Public expenditure for water facility and road transport infrastructure in Ethiopia: A comparison of impacts using an economy-wide model

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Research Article

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Abstract

Background: Ethiopian government is investing in a wide range of pro-poor sectors but the economic effects of public investment widely vary across sectors. With a limited public resource, public investment across sectors has to be prioritized based on their potential socio-economic contributions and/or economy-wide benefits. Therefore, the objective of this study is to compare and explore the economy-wide returns of public expenditure on water facility and energy technology (such as improved cooking stoves) on the one hand and public expenditure on road infrastructure on the other hand.

Methods: The source of data for this study is the 2005/06 updated Social Accounting Matrix (SAM) of Ethiopia. The analysis applies the STAGE Computable General Equilibrium (CGE) model developed by McDonald (2007). This study analyses two policy scenarios; the first scenario is an increase in the total factor productivity (TFP) of water fetching and firewood collection activities due to public investment in water facility and improved cooking stoves and the second scenario is a decrease in the trade and transport margins due to public investment in road transport infrastructure. For ensuring the comparability of the return of public expenditure, the same amount of public capital is invested in both scenarios.

Results: The simulation outcome indicates that public investment in water facility and improved stoves results relatively higher domestic production in most sectors, larger household consumption, improved household welfare and improve in the major macroeconomic indicators (GDP, absorption, private consumption, and total domestic production) as compared to public investment in road transport infrastructure.

Conclusion: It is conducive to explore the potential economic contribution of public expenditure across the different pro-poor sectors before launching public investment in any specific sector. This will ensure limited public budgets are appropriately invested in the sector that can bring relatively highest economic-wide benefits to the wider society.

1. Introduction

Public expenditure is the main instrument for achieving broad based economic growth and reducing poverty in developing countries. The total public expenditure as a percentage of GDP is rising for most African countries from 1996 to 2004 (Akanbi & Schoeman, 2010). In most Sub-Saharan Africa (SSA) countries public expenditure is composed of spending on agriculture, education, health, infrastructure (road, water, sanitation and electricity), defence and social protection (Mogues et al., 2012). For example, in 2005 the largest shares of public expenditure spent on health, education, and defence. Various types of public expenditures differently contribute to economic growth. For instance, public expending on agriculture and health strongly promotes economic growth in Africa (Fan & Rao, 2003; Fan et al., 2009).

In most developing countries, aggregate public expenditure outweighs its revenue and hence public investment is constrained by a lack of financial resources (Allen & Qaim, 2012). For example, the average fiscal deficit was 5% of GDP in 2017 and debt levels continue to increase for most Sub-Saharan African countries (International Monetary Fund, 2018). Because of public budget constraints in developing countries, government is unable to allocate sufficient budget in multiple sectors. Since governments have limited financial capacity for adequately investing in all economic sectors simultaneously, public investment has to be prioritized across the different pro-poor sectors.

In other words, with a limited public resource, public investment across sectors has to be evaluated based on their potential socio-economic contributions, economic growth, and/or economy-wide benefits. Similar to most developing countries, the government of Ethiopia invest in multiples of pro-poor sectors (such as education, health, social protection, water and sanitation, etc). However, the government has the budget constraints that hinder adequate public investment in all pro-poor sectors. For instance, the fiscal deficit of Ethiopia in 2013/14 was 2% of GDP (World Bank, 2016).

Therefore, the objective of this study is to examine and compare the economy-wide return of public expenditure on water facility and energy technology (such as improved cooking stoves) on the one hand and public expenditure on road infrastructure on the other hand.

This paper is organized as follows: the second section highlights the literature review, the third section reports the data and method, section four provides the policy simulations and model closure rules, section five describe the results and discussion of the study, section six provides the sensitivity of model results and the conclusion of the study reported in last section.

2. Literature Review

One of the main goals of public expenditure is achieving efficiency and equity. Public expenditure is efficient if maximum output is gained through the allocation of spending across the different uses. On the other hand, equity of public expenditure refers to the distribution of the benefits from public spending. For example, if the non-poor (who constitute the smaller share of the populations than the poor) gains disproportionate shares of benefits, public spending can be considered as inequitable or not pro-poor. Public expenditure can be sourced from domestic and foreign sources. Domestic sources include taxes, fees and charges, sales of goods and services and investment. On the other hand, foreign sources include loans and grants (Briceño-G et al., 2008; Deolalikar, 2008).

