Addis Ababa University, Ethiopian Journal of Business and Economics, EJBE Vol. 10, No 1,
DOI: https://dx.doi.org/10.4314/ejeb.v10i1.4 , p-ISSN: 2311-9772, e-ISSN: 2410-2393
Available online: https://ejol.aau.edu.et/index.php/ejbe and https://www.ajol.info/index.php/ejbe

The Impact of International Price Shock Transmission on the Ethiopian Economy: VECM and CGE Modelling Approaches

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Abstract

This study examines the impacts of selected cash crops (coffee and oilseeds) international price shock transmission on Ethiopia's macro economy in general and households' welfare in particular, which is transmitted to the domestic market via sales tax or value added tax. For the analysis, we employed the Vector Error Correction Model (VECM) and the Stage Computable General Equilibrium (CGE) Model. The VECM result confirms that international and domestic prices for both commodities have a long-term association and the domestic price is more elastic than the international price. The Stage CGE Model simulation result portrays that the positive shock transmission to domestic prices (domestic price increment) slows down the macro-economic performance of the country (GDP, government consumption demand, household consumption, investment demand, export and import) and vice versa. Moreover, households' welfare is better off when domestic prices of coffee and oilseeds rise and worse off when they fall, as the equivalent variation increases when prices rise and decreases when prices fall. The research result implies that policy makers need to investigate the international price trends of exportable commodities so as to forecast and design appropriate policies that assure the welfare of households and macro-economic stability. It is also recommended to formulate policies that enhance productivities, especially agricultural productivity, to offset fully or at least partially impacts on the macro-economy and households' welfare.

Keywords: CGE, VECM, price transmission, price variation, price shock

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Introduction

In today's era of globalization, the interdependence among countries has increased over time, and countries have become more integrated in international trade. In international trade, agricultural commodities are the most important trade items for Least Developed Countries in terms of export revenue earnings. Least Developed Countries (LDCs) export mainly agricultural commodities and import food items, machinery, equipment, and petroleum oil. The prices of agricultural commodities are highly volatile due to supply shocks and the influence of developed countries agricultural policies, and LDCs' economies are highly affected by price shocks (Haile et al., 2016).

Food prices had been declining from the early 1960s to the early 2000s, when they reached historic lows, and then started increasing slowly from 2003 to 2006 before surging upward. Commodity prices have shown remarkable peaks in the middle of 2008 and in 2011 and then went down in other years, though prices are still above their historical trends. According to the FAO food price index, the food price index increased by 7 percent in 2006 and 27 percent in 2007 and reached a peak in the first half of 2008, even if prices have steadily fallen since 2008 (FAO, 2009).

Historically, commodity price volatility has increased over the past 50 years, and in the period 2003–2010, the volatility reached its highest level. The volatility of commodity prices during the period 1974–1990 was greater than that during the period 1960–1972. The volatility boom occurred in the periods 1973–1974 and 1979–1981, then fell down and reached its lowest level in the period 1991–2002; this period is called "great moderation", meaning the period when the world economy exhibited high, stable, and non-inflationary rates of economic growth (UNCTAD, 2012). Von Arnim et al. (2015) also explained that commodities showed an extraordinary price boom since the early 2000s, with price peaks in the middle of 2008 and 2011 after decades of low commodity prices. Though a general price decline has been evident since 2014, prices of agricultural commodities remained above historical trends.

In developing countries whose main export earnings come from primary commodities, price volatility creates foreign exchange reserve instability, growth inconsistency, indebtedness, and macroeconomic instability. The more a country exports primary commodity, the more vulnerable

it is to commodity price shocks, and if a country earns the lion's share of its export earnings from a few commodities, price volatility exacerbates the incidence of poverty because the majority of the poor rely on the production of those commodities (UNDP, 2015).

Commodity price volatility increases risk and uncertainty, which discourages investment and in turn affects long-term economic growth. Countries that specialize in commodities with high price volatility see their terms of trade fluctuate, which attracts less foreign direct investment and lower economic growth rates (UNCTAD, 2012). Not only the price trends but also the international price transmission have attracted the attention of scholars and researchers. The degree of international price transmission to domestic markets depends on, but is not limited to, a country's exchange rates, import tariffs, infrastructure (transaction costs), and market structures.

