 9Systematic sensitivity analysis of the impact of change in capital stock on intermediate input use by activities

Intermediate input use	X	SD	K	X+KSD	X-KSD
AGRA for AGRC	5.14^{ns}	0.52	4.47	6.71	2.03
AGROA for AGRC	5.11**	0.40	4.47	5.12	1.54
SA for AGRC	3.90^{ns}	0.47	4.47	5.99	1.81
AGRA for AGROC	1.30^{ns}	0.16	4.47	2.00	0.60
AGROA for AGROC	3.55**	0.43	4.47	5.45	1.65
SA for AGROC	3.63^{ns}	0.44	4.47	5.58	1.68
AGRA for OMIC	1.54^{ns}	0.17	4.47	2.23	0.67
AGROA for OMIC	1.08**	0.11	4.47	1.38	0.42
OMIA for OMIC	5.9^{ns}	0.66	4.47	8.43	2.55
SA for OMIC	3.27**	0.39	4.47	5.02	1.52
AGRA for SC	2.49^{ns}	0.26	4.47	3.36	1.02
AGROA for SC	4.59**	0.54	4.47	6.96	2.10
OMIA for SC	3.75**	0.45	4.47	5.76	1.74

SA for SC	12.36 ns	1.48	4.47	18.99	5.73

Note: Chebyshev's theorem considers the fraction $\left(1-\frac{1}{k^2}\right)$ of any set of observations lies within K standard deviations of the mean. X= Mean, SD= Standard deviation, K=Standard deviation multiplier, X+KSD=Upper limit, X-KSD=Lower limit.

Table 10Systematic sensitivity analysis of the impact of change in capital stock on outputs of activities

Domestic output	X	SD	K	X+KSD	X-KSD
AGRC	102.29 ns	11.13	4.47	142.55	43.01
AGROC	21.90**	2.25	4.47	28.87	8.71
OMIC	15.99**	1.92	4.47	24.57	7.41
SC	54.33 ns	6.52	4.47	83.47	25.19

Source: Own computation (2017).

Table 1Systematic sensitivity analysis of the impact of change in capital stock on labor demand by activities

Labor demand	X	SD	K	X+KSD	X-KSD
AGRA	70.71 ns	8.49	4.47	108.64	32.78
AGROA	2.02 ns	0.24	4.47	3.10	0.94
OMIA	1.03 ns	0.12	4.47	1.58	0.48
SA	15.93 ns	1.91	4.47	24.47	7.39

Source: Own computation (2017).

Table 12Systematic sensitivity analysis of the impact of change in capital stock on households' income

Income	X	SD	K	X+KSD	X-KSD
RHHs' income from labor	82.67 ns	9.92	4.47	127.01	38.33
RHHs' income from capital	13.99 ns	1.68	4.47	21.49	6.49
UHHs' income from labor	14.89	1.79	4.47	22.88	6.90
UHHs' income from capital	24.16	2.90	4.47	37.12	11.20
RHHs' income	100.6	12.07	4.47	154.56	46.64
UHHs' income	46.84	5.62	4.47	71.96	21.72

Source: Own computation (2017).

Table 13Systematic sensitivity analysis of the impact of change in capital stock on households' consumption

	X	SD	K	X+KSD	X-KSD
RHHs' consumption of AGRC	51.23	6.15	4.47	78.71	23.75
UHHs' consumption of AGRC	7.05	0.85	4.47	10.83	3.27
RHHs' consumption of AGROC	6.63	0.80	4.47	10.19	3.07
UHHs' consumption of AGROC	2.58**	0.31	4.47	3.96	1.20
RHHs' consumption of OMIC	24.42	2.93	4.47	37.52	11.32
UHHs' consumption of OMIC	7.17**	0.86	4.47	11.02	3.32
RHHs' consumption of SC	9.84	1.18	4.47	15.12	4.56
UHHs' consumption of SC	4.17**	0.50	4.47	6.41	1.93

Source: Own computation (2017).

4Conclusions

The finding would support industrial policy as a base for industrialization and economic growth in developing countries if the industries operated at their full capacity. Thegovernment should work on second scenario to bring about significant and positive changes in intermediate input demand,the output of all sectors, labor demand and urban and rural households' income and consumption. If the government does not give attention to the productivity of industries, under capacity utilization of capital stocks and the higher capital-output ratio will continue in the industriesof Oromia region.This is a strong empirical evidence to justify the need to reform industrial policy and enable industries to realize their full capacity utilization which are highly associated with intermediate input use, labor demand, outputs, rural and urban households' income and consumption. The study suggests a combination of incentives with disciplines approach to promote industrialization andenable industries to realize their full capacity utilization.

Availability of data and material

The data and material are available. But we do not want to share data because we will use data for other purposes.

Competing interests

The authors declare that they have no competing interests.

Funding

The sources of funding were Haramaya University, WolaitaSodo University and Ministry of Education.

Authors' contributions

First, Zewdie developed the methodology and carried out the calculation and generated the quantitative results with assistance of other authors. He also carried out data collection and constructed SAM. All authors wrote manuscript, interpreted the results and drew the conclusions. All authors read and approved the final manuscript.

Acknowledgements

I would like to extend my deepest gratitude to WolaitaSodo University, Haramaya University and Ministry of Education for the financial support. My thanks also go to other people who helped us with this study.

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