Implications of Oil Price Shocks and Subsidizing Oil Prices to the Ethiopian Economy: A CGE Analysis

Birouke Tefera, Frehiwot Fantaw, and Zewdu Ayalew

Ethiopian Development Research Institute, Addis Ababa, Ethiopia
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Ethiopian Development Research Institute (EDRI)
P.O. Box 2479
Tel: 251-11-550-6066
Fax: 251-11-550-5588
Email: info@edri-eth.org
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About the Author(s)

Birouke Tefera, Junior Researcher, Ethiopian Development Research Institute (EDRI), biroukem@gmail.com

Frehiwot Fantaw, Junior Researcher, Ethiopian Development Research Institute (EDRI), ffantaww@gmail.com

Zewdu Ayalew, Junior Researcher, Ethiopian Development Research Institute (EDRI), zewduayalewabro@gmail.com
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Abstract

Economic growth is largely dependent on the availability of reliable sources of energy. As an importer of oil and petroleum products, Ethiopia's economy is potentially vulnerable to fluctuations in the world price of crude oil. The recent oil price shocks adversely affected oil-importing developing countries such as Ethiopia. The paper attempts to quantify the impact of an increase in international price of crude oil and oil subsidy scheme on the Ethiopian Economy by applying the IFPRI's static CGE model using the EDRI's 2005/06 SAM. The results show that the oil price shock causes a depreciation of the Ethiopian Birr (ETB) and brings about an increase in exports and a decline in imports. The depreciation of the ETB also brings a rise in agricultural tradable goods output and a decline in manufacturing and service sectors output. The shock also deteriorates income and consumption of all households. In general, rural households are more negatively affected by the oil price shock as compared to urban households. The oil subsidy scheme increases government expenditure and reduces government savings, hence total investment falls. Output of the construction sector goes down because of the fall in investment demand. On the other hand, the oil subsidy improves consumption of all households. In the short run, the oil price subsidy scheme improves household welfare. Nevertheless, in the long run it is harmful since it absorbs a high share of limited public resources, leads to lower investments and reduces future growth. Financing the oil subsidy scheme by increasing taxes on other goods brings improvement in investments but it distorts the level of domestic production and household welfare. We conclude that this type of subsidy is an inefficient tool to reverse the high oil price increase in developing countries. Rather, finding ways to substitute oil by other energy sources could be a better solution in the medium to long-run.
1. Introduction

Economic growth is largely dependent on the availability of reliable sources of energy. Petroleum oil is one of the most important sources of energy integrated into the production systems of many products and in services (Sepheri 2002). Hence, stability in the petroleum oil market is necessary for the normal functioning of the world economic order.

However, rising of the international oil price becomes a permanent reality, with oil price attaining its climax in 2008. It was mainly driven by the increasing demand from fast-growing economies such as India and China. This led to high levels of unemployment and exacerbating budget-deficit problems in oil-importing developing countries (UNCTAD 2008). The adverse economic impact of oil price shocks on oil-importing developing countries is greater than on developed countries. This is because developing countries have a more energy intensive and less efficient production technology. Besides, the availability of limited alternative sources of energy exacerbates the vulnerability to oil price shocks (IEA 2004).

Similar to other oil-importing developing countries, Ethiopia is highly vulnerable to fluctuations in the world crude oil price. This study first examines the effect of crude oil price shocks on major economic indicators such as domestic production, imports, household income and consumption, household savings, and total investment, applying the International Food Policy Research Institute’s (IFPRI) standard computable general equilibrium (CGE) model. Second, the study looks at the effect of oil price increases on sector allocation of labor and production. Finally, it also analyzes the likely impact of subsidizing oil prices on the Ethiopian economy. By doing so, the paper contributes to the empirical literature on the impact of oil price shocks and subsidies in Ethiopia. It also helps to draw some policy lessons for other developing countries with a similar structure to that of Ethiopia, specifically those with a high dependency on imported oil.

The remaining part of the paper is organized as follows. Section 2 reviews empirical and theoretical evidence from the literature. We describe trends in the oil price and Ethiopia’s vulnerability to oil price shocks in section 3 respectively section 4. Section 5 presents the methodology and data used to estimate the impact of oil price shock on the Ethiopian economy based on Computable General Equilibrium (CGE) technique. Section 6 reports simulation results. Finally section 7 concludes the paper.

2. Literature review

As we have seen in the introduction, the international oil price has been increasing across years. The rise in oil prices benefits oil-exporting countries as a result of high oil revenue. On the contrary, it adversely affects oil importing countries though the level of the impact varies markedly depending on the degree to which they are net importers and the oil intensity of their economies (UNCTAD 2008).