Like other developing countries, Ethiopia has been depending on the export of agricultural commodities. Coffee accounts for 25.8 percent, oilseeds for 21.8 percent, pulses for 12 percent, and cotton for 8.4 percent of Ethiopia's total export (NBE, 2014/15). As the major share of Ethiopia's export earnings comes from agricultural commodities in general and coffee and oilseeds (476%) in particular, it is a victim of world commodity price volatility. According to UNCTAD (2012), Ethiopia and Uganda, whose major commodity export market is coffee, have experienced relatively high price volatility.

Different researchers tried to see the international price transmission to the domestic economy using time series analysis and vector error correction models (econometric price transmission analysis, PTA) and computable general equilibrium (CGE) models to see the impact and magnitude of price transmission from international to domestic markets. Siddig and Grethe (2014) investigated the impact of international price transmission on Israel's three commodity groups: wheat, other cereals, and other crops, using a single country CGE model using the 2004 Israel SAM. They found that the transmission of world market prices to the domestic market is heterogeneous. According to them, the extent of price transmission to Israel's economy depends on factors such as trade share, trade elasticity, production elasticity, factor mobility, and the exchange rate regime (world price transmission is higher under a fixed exchange rate regime than a flexible one if the domestic currency appreciates due to a world market price shock). Von Arnim et al. (2015) investigated the global commodity price shocks for Burkina Faso, Ethiopia,

and Mozambique using a structural CGE model, and their findings show that rising export commodity prices are beneficial, though the net effects may be low or even negative due to increasing import commodity prices.

There are also some studies being conducted in Ethiopia on this issue. For instance, Worako et al. (2008) investigated the impact of producer price and price transmission in a deregulated Ethiopian coffee market using co-integration and an error correction model (ECM). They came up with the result that the short-run world price transmission to domestic markets has improved since the reform (1992), and the domestic price adjusts more rapidly to world price changes today than it did prior to the reform (1992), but negative price transmission is faster than positive ones. Bellemare et al. (2013) studied the welfare impact of commodity price volatility in rural Ethiopia using panel data and found that the welfare gains from eliminating price volatility are increasing households' income, making food price stabilization a distributional regressive policy.

Kelbore (2013) studied the transmission of world food prices to the Ethiopian market for two commodities: wheat and maize, using co-integration analysis. He found that the domestic market for both commodities is integrated with the global market, although more so with geographically proximate markets, and the price transmission elasticities are higher than unitary for both commodities. Haile et al. (2016) analyzed the degree of vertical price shock transmission in the Ethiopian wheat-bread market value chain using a vector error correction model (VECM) and an impulse response analysis using monthly price data for the period 2000–2015. They found that the international price transmission is significantly seen at the downstream markets (flour and bread prices), while the domestic wholesale market price highly affects the upstream markets (producers' prices).

The aforementioned researches did not link the international price transmission to the domestic economy or the welfare effect on different households. Therefore, this study tried to thoroughly investigate the impact of major export commodities (coffee and oilseeds) on international price shock transmission on the domestic economy, identify which economic sector is highly affected by the price transmission, and assess the welfare impact on different households using a single country's Computable General Equilibrium (CGE) model.

Literature Review

Theoretical Literature Review

Price transmission refers to the fact that a change in one price causes another price to change. There are three types of price transmission: spatial price transmission, vertical price transmission, and cross-commodity price transmission. Spatial price transmission happens when a commodity is heavily traded between two regions or countries. It is the effect of a change in the price of a commodity in one country on the price of that commodity in another country if the two countries trade the commodity under consideration. In other words, the high price of a commodity in one market attracts inflows of that commodity from another market, and the price of the importing country falls and the price of the exporting country rises, which brings the prices of the commodity in both countries close to each other. This is called spatial price transmission.

Vertical price transmission occurs between the upstream and downstream markets. That means it occurs when the price of a good changes due to a change in the price of one of the inputs used to produce that good. The third one, which is a more complicated form of price transmission, is cross-commodity price transmission. It happens when a change in the price of a commodity causes a shift in demand to another substitute commodity, and as a result, the price of its substitute commodity changes.