Public expenditure generally categorized into productive and unproductive expenditure. These classifications are based on their impact on economic growth; productive expenditure has positively affects economic growth whereas unproductive expenditure has insignificant or neutral impact on economic growth (Adefeso, 2016). Furthermore, public expenditure can also be classified as current expenditure and capital expenditure. Current public expenditure is non-productive spending such as wages and salaries, maintenance and operation. Larger amount of recurrent spending may indicate the prevalence of operational inefficiencies and hence resources are diverting away from productive investment. On the other hand, capital spending is productive spending such as investment. Most public investment in developing countries goes to unproductive sectors such as military or defence which have little economic benefits for the majority of populations (Briceño-G et al.,2008).

In Africa, a different level of public investment is allocated in various sectors. For example, the majority of SSA countries annually spend around 6–12% of their gross domestic product (GDP) for infrastructure development such as ICT, roads, power, water and sanitations (Briceño-G et al., 2008). African government signed various commitments for increasing public expenditure in different sectors in various years. For instance, in 2001 Abuja Declaration that calls for spending 15% of the national budget on health sector, Maputo declaration which demands spending 10% of national budget on agriculture in 2003 and spending 1% of GDP on science and technology in 2007 (Benin, 2015).

Government invest in ranges of sectors such as agriculture, road, energy, water, education, health, etc. However, the relative returns of various types of public investment differ across sectors. In other words, these different types of public expenditure variously contribute to poverty reduction, economic growth, and enhancing rural welfare. For example, empirical evidence by Mogues et al. 2008 indicates that the public investment in road infrastructure has relatively higher return than investment in agriculture, health and education in Ethiopia.

3. Data And Method

3.1 Data source

The source of data for this study is the 2005/06 updated social accounting matrix (SAM) of Ethiopia (Mosa, 2018). A SAM is a comprehensive and consistent data framework that describes the interdependence that prevails within a socio-economic system. A SAM represents the circular flow of the economy that captures transactions and transfers between all economic agents in the system for a particular period, usually for a year (Pyatt & Round, 1985; Round, 2003). SAMs are generally built by incorporating the following account groups: activities, commodities, factors, institutions (household, enterprise and government), savings and investment, and the rest of the world.

The SAM used for this study comprises 199 activities and 194 commodities, 34 household groups, 31 factors of production (10 labor categories and 21 other factors), 17 tax accounts, trade and transport margins, savings and investment, stock changes, enterprises, government and rest of the world. Therefore, the updated SAM comprises 481 row and column accounts. The balanced macro SAM of Ethiopia is depicted in Table 1. For example, trade and transport margin in the SAM is 23.09 billion birr, which is the cost of supplying marketed commodities (Table 1). The total commodity supply in the market is 315.5 billion worth of birr (Table 1), out of this 235.3 billion birr (81.9%) sourced from domestic supply of commodities, 47 billion birr (14.9%) derived from commodities imported from the rest of world, and the rest 10.1 billion birr (3.2%) is a tax payment.

Table 1
Macro SAM of Ethiopia (in billions Ethiopian birr)

Accounts	Commodity	Margin	Activity	Factor	Household	Gov	Tax	Enterprise	Investment	Row	Total
Commodity		23.09	64.99		162.79	15.91			31.89	16.77	315.45
Margin	23.09										23.09
Activity	235.25										235.25
Factor			170.26							0.45	170.7
Household				163.80		1.55				15.79	181.14
Gov							14.15	5.37		3.73	23.26
Tax	10.10				2.73			1.32			14.15
Enterprise				6.69							6.69
Investment					15.53	5.37			3.72	10.99	35.61
Row	47.01			0.21	0.09	0.43					47.74
Total	315.45	23.09	235.25	170.7	181.14	23.26	14.15	6.69	35.61	47.74	
Source: Mosa (2018)											

3.2 Method

This study uses Computable General Equilibrium (CGE) model. CGE model is a system of equations that illustrate the economy as whole and the interaction among its parts. In other words, CGE models describes the basic general equilibrium macroeconomic interaction among the pattern of demand, incomes of various groups, the balance of payment and structure of production in multi-sectors (Burfisher, 2011; Thissen, 1998).