Both econometric as well as computable general equilibrium (CGE) models have been used to model the impact of oil price shocks in different countries. Vector Auto Regressive (VAR) studies have investigated the macroeconomic impact of oil price shocks. Jin (2008) investigated the impact of oil price shocks and exchange rate volatility on the economic growth of Russia, Japan, and China. The main findings indicate that oil price rises negatively affect economic growth in Japan and China while it affects Russia positively. Specifically, a 10 percent permanent increase in international oil prices is associated with a 5.16 percent
growth in Russian Gross Domestic Product (GDP) and a 1.07 percent decrease in Japanese GDP.

Lee and Song (2009) also found that a temporary rise in the oil price decreases immediately both export and real GDP in Korea. In addition, real GDP permanently declined by 0.5 percent. This was caused by higher marginal cost from energy inputs or by lower consumption after paying higher energy expense. Furthermore, Lee and Song (2009) came up that the price measured by Consumer Price Index (CPI) lowers initially but climbs steadily up. A one standard deviation increase in the oil prices raises the CPI by 0.2 percent.

Another study by Hamilton (1983) found that almost all US post-war recessions appear to have been associated with increasing oil prices. A rise of oil prices causes depreciation of the Dollar that makes import goods expensive in the domestic market. As a result, the demand for imported intermediate input falls and the domestic production decreases.

Gounder and Bartleet (2007) studied causality analysis of oil price-growth nexus in New Zealand’s economy. Their investigation showed the direct link between oil price shocks and growth as well as the indirect linkages via inflation and real exchange rate. The unemployment effects of rising oil prices were also studied by Carruth et al. (1994). As per their study higher energy costs indirectly force up unemployment.

A General equilibrium analysis of oil price shocks in different countries is also available. A CGE micro simulation analysis by Ahmed and O’Donoghue (2008) in Pakistan found that a 10 percent increase in the import price of petroleum brings about a 0.7 percent decline in GDP value added. Private consumption declines by 4.3 percent. As a percentage of nominal GDP, investment and private savings increased by 1.1 percent. Current account deficit as percentage of nominal GDP also increases by 0.2 percent. The overall import price index increases by about 11.9 percent. Given that the trade deficit to nominal GDP ratio increases by 0.2 percent, there is an impact on tariff revenue and government savings, both decreasing by 0.2 and 0.3 percent respectively. They found that the impact of increases in import price of petroleum is greater than any other commodity groups due to the intensity with which this good is used in the production process (as well as by the households), and the knock-on effects that petroleum prices have at the macro as well as micro level.

Fofana et al. (2009) studied the economy of South Africa using an energy focused Macro–Micro CGE model. A sustained 100 percent price rise of oil was experimented under alternative scenarios. The model predicts that GDP would fall between 2.2 and 2.5 percent under the two scenarios. In the first scenario, the rise in the international price of oil and petroleum products is fully transmitted to end users (floating price scenario). The second scenario assumes full compensation of the welfare loss through subsidy (fixed price scenario). A key driver of these results is the exchange rate effect. The exchange rate depreciates more in the fixed price relative to the floating price scenarios leading to a fall in the average domestic prices by 3.4 percent and 2.6 percent, respectively. The impact on the government deficit varies widely among the scenarios, ranging from a worsening of 12 to 22 percent in the floating prices and the fixed price scenarios, respectively. Unemployment increases among medium and low skilled workers. Poverty headcount ratio increases by 1 percent when the imported crude oil and oil products prices rise by 50 and 25 percent respectively. The poorest households are most adversely affected by the increase of oil prices.

McDonald and Van Schoor (2005) in South Africa found a 20 percent increase in oil prices results in a drop in GDP of 1 percent. It is found that the major impact is to be found in the petroleum industry itself, whereas the effects on liquid fuel dependent industries such as transport is not as large as may be supposed. In agriculture, it is found that the depreciating currency has a positive effect, offsetting most of the negative effects of higher petroleum
prices, particularly in export-oriented areas. In a long-term scenario, capital and skilled labor becomes mobile, and the results suggest that such reallocation may not be to the overall advantage of the economy.

Applying a CGE model Al-Amin et al. (2008) in Malaysia found that an imported crude oil price shock causes a decline of household income, household consumption, and household savings. In addition, real GDP declines, while the resulting drop in government revenue has a significant negative impact on investment and fixed capital formation. Specifically, the model results indicate that the a 15 percent crude oil price shock decreases the domestic production of the building and construction sector by 25.87 percent, hotels, restaurants and entertainment sector by 12.04 percent, industry sector by 12.02 percent, agriculture, sector by 11.01 percent, and electricity and gas sector by 9.55 percent. On the import side, import decreases significantly in all sectors from base level. The largest negative impact is on the industry sector. Import in the industry sector declines by 29.67 percent, followed by the decline by 22.42 percent in the building and construction sector, by 19.45 percent in the hotels, restaurants and entertainment sector, by 13 percent in the electricity and gas sector, by 12.63 percent in the agriculture sector, and by 11.17 percent in other service sectors.

In the case of Ethiopia, Fekadu (2005) assessed the impact of oil price increases in the Ethiopian economy using trend and econometric analysis. He found that an oil price increase has a significant impact on the core inflation while it is minimal on the general inflation in the short run. He concluded that non-food price index is relatively more sensitive to the oil price increase.