The international price variations are different. Global price volatility can be caused by: climate shocks, pests, and other natural calamities; poor infrastructure (access to technologies); absence of credit or insurance markets; high transportation costs; petroleum oil price variations; policy and governance failures; policies of developed countries like maize demand for bio-fuel; and growing food demand in emerging economies.

The extent of international price variation transmission to domestic markets depends on the level of integration of the domestic economy to the global market (degree of market openness), exchange rate movements, level of trade barriers (import duties, export taxes, and non-tariff barriers), domestic policies such as price support, the degree of processing of final consumption goods, the level of domestic infrastructure development, and the efficiency of the level of market

structures. In a monopolistic market structure, higher global prices may not always translate into better prices for producers. Because of differences in the above-mentioned factors, the degree of price transmission and its subsequent impacts on domestic economies and respective households vary across different countries at a given time. The price variation transmission highly affects poor consumers and rural smallholders living in developing countries, whose livelihood depends on their own production.

The international price shock transmission to the domestic market is incomplete, which reduces the impact on food price volatility. When there is high price volatility, the welfare of the consumers who spend a large portion of their income on food is highly affected, and their spending on health, education, etc. falls, which aggravates the vulnerability of the poorer households (Gilbert and Morgan, 2011).

The market for most agricultural commodities is characterized by high degree of price variations due to market fundamentals such as natural factors (weather and pest) induce output variation from period to period, relatively small demand elasticities and low price and supply elasticities, at least in the short run, and prices highly vary to take demand and supply back after supply shock and agricultural production takes sometimes to respond to supply shock and stabilize the price.

Before 1776 when Adam Smith, the father of modern economics, developed the concept of absolute advantage, mercantilism was the dominant philosophy in international trade that means, nations export more to get more accumulation of precious metals and restrict imports so as to enrich the nation which is difficult to talk about price transmission as nations traded with bartering system. However, Adam Smith countered mercantilism idea and came with the idea of Absolute Advantage which states nations can gain simultaneously if they have free trade and specialize in the production and export of goods which they have high labor productivity or low cost of production as compared with other countries and import those goods which they have absolute disadvantage. The world price for a good is always in between the two prices under autarky that means, it is in between the higher price of a good when it is produced in a country that has absolute disadvantage and the lower price of that good when it is produced in a country, which has absolute advantage under no trade condition.

In absolute advantage theory, prices can transmit from one country to another since there are no trade barriers. The price transmission occurs in this way: when the price of a commodity in the importing country changes (increases or decreases), then workers feel the price change on their consumption goods and bargain with wage changes in the production of a good in which a country has an absolute advantage. This inflates the cost of production of the good, over which the country has an absolute advantage, and this in turn raises the world price. Therefore, based on the assumption of two countries, a price increase in one country's good, for which it has an absolute advantage, will increase the price of other tradable goods produced by the other trading partner.

Smith failed to see the possibility of making trade between two nations if one country has an absolute advantage in the production of both goods and the other nation has an absolute disadvantage in the production of both goods when comparing only labor productivity. However, David Ricardo (1817) came up with the idea of comparative advantage: nations can trade with each other even if one nation has an absolute advantage in the production of both goods by comparing the relative opportunity costs. According to D. Ricardo, a nation should specialize in the production of one good that has a lower opportunity cost than its trading partners.

Under an autarky situation, the wage of labor is the product of the marginal product of labor and the price of a good produced by that labor, which in turn is the product of the wage and the amount of labor employed in the production of that good. When there is international trade, the price of the good produced by a country that has a comparative advantage rises because of the additional demand abroad. This in turn increases the wages in both trading nations and then causes the price of the other nation's goods to increase since one of the assumptions of comparative advantage is price competition. In general, due to comparative advantage, due to the additional demand for a good abroad because of trade, the world price of the good increases, and through wages, the price increment is transmitted to the price of other goods produced by the other nation involved in trading.