The analysis applies the STAGE CGE model developed by McDonald (2007). STAGE is a single-country CGE model and it is implemented in General Algebraic Modeling System (GAMS). It is a SAM based model. The SAM helps to distinguish economic actors, and it provides the database for calibration of the model. Behavioral relationships in the STAGE model comprise linear and non-linear relationships. Households choose a bundle of commodities to consume in order to maximize Stone-Geary utility function. The commodities consumed by households are a composite of imported and locally produced commodities. The constant elasticity of substitution (CES) is used to combine imported and locally produced commodities by assuming that these commodities are imperfect substitutes using the Armington assumption (Armington, 1969).

4. Policy Simulations And Model Closure Rules

4.1 Policy simulations

The following two policy scenarios are conducted:

Scenario one: Increasing the total factor productivity (TFP) of water fetching and firewood collection

The construction of drinking water infrastructure around the vicinity of households and providing access to energy technology (such as improved cooking stoves) potentially reduce the time spent on water fetching and firewood collection. This would improve the efficiency of collecting water and firewood as less labor would be required to collect the same amount of water and firewood. This study analyzes the scenario of an increase in the TFP of water fetching and firewood collection activities due to improved access to drinking water and energy efficient technology (such as improved cooking stoves).

Empirical evidence conducted in Ethiopia such as Cook et al. (2013) and Gaia Consulting Oy and Ethio Resource Group (2012) indicates that improved access to water facility and cooking stoves can reduce the time spent for collecting water and firewood by at least 50%. Therefore, based on these evidences, in this scenario the TFP of both water fetching and firewood collection is increased by 50% due to improved access to water infrastructure and energy technology. For calculating the effect of government expenditure on reducing water fetching and firewood collection time, the budget estimated for achieving universal water access as defined by the United Nation Millennium Development Goals (UNMDG) are used in this study. According to World Bank (2016), the budget required for achieving universal access to water (hence reducing water fetching time by 50%) in Ethiopia is 16.7 billion birr. The country already spent 13.6 billion birr in the year 2012. Therefore, it is assumed that an extra 3.1 (16.7–13.6) billion birr investment is needed for achieving universal water access (World Bank, 2016). In the updated SAM, the total government savings are 5.4 billion birr. It is also assumed that the required capital is generated through a 57.4% $\left(\frac{3.1 billionbirr * 100\%}{5.4 billionbirr}\right)$ increase in government savings. Therefore, government savings exogenously increase by 57.4% for financing water and energy infrastructure.

Scenario two: Reducing trade and transport margin

Investment in road infrastructure expands the size of the road transport network and increases road density in the country. Increased road density facilitates transportation services that reduce the costs of transportation and hence transport margins. Road and transport margin is reduced using the elasticity of the transport margin with respect to road density estimated by Schürenberg-Frosch (2014) and based on the growth rate of road network density during the period of the Growth and Transformation Plan of Ethiopia (GTP) (2010–2015). Based on data from African countries, Schürenberg-Frosch (2014) estimated the elasticity of transport margins with respect to road density to be 0.19 and 0.16 for agricultural and non-agricultural commodities, respectively i.e. a 1% increases in road density results in a transport margin decline by 0.19% for agricultural commodities and by 0.16% for non-agricultural commodities.

During the GTP period, 7.4 billion birr was invested for road construction annually and on average the road density annually expanded by 22% (Ministry of Finance and Economic Development, 2014). For ensuring the comparability of the return of public expenditure in the two scenarios, the same quantity of public expenditure is applied in both scenarios. Therefore, 3.1 billion birr is invested for improving road infrastructure and hence the increased government savings from scenario one is applied to this scenario. The 3.1 billion birr road investment would expand road density by 9.2% $\left[\frac{22\%*3.1\text{billionbirr}}{7.4\text{billionbirr}}\right]$(based on the GTP period’s road density growth and road budget).