A CGE analysis by Ahmed (2007) found that oil price shocks deteriorate absorption, particularly private consumption and investment, and depreciation of the Birr in the Ethiopian economy. In addition, he found that a progressive increase in oil prices cuts household consumption since the increase in oil prices reduces real per worker income of households. He also found that subsidizing the oil market generates a structural adjustment problem in Ethiopia. Increasing cost of subsidies also absorbs an increasing share of the scarce public resources thus adversely affecting the public investment.

As a coping strategy for oil price increase, price subsidies and petroleum product tax reduction are the two most commonly used methods of partially offsetting higher oil prices in the international market. In recent years, the amount of subsidies carried by different governments is very large to mitigate adverse effects on poor households. Ethiopia spent more than 7.7 billion ETB (794 million USD) on fuel subsidies to stabilize the oil market between August 2006 and January 2008 (Kojima 2009).

Fuel subsidies in Indonesia tend to be highly regressive and inefficient in targeting the poor, undermine macroeconomic stability, hinder competitiveness, distort price signals to industry and households, reduce fiscal space, and generate opportunities for corruption and smuggling (World Bank 2008). A distributional effect of oil subsidy is observed in Mali. While the government wants to target the poor with the oil subsidy, high-income households benefit disproportionately from oil price subsidies. Thus the petroleum price subsidies are ineffective in protecting the income of poor households compared with a targeted subsidy (Kpodar 2006).
3. Trends in international and domestic price of oil

The international crude oil price has been rising year to year. It rose by 28 percent in July 2006, 38 percent in July 2007, 153 percent July 2008, and 23 percent in July 2009 as compared to July 2005. In the same way, the year-on-year percentage change sharply rose by about 7 percent, 86 percent and 51 percent in July 2007, July 2008 and July 2009, respectively (see Figure 3.1).

Figure 3.1. Trends of international crude oil and domestic wholesale price of oil products, July 2005–June 2010 (USD/Barrel)

The international price of crude oil went up sharply between March and August 2008 because of a high world demand as a result of strong economic growth in China and India, commodity price speculations, and OPEC monopoly pricing. The time lags and geological limitations to increase production also stagnated supply resulting in tightening the balance of supply and demand (Hamilton 2008; Behr 2009). From August 2008 onwards, it started declining until May 2009 due to low demand as a result of the global financial crisis (Schubert 2009). However, it again started rising since June 2009 from its lowest level of the past five months and varies in between 65 to 85 USD per barrel.

The international oil price hike has also repercussions on the Ethiopian economy by pushing average domestic wholesale oil products price up from 56.07 USD per barrel in July 2005 to 126.05 USD per barrel in May 2008. A close examination of Figure 3.1 reveals that the international and domestic oil price has a strong correlation in that the two prices moves together. Until the end of August 2008, the gap between domestic and international price was very minimal since the government has been subsidizing oil prices. From September 2008 onwards however, the government suspended the oil price subsidy scheme resulting in widening of the gap between international and domestic price of oil. Besides, the gap was precipitated by the decline in the foreign exchange value of the Ethiopian birr from the end of 2008 onwards.

Even though the oil price increases over time, Ethiopia’s volume of import for petroleum products continued rising significantly each year on average by 10 percent between 2004/05–2008/09. In value terms, import rose by 67.89 percent in 2004/05, by 34.28 percent in 2005/06, by 18.07 percent in 2006/07, and by 90.65 percent in 2007/08. The reason for

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this large rise in value of imports was the persistent rise in international oil prices. On the contrary, the value of import for the 2008/09 fiscal year fell by 14.85 percent due to a continuous drop in the international price of crude oil.

Furthermore, the share of oil import to the total GDP showed an upward trend over time except the drops in 2003/04 and 2005/06 fiscal years, as illustrated in Figure 3.2. The share of oil import to the total import is significantly higher and fluctuates within the range of 15 to 24 percent between 1999/00 to 2007/08.

Figure 3.2. Trends in the percentage of oil imports to GDP and to the total imports, 1999/2000–2007/2008 (percentage change)

4. Ethiopia’s vulnerability to oil price shocks

Nowadays, high oil price is the permanent reality of the world. A persistent rise in oil price in the international market pushes domestic prices up. It also shifts the terms of trade in favor of oil exporting countries through a transfer of income coming from Ethiopia. Rise in oil price drains more of the country’s foreign exchange (about USD 192 million in 2004/05, for example) than anticipated. This implies that Ethiopia is at the sharp edge of an oil price shock and hence highly vulnerable to it.

This study estimated the vulnerability of Ethiopia to oil price shocks following the methodology of Bacon and Mattar (2005) as shown in Table 4.1. A major factor that explains high oil vulnerability is the complete reliance of Ethiopia on imported oil. Furthermore, the share of oil in the total energy mix (oil energy dependence) also remains high above 65 percent, though it declined from 72 percent in 2003 to 66 percent in 2009.