The Heckscher-Ohlin (H-O) Resource Endowment Trade Model states that the pattern of trade reflects the relative endowment of productive resources. Countries should specialize in the production of goods that intensively use relatively low production factors and import those

goods, which use scarce resources intensively. According to the H-O trade model, in order for trade to occur between two nations, the terms of trade between the two countries must be at autarky prices. It also says that opening up trade benefits the relatively abundant factor of production and harms the scarce factor of production. It means that, when there is free trade, countries export those goods for which they deploy the most abandon factor of production, which creates additional demand and pushes the price up. This price increase in one commodity transfers to the price of another commodity produced in the other country: since the autarky price of a good that uses relatively little factor of production is less than the world price, countries export that good and production will increase, which needs more factor of production, and then factor cost will rise as a result of the price going up. This price increment is transferred to the other trading partner in the same way.

Empirical Literature Review

Ghoshray (2011) investigated the international price transmission to domestic prices of selected Asian countries (China, India, Indonesia, Malaysia, the Philippines, and Thailand) for selected thirteen commodities by applying co-integration and error correction models. His regression results portray different results for different countries and commodities. For India, wheat and tea are the two commodities that have long-run co-integration between international and domestic prices with price transmission elasticities of 0.11 and 0.54, respectively (that means for wheat, 11 percent, and for tea, 54 percent of world price change is transmitted to domestic prices).

In the Philippines, rice and coffee show long-run relationships between international and domestic prices with respective price transmission elasticities of 0.23 and 0.78. Beef in Thailand has price integration with the international price, with 42 percent of the global price variation going to Thailand's domestic beef price, with no immediate impact of a world price change. In Malaysia, rubber has both a short- and long-term relationship between world and domestic prices, with 89 percent of world price variation being transmitted to domestic prices in the long run. In the case of Indonesia, long-run price relations exist between global and domestic prices only for rice, and for China, soya bean oil and rice display long-run relations between international and domestic prices, with 50 percent of the world price change transmitted to domestic prices for both commodities.

Selliah et al. (2015) investigated the global food price transmission to Sri Lanka's domestic prices by applying co-integration and vector error correction (VECM) models to monthly price data starting from the first month of 2003 to the last month of 2013. They found that there is co-integration between global and domestic prices, that global prices have influence on domestic inflation rates, and that the price transmission for food items is greater than for non-food items.

The empirical literature conducted on the international price transmission effect to domestic economies using a CGE approach shows: Siddig and Grethe (2011) studied the international price transmission to the Israeli economy using a single-country CGE model and the Israeli Social Accounting Matrix (SAM) of 2004. For their analysis, they chose three commodities: wheat, other cereals, and other crops. Their findings show that at first, a 100 percent world price increase on the three commodities resulted in an increase in the domestic price of imports and export prices of 96 percent, while producer prices of wheat, other cereals, and other crops increased by 25 percent, 32 percent, and 74 percent, respectively. However, they observed that the price transmission is low and looked for other sensitivity analyses, making priori assumptions. Their result indicates that world market price transmission to the domestic market is greater for those sectors that have higher trade shares; increasing export prices together with low constant elasticity of transformation (CET) elasticity and high production elasticity result in negative effects on domestic consumer prices. The greater factor mobility, the higher price transmission; higher trade elasticity results in greater price transmission; higher production elasticity results in less price transmission; and world price transmission is higher under a fixed exchange regime than a flexible one if the domestic currency appreciates due to a world market price shock. Alam et al. (2016) examined the impact of trade liberalization and world price change in Bangladesh using a static single-country CGE model, and they found that world price increases have a negative impact on output, value added, factor wages, household income, and welfare.

Conceptual Framework

The review of theories and empirical evidence depicts that price variation occurred due to supply shock-induced factors such as climate change and natural calamities (drought, flood, pests), access to credit, insurance, and technology for producers, agricultural infrastructure

development, oil and fertilizer prices, and trade barriers and export restrictions, as well as demand-driven factors such as world food demand, bio-fuel and ethanol demand, and futures market speculations.

These factors cause the global price to vary, and the global price variation is transmitted to domestic markets and causes the domestic price to fluctuate. However, the degree or extent of global price transmission to the domestic economy depends on import-export policies, market openness, exchange rate policy, market structure and efficiency, infrastructure, and the price support policies of countries. When the international price of export commodities falls, countries borrow to finance their imports, resulting in growth variability, macroeconomic instability, foreign currency reserve variation, risk and uncertainty in crop production and foreign direct investment, food insecurity and welfare deterioration, and foreign debt accumulation.