Based on the above mentioned elasticity of transport margins with respect to road density, this is equivalent to a 1.7% (9.2%*0.19) reduction of trade and transport margins for agricultural commodities and a 1.5% (9.2%*0.16) reduction for non-agricultural commodities. Therefore, this scenario is a 1.7% reduction of trade and transport margins for agricultural commodities and 1.5% reduction of trade and transport margins for non-agricultural commodities. The policy scenarios are summarized in Table 2. In each scenario, government spends 3.1 billion birr worth of investment.

Table 2
Summaries of policy scenarios

Scenarios	Policy shocks
Scenario one	50% increase in TFP of water fetching and firewood collection
Scenario two	1.7% decrease in trade and transport margins for agricultural commodities
	1.5% decrease in trade and transport margins for non-agricultural commodities
Source: Author’s compilations	

4.2 Model closure rules

The exchange rate is flexible while the external balance is fixed in the model. The exchange rate is flexible to produce the fixed level of foreign savings for funding water facility, improved stoves and road infrastructure. Investment driven savings is chosen where investment is fixed and savings are flexible in the model such that savings adjust for the saving-investment balance. Government raises funds through income tax replacement. Government savings are fixed and income tax rates are endogenously adjusted to produce a fixed level of government savings for financing the construction of water, energy efficient technology and road infrastructure. The consumer price index (CPI) is chosen as a numeraire. Furthermore, factor supplies are fixed in the model and in order to enable the mobility of water fetcher and firewood collectors across different sectors, perfect factor mobility is assumed in the model.

5. Results And Discussions

The study examines the impact on domestic production, household consumption, domestic prices, household welfare and major macroeconomic indicators.

5.1 Effect on domestic production

Table 3 depicts the change in domestic production because of increased TFP of water fetching and firewood collection activities and reduction of trade and transport margins. Domestic production increases in both scenarios. Specifically, production of water fetching on average increases by 18.9% and firewood collection on average increases by 18.8% due to enhanced TFP in the first scenario. Labor freed from water fetching and firewood collection is reallocated to agricultural, industry and services and stimulates production in the destination sector. Production of agriculture, industry and services on average increases by 0.5%, 1.8% and 0.1%, respectively in the first scenario.

The production of leisure increases by 2.4% in the first scenario, which is relatively greater than other sectors such as agriculture, industry, and services. This happens because there was less or no time left for leisure activities when household collects water and firewood from the distant sources and therefore, the freed labor prefers to enjoy leisure and hence more labors are reallocated to leisure. On the other hand, less trade and transport margins encourage larger supply of commodities to the market, and enhance domestic production. Production of agriculture, industry, service, water fetching, firewood collection and leisure increases by 0.1%, 0.3%, 0.8%, 12.5%, 12.5% and 1.6%, respectively in the second scenario. Since trade and transport margins are higher for non-agricultural commodities relative to agricultural commodities, the reduction of margins provides bigger incentives for non-agricultural production. For instance, industrial and service production increases by a larger proportion relative to other sectors in the second scenario.

Table 3
Simulated changes (percentage) in domestic production by sectors

Sector	Scenario one	Scenario two
Agricultural	0.54	0.09
Industry	1.77	0.26
Service	0.13	0.78
Water fetching	18.89	12.53
Firewood collection	18.84	12.47
Leisure	2.37	1.64

Source: Author’s computation based on model results

5.2 Effect on domestic consumption

The labor reallocated to other sectors enhances domestic production (Table 3) and at the same time results in higher income for households. The freed labor from fetching water and firewood and subsequently reallocated to other sectors brings extra income to the households which increases household consumption demand (QCD). The extra income results an upward shift in household’s consumption demand. Table 4 describes the percentage change (weighted) in QCD. The QCD increases for all commodities in the first scenario. Specifically, the QCD for HPHC (home production for home consumption) food, HPHC non-food, market food and market non-food commodities increase by 0.7%, 3.9%, 0.3% and 0.9%, respectively in the first scenario. Since water fetching and firewood commodities are categorized under HPHC non-food, the consumption of these commodities are higher relative to other commodities in the first scenario.

On the other hand, lower trade and transport margins makes marketed commodities relatively cheaper and hence household consumption increases. Household demand for marketed commodities increases in the second scenario: by 0.2% for market food and by 1% for market non-food commodities. Trade and transport margins constitute a higher share of the cost of marketed non-food commodities in comparison to marketed food commodities. Therefore, due to less trade and transport margins, consumption of marketed non-food commodities increases more compared to marketed food commodities.