Final consumers and energy using producers have little flexibility to reduce oil consumption or find other options immediately after price changes since technology is fixed in the short run. Close to 80 percent of the imported oil is consumed by the construction sector (nearly 39 percent), wholesale and retail trade and repair of motor vehicles, motorcycles and personal and households sector (nearly 28 percent), and urban as well as rural households.

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(13 percent for all households) (EDRI 2009). As a result, these groups of oil users suffer the worst from oil price shocks.

The availability of alternative energy substitutes also matters to cope with oil price shocks. However, energy substitutes are hardly available in Ethiopia. Recently, Ethiopia started bio-fuel production and the massive expansion of the hydropower. Electricity production has grown, on average, by 10 percent per year between 2003/04–2008/09. However, import volume of petroleum products also increased by almost the same rate. It seems there is no substitutability; rather, both energy sources go together to fulfill the domestic demand for energy.

At the household level, fuel switching to the use of ethanol and the promotion of stove efficiency improvements by disseminating improved stoves is under promotion. The application of such types of technologies may increase efficiency and reduce oil vulnerability. It has also a potential of reducing the risks of environmental pollution.

Furthermore, experts in the area recommended the transport sector to use hybrid vehicles with low fuel consumption, taking fuel wasting vehicles off the road, and promoting the use of alternative mass transportation (such as electric trains) and the use of non motorized transport (MOWR 2007; Bekele 2007). However, the recommendations are not implemented as we daily encounter fuel-inefficient old cars emitting dark, cloudy, and polluting smokes everywhere in the country.

Low energy intensity keeps vulnerability down since the cost of converting energy to GDP is going to be low. Therefore, both oil and total energy intensity showed a consistent decline across years maybe because of increasing efficiency of oil use by firms and households (see Table 4.1). The overall vulnerability of Ethiopia to oil price shocks went up high across years reaching its maximum in 2008 because of the high oil price in this year. On the contrary, it sharply declined in 2009.

Table 4.1. Estimated vulnerability of Ethiopia to oil price shocks, 2003–2009

<table>
<thead>
<tr>
<th>Measures</th>
<th>2003</th>
<th>2004</th>
<th>2005</th>
<th>2006</th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oil import dependence</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td>Oil energy dependence</td>
<td>0.72</td>
<td>0.71</td>
<td>0.69</td>
<td>0.69</td>
<td>0.69</td>
<td>0.72</td>
<td>0.66</td>
</tr>
<tr>
<td>Total energy intensity</td>
<td>8071.96</td>
<td>6912.15</td>
<td>5991.35</td>
<td>5211.22</td>
<td>3849.87</td>
<td>3263.50</td>
<td>3548.74</td>
</tr>
<tr>
<td>Oil intensity</td>
<td>5788.04</td>
<td>4911.76</td>
<td>4156.65</td>
<td>3610.17</td>
<td>2673.44</td>
<td>2358.20</td>
<td>2333.26</td>
</tr>
<tr>
<td>Estimated vulnerability</td>
<td>0.03</td>
<td>0.03</td>
<td>0.04</td>
<td>0.04</td>
<td>0.03</td>
<td>0.04</td>
<td>0.02</td>
</tr>
</tbody>
</table>

Source: Authors’ computation from International Energy Agency (IEA) database

Notes: Oil Intensity = Oil consumption in BTU per GDP in dollars.
Total energy intensity = total primary energy consumption in BTU/ GDP in dollars.
Oil energy dependence = oil consumption in BTU/ Total primary energy consumption in BTU.
Estimated vulnerability = (net oil imports*average price of crude oil in dollars)/ GDP in dollars.
Oil import dependence = net oil imports/total oil consumption.

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4 National Bank of Ethiopia annual reports various issues.

5 A BTU, an abbreviation for British Thermal Unit, is equivalent to 252 calories and serves as the base unit for measuring the heat content of a fuel source.
5. The model, macroeconomic closures, and the simulations

5.1. The model and closure rules

This paper uses the standard IFPRI static CGE model using 2005/06 Ethiopian Social Accounting Matrix (SAM) (EDRI 2009). The SAM disaggregates activities in 99 accounts, commodities in 91 accounts, factors in 25 accounts, households in 14 accounts, and finally taxes in 17 accounts (8 indirect commodity taxes and 9 direct taxes). The SAM also has government, saving-investment, inventory, and rest of the world accounts.

The standard CGE model explains all of the payments and receipt recorded in the SAM. The model follows the SAM disaggregation of factors, activities, commodities, and institutions. It is written as a set of simultaneous linear and nonlinear equations. The equations define the behavior of the different actors. Some of these behaviors follow simple rules captured by fixed coefficients (ex. Ad valorem tax rates). For production and consumption decisions, behavior is captured by nonlinear first-order optimality conditions. Production decisions are driven by the maximization of profits subject to costs of factors and intermediate inputs. Consumers maximize their utility subject to the budget constraints. The equations also include a set of constraints that have to be satisfied by the system as a whole but are not necessarily considered by any individual actor. These constraints cover factor and commodity markets. Furthermore, the equations have also macroeconomic balances for saving and investment, the government, and the current account of the rest of the world (Löfgren et al. 2002).