Data and Methods

A secondary source of data is employed for the econometric regression, and the type of data used in this paper is international and domestic monthly prices of coffee and yearly prices of oilseeds. The domestic price of coffee data was gathered from Ethiopian Commodity Exchange auction price data from January, 2009, to June, 2016, while the international price of coffee data was collected from the International Coffee Organization (ICO) website monthly composite price with the same time span. Regarding oilseeds, it is very difficult to get organized price data for all oilseed types produced and traded domestically and internationally. As a solution, the sesame seed price is taken as a proxy for the oilseed price since sesame seed is the major export commodity in Ethiopia, which accounts for about 80 percent of the total oilseed export income. Both the domestic and international price of sesame seed is collected from the Food and Agricultural Organization (FAO) website agricultural commodity statistics price data. For CGE simulation, the 2009/10 Ethiopian Social Accounting Matrices (SAM) developed by the Ethiopian Development Research Institute (EDRI) are used.

Econometrics Model Specification

In theory, price data are non-stationary, and it is difficult to use the traditional simple regression analysis. Therefore, co-integration analysis is ideal to represent how non-stationary variables are

linked in the long run, though they can diverge from it in the short run. The co-integration model reveals both short- and long-run dynamics in price interdependence. Its empirical specification takes the form of the Vector Error Correction Model (VECM), which can be intended as the natural development of the Vector Autoregressive (VAR) model and the re-parameterization of the Autoregressive Distributed Lagged (ARDL) model. The standard VECM can be written as follows (Engle and Granger, 1987): In theory, price data are non-stationary, and it is difficult to use the traditional simple regression analysis. Therefore, co-integration analysis is ideal to represent how non-stationary variables are linked in the long run, though they can diverge from it in the short run. The co-integration model reveals both short- and long-run dynamics in price interdependence. Its empirical specification takes the form of the Vector Error Correction Model (VECM), which can be intended as the natural development of the Vector Autoregressive (VAR) model and the re-parameterization of the Autoregressive Distributed Lagged (ARDL) model. The standard VECM can be written as follows (Engle and Granger, 1987):

$$\Delta P_{1t} = \alpha\beta' P_{1t-1} + \sum_{i=1}^{k-1} \Phi_i \Delta P_{2t-i} + \mathcal{E}_t$$

Where P_{1t} and P_{2t} are the (nx1) vector of prices at time ***t*** and places 1 and 2, α (nxr) is the loading matrix which contains the adjustment parameters towards the equilibrium (the speed of price transmission), β (nxr) is the co-integration matrix containing the ***r*** long run relationships (co-integration vectors) expressing the degree of price transmission (when prices are expressed in logs, the coefficients of β can be read as price transmission elasticities; Φ_i (nxn) matrices containing coefficients expressing short run responses to price shocks, it is a conventional (nx1) vector of zero mean, unit variance and independent and identically distributed disturbances.

Stage CGE Model

The standard CGE model explains all of the payments recorded in the SAM, and therefore the model follows the SAM disaggregation of factors, activities, commodities, and institutions (households, government, and the rest of the world). The model is written as a set of simultaneous equations, many of which are non-linear. The equations define the behavior of different actors such that production and consumption decisions are driven by the maximization

of profits and utility, respectively, using first-order optimality conditions. The equations also include a set of constraints that have to be satisfied by the system as a whole, which covers markets (for factors and commodities), macroeconomic aggregates (balances of savings and investment), the government, and the current account of the rest of the world (Lofgren et al., 2002). The SAM is a double-entry square matrix; entries represent payments from column accounts to row accounts, and the corresponding row and column sums must be balanced since they portray the double-entry receipt-expenditure accounts of the various economic actors (McDonald and Thierfelder, 2009).