Table 4
Simulated changes (percentage) in household consumption demand (QCD)

Commodities	Scenario one	Scenario two
HPHC food	0.73	0.25
HPHC non-food	3.97	0.58
Market food	0.25	0.16
Market non-food	0.91	1.04
Source: Author's computation based on model results		

The policy simulations also influence consumption of HPHC commodities. Consumption of HPHC commodities increases in second scenario: by 0.3% in HPHC food and by 0.6% in HPHC non-food commodities. Although trade and transport margins do not directly affect HPHC commodities, the consumption of these commodities increase due to the income effect. Particularly, improved road infrastructure enhanced domestic production that led to increased household income and hence increased consumption of HPHC commodities.

5.3 Effect on domestic price

The freed labor from fetching water and firewood and reallocated to other sectors brings extra income to the households which increases household consumption demand (QCD and hence increases domestic prices (PQD). Table 5 describes the percentage change (weighted) in PQD in response to higher TFP in water fetching and firewood collection and less trade and transport margin. In the first scenario the PQD for HPHC food, HPHC non-food, market food and market non-food commodities on average increase by 2%, 15.3%, 0.7% and 0.9%, respectively. This implies that effect of income increase dominates the price effect. The extra income results an upward shift in household's consumption demand and hence increases domestic prices. The increases in price for HPHC non-food commodities are relatively higher because of a bigger upward shift for the demand for these commodities and hence their prices increase by the higher percentage.

On the other hand, improved access to road transport infrastructure mainly affects prices of marketed commodities. This is because these groups of commodities use the services of trade and transport. The decrease in trade and transport margins reduces the gap between consumer price and producer price. In the second scenario, due to less trade and transport margins, the PQD decrease by 0.9% and 0.6% for market food and market non-food commodities, respectively. However, the PQD for HPHC food and HPHC non-food commodities increase by 1.4% and 0.9%, respectively. Even though HPHC commodities are not directly affected by the second policy scenarios, the price for these commodities is influenced indirectly through the income effect.

Table 5
Simulated changes (percentage) in domestic price (PQD)

Commodities	Scenario one	Scenario two
HPHC food	2.00	1.36
HPHC non-food	15.25	0.89
Market food	0.70	-0.90
Market non-food	0.86	-0.60
Source: Author's computation based on model results		

5.4 Effects on welfare

Increased TFP of water fetching and firewood collection and reduction of trade and transport margin also affects household welfare. Table 6 shows the equivalent variation (EV) in percent of base income to examine the actual welfare changes across household groups. Welfare improvement happens to all groups of households in both scenarios except non-poor households located in urban areas but the amount of welfare gain varies among households.

Different household groups allocate divergent quantities of labor for water fetching and firewood collection. Accordingly, the welfare gains in the first scenario depend on household endowment of labor that can be potentially allocated to water fetching and firewood collection. In other words, households that allocate a relatively larger proportion of labor to water fetching and firewood collection obtain high welfare gains. For instance, non-poor and poor rural households in agro-ecology zones 1 and 5 allocate the highest proportion of labor to water fetching and firewood collection relative to other groups of households. Because of increase in the TFP of water fetching and firewood collection, welfare gains by these household groups are higher than other groups of households.

On the other hand, welfare gains in the second scenario are driven by the increase in the consumption of households in response to less trade and transport margins and hence lower price. Households that consume a larger proportion of market non-food commodities are relatively better off than other households are. This is because the cost of margin services accounts for a relatively high proportion of the total expenditure of market non-food commodities. Accordingly, lower trade and transport margins strongly increase the consumption of market non-food commodities and hence contribute to the well-being of households.

However, the welfare of urban non-poor households is negatively affected in both scenarios. This can be explained by the fact that financing the construction of water facility, energy technology and road infrastructure are obtained from government savings that are raised through income tax. Since urban non-poor households contribute a larger share of tax to the government, their consumption expenditure decreases and hence welfare declines.