The behavior of major economic agents such as savers, investors, the government, and the rest of the world has to be clearly specified in order to close the model. Therefore, the closure rules determine how the macro economy and the factor markets work. For this paper, government savings are flexible; direct tax rate is fixed implying the government finances its budget deficit through borrowing and is constrained in raising taxes to cover additional public spending. The paper also exercises under fixed government savings which implies that government finances its budget through raising tax. Saving-driven investment closure is adopted in which investment adjusts endogenously to the availability of loanable funds. The level of foreign savings is fixed and the exchange rate is flexible. The implication of this closure is that during shortage of foreign savings the real exchange rate adjusts by simultaneously reducing spending on imports and increasing earnings from export. Furthermore, land and capital is fully employed and activity-specific while labor is assumed to be fully employed and mobile across sectors.

5.2. Simulations

This paper uses two alternative scenarios. The first scenario assumes 50 percent rise of international petroleum price and this price change is fully transmitted to end users (consumers and producers) through an increase in purchasing prices of petroleum products. The 50 percent shock is not arbitrarily chosen, rather, it is based on the trends of international oil prices. The removal of fuel price subsidies by the Ethiopian government in October 2008 resulted in a price increase of 50 percent for kerosene and 40 percent for diesel (Kojima 2009). In addition, average international crude oil price increase by more than 50 percent in 2008 as compared to the year 2007. As a result, we simulate the Cost, Insurance and Freight (C.I.F) import price in foreign currency units (PWM) assuming a 50 percent increase in international oil price as shown in the following equation.

\[ PM_c = PWM_c \times (1 + tm_c) \times EXR + \sum_{s \in \mathcal{F}} PQ_c \times icm_{c,s} \]
Where $PM_c =$ import price in local currency units including transaction costs, 
$pwm_c =$ C.I.F import price in foreign currency units, 
$tm_c =$ import tariff rate, 
$EXR =$ exchange rate local currency unit per foreign currency units, 
$icm_{ce} =$ quantity of commodity C as trade input per imported unit of C, 
\[
\sum_{c \in C} PQ_c * icm_{ce} = \text{cost of trade inputs per import unit},
\]
$C =$ a set of commodities, and 
$c =$ a set of imported commodities.

The second scenario assumes that the government subsidizes the oil price to compensate consumers' loss from higher international fuel price. The subsidy is used to compensate for the 50 percent increase in crude oil price through a reduction of domestic sales tax on fuel. The rate of domestic sales tax ($tq_c$) to keep consumers at a welfare level as equal as before the oil price shock happens is equal to -0.378. This rate ($tq_c$) is calculated keeping domestic selling price ($PQ_c$) unchanged (i.e. constant at the amount it was before the world price shock), and import price changing accordingly. Since Ethiopia is a net fuel importer (the locally manufactured fuel became zero) we take the composite commodity price.

\[
PQ_c * (1 - tq_c) * QQ_c = PDD_c * QD_c + PM_c * QM_c
\]

Where $PQ_c =$ domestic sales price (price of composite goods), 
$PDD_c =$ demand price for commodity produced and sold domestically, 
$PM_c =$ import price in LCU (local-currency units) including transaction costs, 
$QQ_c =$ quantity of goods supplied to domestic market (composite supply), 
$QD_c =$ quantity sold domestically of domestic output, 
$QM_c =$ quantity of imports of commodity, and 
$tq_c =$ rate of sales tax (as share of composite price inclusive of sales tax).

6. Results

6.1. Macro effects of the oil price shock

Scenario one: It is assumed that a 50 percent rise in imported crude oil price is fully transmitted to end users (consumers and producers) through an increase in purchasing prices of petroleum products.

The immediate effect of an oil price increase is through its effect on increasing prices of tradable commodities. On average, the price of tradable commodities increases by 5.19 percent from the baseline. The price increase induces the import bill to rise which in turn results in foreign exchange shortage since the demand for oil import is price inelastic. As a result, real exchange rate of the Birr depreciates by 5.8 percent. Depreciation of the Birr encourages exports to increase by 5.34 percent and real imports in base year prices fall by 3.83 percent. When the oil price increases, Ethiopia’s international purchasing power reduces due to the rise in real price of imported oil. Hence the oil price shock decreases total absorption by 1.84 percent, private consumption by 1.7 percent, and fixed investment by 3.65 percent, as shown in Table 6.1.
Table 6.1. Percentage changes in the impact of oil price increase and oil subsidy in macro variables