Table 6
Simulated changes (percentage) in household welfare (EV/base income)

Households	Scenario one	Scenario two
Household rural zone 1 poor agricultural	3.64	0.84
Household rural zone 1 poor mixed	3.64	0.84
Household rural zone 1 poor non-agricultural	3.64	0.84
Household rural zone 2 poor agricultural	3.15	1.38
Household rural zone 2 poor mixed	3.15	1.38
Household rural zone 2 poor non-agricultural	3.15	1.38
Household rural zone 3 poor agricultural	3.42	1.44
Household rural zone 3 poor mixed	3.42	1.44
Household rural zone 3 poor non-agricultural	3.42	1.44
Household rural zone 4 poor agricultural	3.17	1.28
Household rural zone 4 poor mixed	3.17	1.28
Household rural zone 4 poor non-agricultural	3.17	1.28
Household rural zone 5 poor agricultural	3.59	0.80
Household rural zone 5 poor mixed	3.59	0.80
Household rural zone 5 poor non-agricultural	3.59	0.80
Household rural zone 1 non-poor agricultural	3.06	0.97
Household rural zone 1 non-poor mixed	3.06	0.97
Household rural zone 1 non-poor non-agricultural	3.06	0.97
Household rural zone 2 non-poor agricultural	2.19	1.02
Household rural zone 2 non-poor mixed	2.19	1.02
Household rural zone 2 non-poor non-agricultural	2.19	1.02
Household rural zone 3 non-poor agricultural	2.63	1.23
Household rural zone 3 non-poor mixed	2.63	1.23
Household rural zone 3 non-poor non-agricultural	2.63	1.23
Household rural zone 4 non-poor agricultural	2.40	1.13
Household rural zone 4 non-poor mixed	2.40	1.13
Household rural zone 4 non-poor non-agricultural	2.40	1.13
Household rural zone 5 non-poor agricultural	3.13	0.71
Household rural zone 5 non-poor mixed	3.13	0.71
Household rural zone 5 non-poor non-agricultural	3.13	0.71
Household small urban poor	1.59	1.08
Household big urban poor	1.63	0.77
Household small urban non-poor	-6.60	-6.93
Household big urban non-poor	-3.54	-3.83

Source: Author’s computation based on model results

5.5 Macroeconomic effects

Increase TFP of water fetching and firewood collection and reduction of trade and transport margins creates economy-wide linkages and positively affects the macroeconomic indicators such as GDP, total domestic production, absorption, import, export and exchange rate. Table 7 depicts the macroeconomic effect of higher TFP in water fetching and firewood collection and less trade and transport margins.

Total domestic production increases by 1.4%, private consumption by 1.7%, GDP by 1.5%, absorption by 1.3% and import by 0.1% in the first scenario. The released labor from water fetching and firewood collection is reallocated to productive sectors that accelerate domestic production. This leads to an increase in domestic consumption (absorption) and import. Furthermore, reallocated labor promotes the growth of the economy and hence the GDP increases.

On the other hand, in the second scenario GDP increases by 0.2%, private consumption by 0.1%, investment consumption by 1%, absorption by 0.2%, total domestic production by 0.2% and import demand by 0.1%. Improved road infrastructure facilitates trade and transport activities in the economy that enhance transportation of commodities into the market and results low prices of commodities. This leads to an increases in domestic demand and hence more domestic production that accelerate the growth of the economy and increases GDP.

Table 7
Real macroeconomic effects (percentage changes)

Real macroeconomic indicators	Scenario one	Scenario two
Private consumption	1.67	0.05
Investment consumption	0.38	0.96
Absorption	1.34	0.16
Import	0.08	0.10
GDP	1.54	0.18
Total domestic production	1.35	0.24
Source: Author’s computation based on model results		

6. Sensitivity Analysis

Sensitivity analysis is conducted to ensure the stability of model results in response to changes in behavioral parameters. The sensitivity of model results due to the change in the core model parameters such as the income elasticity of leisure and the income elasticity of demand for marketed commodities is discussed in this section. Sensitivity analysis is carried out by 50% decreases and increases in the income elasticity of leisure and in the income elasticity of marketed commodities. Specifically, this section discusses the sensitivity of domestic production, household welfare, and major macroeconomic effects due to the change in the income elasticity of leisure and marketed commodities.

The sensitivity of model results in response to the change in income elasticity of leisure and marketed commodities is provided in Appendix A. The percentage change in domestic production varies when the income elasticity of leisure and marketed commodities increases and decreases by 50%. When the income elasticity of leisure is higher, a larger share of the freed labor gets into leisure and a smaller proportion is reallocated to other sectors (agriculture, industry and service). On the other hand, domestic production is sensitive to the change in the income elasticity of marketed commodities. The higher the income elasticity of demand, the larger the increase of domestic production in all scenarios.

Household welfare is also sensitive to the change in the elasticity of leisure and marketed commodities. All groups of households except urban non-poor households have less welfare gains when the elasticity of leisure increases. The magnitude of welfare gain varies by a small margin in response to the change in the elasticity of leisure and marketed commodities. Furthermore, the macroeconomic indicators such as absorption, import demand, GDP from expenditure and total domestic production also slightly vary due to the change in the income elasticity of leisure and marketed commodities.

The magnitude of changes in the first scenario is bigger than the second scenario in the entire sensitivity of model outcome. Although the changes in the income elasticity of leisure and income elasticity of demand for marketed commodities result in little disparities in the magnitude of simulation outcome, the direction of changes and the order of size remains the same in all scenarios.

7. Summary And Conclusions

Since Ethiopian government has limited financial capacity for adequately investing in all economic sectors simultaneously, public investment has to be prioritized across the different pro-poor sectors. With a limited public resource, public investment across sectors has to be evaluated based on their potential economy-wide benefits. The objective of this study is to investigate a comparative analysis of public expenditure on water facility and energy technology (such as improved cooking stoves) on the one hand and public expenditure road infrastructure on the other hand.

This study analyses two policy scenarios such as an increase the TFP of water fetching and firewood collection activities and decreases in the trade and transport margins due to increase in public expenditure. Specifically, the TFP of water fetching and firewood collection activities increased by 50% and a 1.7% reduction of trade and transport margins for agricultural commodities and a 1.5% reduction for non-agricultural commodities due to public investment in water facility, access to improved stoves and road infrastructure. The construction of water facility, energy saving technology (access to improved stoves) and road infrastructure are sourced from government savings (through income tax replacement).

The simulation results indicates that public investment in water facility and access improved stoves results relatively higher domestic production in most sectors, larger household consumption, improved household welfare and improved in the macroeconomic indicators (GDP, absorption, private consumption, total domestic production) as compared to public investment in road transport infrastructure.

Sensitivity analysis is conducted to ensure the stability of model results in response to changes in behavioral parameters. Although the changes in the income elasticity of leisure and income elasticity of demand for marketed commodities result in little disparities in the magnitude of simulation outcome, the direction of changes and the order of size remains the same in all scenarios. Sensitivity analysis also confirms that the economic-wide effect of public investment in water facility and improved stoves is relatively higher than road infrastructure investment.

Therefore, before launching public investment in any specific sector, it is helpful to explore the potential economic-wide benefits of public investment across the different pro-poor sectors. This will ensure limited public budgets are appropriately invested in the sector that can bring relatively highest economic-wide benefits to the wider society.

Abbreviations

CGE: Computable General Equilibrium; CPI: Consumer Price Index; GDP: Gross Domestic Product; EV: Equivalent Variation; EDRI: Ethiopian Development Research Institute; PQS: Domestic Supply Prices; PQD: Domestic Purchaser Prices; QCD: Household Consumption Demand; STAGE: Static General Equilibrium Model; SAM: Social Accounting Matrix; TFP: Total Factor Productivity; UNMDG: United Nation Millennium Development Goal; WHO: World Health Organization; UNICEF: GAMS: General Algebraic Modeling System; CES: Constant Elasticity of Substitution; GTP: Growth and Transformation Plan of Ethiopia; HPHC: Home Production for Home Consumption.

Declarations

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Authors' contributions

The corresponding Author was the sole contributor of this manuscript.

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Availability of data and materials

Some of the data used for this study can be accessed from Ethiopian Development Research Institute. Other support data can be obtained from the corresponding author up on request.

Ethics approval and consent to participate

Not applicable.

Consent for publication

Not applicable.

Competing interests

The authors declare that they have no competing interests.

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