<table>
<thead>
<tr>
<th>Macro amounts</th>
<th>Increase in oil price (percent)</th>
<th>Oil subsidy (percent)</th>
<th>Increase in oil price (percent)</th>
<th>Oil subsidy (percent)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Real effective exchange rate</td>
<td>5.80</td>
<td>6.40</td>
<td>5.80</td>
<td>6.90</td>
</tr>
<tr>
<td>Nominal effective exchange rate</td>
<td>2.00</td>
<td>2.70</td>
<td>2.10</td>
<td>3.20</td>
</tr>
<tr>
<td>Investment as a percent of GDP</td>
<td>0.30</td>
<td>-1.60</td>
<td>0.40</td>
<td>0.50</td>
</tr>
<tr>
<td>Private saving as a percent of GDP</td>
<td>-</td>
<td>0.30</td>
<td>-</td>
<td>0.10</td>
</tr>
<tr>
<td>Foreign saving as a percent of GDP</td>
<td>0.30</td>
<td>0.40</td>
<td>0.30</td>
<td>0.50</td>
</tr>
<tr>
<td>Governments saving as a percent of GDP</td>
<td>-</td>
<td>-2.20</td>
<td>0.10</td>
<td>0.10</td>
</tr>
<tr>
<td>Absorption</td>
<td>-1.84</td>
<td>-1.94</td>
<td>-1.90</td>
<td>-2.00</td>
</tr>
<tr>
<td>Private consumption</td>
<td>-1.70</td>
<td>-0.63</td>
<td>-1.80</td>
<td>-2.40</td>
</tr>
<tr>
<td>Fixed investment</td>
<td>-3.65</td>
<td>-8.63</td>
<td>-3.50</td>
<td>-1.30</td>
</tr>
<tr>
<td>Exports</td>
<td>5.34</td>
<td>5.28</td>
<td>5.40</td>
<td>7.20</td>
</tr>
<tr>
<td>Imports</td>
<td>-3.83</td>
<td>-4.01</td>
<td>-3.80</td>
<td>-3.50</td>
</tr>
</tbody>
</table>

Source: Authors’ computation

Impact of the shock in level of domestic activities and labor demand

The oil price shock leads to a transformation of labor and production from the oil intensive industry to other sectors. Hence the oil price shock causes a ‘contractionary’ effect on output of the manufacturing and the service sectors. Output of the construction sector was affected significantly. The manufacture of furniture fell by about 3.38 percent; manufacture of jewellery and related articles (aoman) declined by about 1.83 percent; the manufacture of chemicals, rubber, and plastic products (achem) sector declined by about 1.74 percent; and the food processing sector output decreased by about 1.22 percent. The least affected sector is the financial services, real estates, and other services (apsrv) sector which fell by 0.01 percent (see Table 6.2).

Table 6.2. Percentage changes in the impact of oil price increase and oil subsidy in level of domestic activities

<table>
<thead>
<tr>
<th>Activities</th>
<th>Increase in oil price (percent)</th>
<th>Oil subsidy (percent)</th>
<th>Increase in oil price (percent)</th>
<th>Oil subsidy (percent)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Production of Teff (ateff)</td>
<td>-0.25</td>
<td>-0.18</td>
<td>-0.3</td>
<td>-1.1</td>
</tr>
<tr>
<td>Production of Maize and Wheat (amzwh)</td>
<td>0.11</td>
<td>0.22</td>
<td>0.1</td>
<td>-1.2</td>
</tr>
<tr>
<td>Non-traded agriculture (antag)</td>
<td>0.42</td>
<td>0.25</td>
<td>0.4</td>
<td>-0.5</td>
</tr>
<tr>
<td>Export crops (axcrp)</td>
<td>2.22</td>
<td>1.64</td>
<td>2.2</td>
<td>1.8</td>
</tr>
<tr>
<td>Livestock (alive)</td>
<td>0.55</td>
<td>0.41</td>
<td>0.5</td>
<td>-0.3</td>
</tr>
<tr>
<td>Food processing (afood)</td>
<td>-1.22</td>
<td>0.15</td>
<td>-1.2</td>
<td>-0.4</td>
</tr>
<tr>
<td>Chemical production (achem)</td>
<td>-1.74</td>
<td>1.18</td>
<td>-1.7</td>
<td>1.3</td>
</tr>
<tr>
<td>Machinery and vehicles (amach)</td>
<td>1.03</td>
<td>0.69</td>
<td>1.1</td>
<td>1.5</td>
</tr>
<tr>
<td>Other manufacturing (aoman)</td>
<td>-1.83</td>
<td>0.91</td>
<td>-1.8</td>
<td>2.2</td>
</tr>
<tr>
<td>Construction (acons)</td>
<td>-3.38</td>
<td>-7.67</td>
<td>-3.2</td>
<td>-1.1</td>
</tr>
<tr>
<td>Electricity and water (autil)</td>
<td>-0.76</td>
<td>-0.35</td>
<td>-0.8</td>
<td>-0.4</td>
</tr>
<tr>
<td>Trade and transport (atrad)</td>
<td>-0.43</td>
<td>0.38</td>
<td>-0.4</td>
<td>0.6</td>
</tr>
<tr>
<td>Trade and transports (apsrv)</td>
<td>-0.01</td>
<td>0.1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Government services (agsrv)</td>
<td>-0.08</td>
<td>0.03</td>
<td>-0.1</td>
<td>-0.1</td>
</tr>
</tbody>
</table>

Source: Authors’ computation
Alike the export tradable, the oil price shock increases the output of the manufacture of ovens, furnaces, and furnace burners and the manufacture of machinery for food, beverage, and tobacco processing (amach) sector by 1.03 percent, perhaps because it uses a small fraction of oil as an intermediate input (only 0.15 percent). Depreciation of the Birr encourages agricultural tradable goods so that output rises on average by 0.81 percent. However, output of teff production declined by about 0.25 percent because farmers may shift their production to exportable crops. As a consequence of the decline in output, labor demand for the manufacturing and service sectors fell extremely. The construction sector recorded the highest decline by about 12.61 percent (see Table 6.3).

Table 6.3. Percentage changes in the impact of oil price increase and oil subsidy to labor demand

<table>
<thead>
<tr>
<th>Activities</th>
<th>Increase in oil price (percent)</th>
<th>Oil subsidy (percent)</th>
<th>Increase in oil price (percent)</th>
<th>Oil subsidy (percent)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Production of Teff (ateff)</td>
<td>-0.3</td>
<td>-0.22</td>
<td>-0.33</td>
<td>-1.3</td>
</tr>
<tr>
<td>Production of Maize and Wheat (amzwh)</td>
<td>0.13</td>
<td>0.26</td>
<td>0.09</td>
<td>-1.45</td>
</tr>
<tr>
<td>Non-traded agriculture (antag)</td>
<td>0.51</td>
<td>0.3</td>
<td>0.48</td>
<td>-0.62</td>
</tr>
<tr>
<td>Export crops (axcrp)</td>
<td>3.49</td>
<td>2.57</td>
<td>3.5</td>
<td>2.9</td>
</tr>
<tr>
<td>Livestock (alive)</td>
<td>0.8</td>
<td>0.6</td>
<td>0.77</td>
<td>-0.44</td>
</tr>
<tr>
<td>Food processing (afood)</td>
<td>-3.4</td>
<td>0.42</td>
<td>-3.44</td>
<td>-1</td>
</tr>
<tr>
<td>Chemical production (achem)</td>
<td>-5.93</td>
<td>4.2</td>
<td>-5.93</td>
<td>4.52</td>
</tr>
<tr>
<td>Machinery and vehicles (amach)</td>
<td>3.99</td>
<td>2.63</td>
<td>4.07</td>
<td>5.71</td>
</tr>
<tr>
<td>Other manufacturing (aoman)</td>
<td>-3.52</td>
<td>1.77</td>
<td>-3.45</td>
<td>4.38</td>
</tr>
<tr>
<td>Construction (acons)</td>
<td>-12.61</td>
<td>-27.42</td>
<td>-11.98</td>
<td>-4.26</td>
</tr>
<tr>
<td>Electricity and water (autil)</td>
<td>-2.61</td>
<td>-1.21</td>
<td>-2.61</td>
<td>-1.26</td>
</tr>
<tr>
<td>Trade and transport (atrad)</td>
<td>-2.03</td>
<td>1.81</td>
<td>-2</td>
<td>2.93</td>
</tr>
<tr>
<td>Trade and transports (apsrv)</td>
<td>-0.05</td>
<td>0.68</td>
<td>-0.08</td>
<td>-0.24</td>
</tr>
<tr>
<td>Government services (agsrv)</td>
<td>-0.21</td>
<td>0.08</td>
<td>-0.22</td>
<td>-0.16</td>
</tr>
</tbody>
</table>

Source: Authors’ computation

Repeating the same scenario with the alternative government closure, i.e., government savings are fixed, exhibits nearly no difference in most of the macro variables and level of domestic activities.

6.2. Macro effects of the oil subsidy scheme

**Scenario two:** The second scenario assumes that the government compensates domestic consumers for the price rise through an oil subsidy. The subsidy is used to compensate for the 50 percent increase in crude oil price and is modeled as a reduction in domestic sales tax on petroleum products.

As a result, the oil price shock still persists and the subsidy scheme leads to a 5.87 percent increase in prices of imported commodities in the domestic market. The real exchange rate of the Birr further depreciates by 6.4 percent leading to a rise in export by 5.28 percent, a bit less than the rise in the first scenario. Real imports further decline by 4.01 percent. The oil subsidy scheme reduces government savings so that fixed investments decline by 8.63 percent. Private consumption improves. However, the increase in private consumption is at
the expense of a lower level of fixed investments. It further declines as compared to the first scenario.

**The impact of oil subsidy on the level of domestic activities and labor demand**
The oil subsidy scheme brings improvement in output of the manufacturing and service sectors except for the construction sector. Output of construction sector declines further since high proportion of the investment spending goes to this sector. On average, production of the agricultural tradable goods, rise by 0.63 percent at a little lower rate than the rise in the first scenario. In parallel to the sector shift in production, workers move into the production of agricultural tradable goods and out of the construction sector.

### 6.3. The impact of oil price shock and oil subsidy on household consumption

The 2005/06 Ethiopian SAM data (EDRI 2009) showed that both rural and urban non-poor households have the largest share in oil consumption relative to poor households which implies that the effect of an oil price shock is high on rural and urban non-poor households compared with their respective poor households. Due to the oil price shock the consumption of rural and urban non-poor households dropped by 2.1 percent and 1.3 percent, respectively. Rural and urban poor households consume a small share of oil and they are the least affected, only by 0.9 and 1.69 percent respectively.

When the government subsidizes oil prices through borrowing, the oil price subsidy scheme improves the consumption of all households. The rural and urban non-poor households increase their consumption by 1.99 and 1.82 percentage points, respectively, compared to their consumption before (without subsidy) and which is higher than their counterpart poor households. Hence the rural and urban non-poor households benefited more by the oil subsidy compared to their poor counterparts, as shown in Table 6.4.

<table>
<thead>
<tr>
<th>Households</th>
<th>Government savings are flexible</th>
<th>Government savings are fixed</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Simulation 1 (sim 1)</td>
<td>Simulation 2 (sim 2) Sim 1 vs Sim 2 (percent difference)</td>
</tr>
<tr>
<td>Rural poor</td>
<td>-1.68</td>
<td>0.28</td>
</tr>
<tr>
<td>Rural non-poor</td>
<td>-2.09</td>
<td>0.04</td>
</tr>
<tr>
<td>Urban poor</td>
<td>-0.91</td>
<td>0.76</td>
</tr>
<tr>
<td>Urban non-poor</td>
<td>-1.25</td>
<td>0.55</td>
</tr>
</tbody>
</table>

Source: Authors’ compilation

We replicated the same experiment with alternative government closure, it is government savings are fixed. Where the government subsidizes oil price through taxation shows substantially different result in the macro variables, level of domestic production, labor demand, and household consumption.

Compared with the previous government closure, in the current government closure the level of exports largely increased on account of a further depreciation of the Birr. Since the oil subsidy scheme is financed through direct tax revenue it doesn’t affect the government
saving. Rather improvement in investment as a percentage of GDP and fixed investment as the expense of decline in private consumption is observed. The new subsidy scheme deteriorates the level of output and labor demand of almost all agricultural activities. While it improves the manufacturing sector output and labor demand with the exception of the construction sector.

The subsidy scheme deteriorates the households' welfare further since it has double burden, i.e. it decreases their disposable income and their level of oil consumption. Compared with the non-poor households poor households found to be more vulnerable to the subsidy scheme.

7. Conclusions

The international crude oil price has increased for the last two decades. Oil importing countries like Ethiopia are seriously affected by this price hike. Ethiopia is highly vulnerable to this shock because of its high oil energy intensity and complete dependence on imported oil. This paper attempts to analyze the impact of a 50 percent increase in international oil prices and the oil subsidy scheme to compensate this crude oil price increase, using the standard IFPRI's static CGE model. Under the fixed foreign savings and flexible government savings closure the oil price shock causes a 5.8 percent depreciation of the real exchange rate of the Ethiopian birr and brings about an increase in exports and a decline in imports in real terms. The depreciation of the birr also brings a rise in agricultural tradable goods output and a decline in manufacturing and service sectors output. The shock also deteriorates the purchasing power of the country and consumption of all households.

The rising oil prices in the international market are affecting the Ethiopian economy. It affects the balance of payments (BOP) and domestic prices through various channels. Higher fuel prices raise food prices reducing the purchasing power of the birr and in turn affecting the welfare of households since fuel and food are core elements of household budgets in Ethiopia.

The oil subsidy scheme under the flexible government savings scenario increases government expenditure and reduces government savings, hence, total investment falls. Output of the construction sector goes down because of the fall in investment demand. The oil subsidy improves consumption of all households at the expense of the aggregate level of investment. Urban households get the largest benefits in part because they consume more fuel than rural households. However, comparing the two scenarios rural households benefit from the oil subsidy scheme. Moreover, the findings indicated that the rural and urban non-poor households benefited more by the oil subsidy. In the short run, the oil price subsidy scheme improves household welfare. Nevertheless, in the long run oil subsidy is harmful since it absorbs high share of limited public resources, leads to lower investment, and reduces future growth.

Financing the oil subsidy scheme by increasing the tax rate on other goods brings improvement in investment but it distorts the level of domestic production and household welfare. From this, one can conclude that subsidy is an inefficient tool to reverse high oil price increases in Ethiopia. Rather, finding ways to substitute oil for other energy sources would be a remedy that would attack the core of the problem.
References


List of previously published EDRI Working Papers in order of publication