To make a simulation, it is important to select the appropriate parameter. The Ethiopian 2009/10 SAM shows that there is no export tariff for every export and no tariff figure on the import of coffee and oilseeds (since Ethiopia is a net exporter of coffee and oilseeds). The only parameter applicable for both coffee and oilseeds in SAM is sales tax. But, in Ethiopia's case, sales tax is substituted by value-added tax (VAT). Therefore, value added tax is used as a simulation parameter as a proxy for price shock transmission. The following scenarios are simulated: (1) Increasing the domestic price of selected export cash crops' price by 20%. (2) Reducing the domestic price of selected export cash crops' price by 20%

Results and Discussions

Results of Co-integration Test

Before testing for long-run co-integration, it is indispensable to determine the optimal lag length and number of co-integration equations in the model. The lag selection order criteria result shows that the optimal lag length for coffee prices is 2 lags, since the majority of the tests (likelihood ratio-LR, Akaike information criteria-AIC, final prediction error-FPE, and Hannan Quinn information criteria-HQIC) confirm that the lag length is 2. The lag length for sesame seed price is three (lags) because four of the lag selection order tests (likelihood ratio (LR), Akaike information criteria (AIC), final prediction error (FPE), and Hannan criteria (HQIC) show that the lag length is three.

The third precondition for estimating VECM parameters is testing for the long-run relationship between time series variables. If the variables under consideration have long-run relations, one can proceed to VECM; but if the variables are not co-integrated or they do not move together in

the long run, we need to go back to vector autoregressive (VAR) regression with the first difference of the variables (I) (1). Johansen (1995) developed three types of tests for long-run co-integration between variables. These are Johansen's trace statistic method, the maximum Eigen value statistic method, and the information criteria minimizing method. The third method, the information criteria minimizing method, uses to solve problems of co-integration in the first two methods. This method chooses the number of co-integration equations that minimize either SBIC or HQIC, which provides a consistent estimator of the number of co-integrating equations.

Therefore, considering the above fact, the Johansen co-integration test of the trace statistic and the maximum Eigen value statistic failed to show a long-run relationship between domestic and world coffee prices, and the third alternative method was chosen for the coffee price model. Coffee price model has one co-integration equation based on information criteria minimizing method of co-integration test. On the other hand, the Johansen trace statistic and maximum Eigen value depict that the oilseed price model has one co-integration equation. The co-integration statistic result is presented in Table 1.

Table 1

Johansen Test of Co-Integration

Sesame seed Price Model		Coffee Price Model		
Hypothesis	Trace Statistics	5% Critical Value	SBIC	HQIC
H_0: rank=0 H_1: rank>0	37.808	15.41	-5.7751	-5.8760
H_0: rank ≤1 H_1: rank>1	1.549**	3.76	-5.7888**	-5.9401**

*** shows the null hypothesis (H0) is not rejected with 5% significance level critical values; H_0 stands for null hypothesis and H_1 stands for alternative hypothesis.*

VECM Regression Results

The co-integrated VECM parameters estimation result shows both the long-run and short-run dynamics of price data. Since the price variables are transformed into logarithmic form, the coefficients measure price transmission elasticities. The long-run equations of coffee and oilseeds can be interpreted by normalizing the coefficients of the domestic prices of coffee and

oilseeds to one. The long run coefficients for coffee and oilseed prices are negative and significant, which reveals that the domestic prices of coffee and oilseeds are below the long run equilibrium. This means the domestic price of coffee and oilseeds should adjust upward to stay in equilibrium, and the short-run adjustment coefficients, or error correction terms, help to restore the deviations back to equilibrium. The finding shows that, in the long run, when there is a unit percentage change in the international price of coffee and oilseeds, there would be a 1.11 and 1.12 percentage change in the domestic price of coffee and oilseeds, respectively.

Table 2

Long Run Relationship Between Prices (Domestic Price and World Price)

Coffee		Oilseeds	
Variable	Co-integration Coefficient	Variable	Co-integration Coefficient
Logdomcoff_p	1	Logdomss_p	1
Logworcoff_p	-1.11** (0.119)	Logworss_p	-1.12** (0.071)
Intercept	0.929	intercept	0.712

*** Represents statistical significance at 5% level and standard errors of coefficients are in parenthesis*

The short-run dynamics are presented in table 3. In the short run dynamics, the error correction terms (adjustment coefficients) for both coffee and oilseed prices have the expected negative sign, and they are statistically significant at the 5% level of significance. Coffee and oilseeds each have one significant error correction term (ECT). The error correction terms show that the speed of adjustment towards long-run equilibrium, after a one-time short-run price shock, is faster in the coffee price than the oilseeds price. In other words, the domestic price of coffee moves back to equilibrium within 21 days after a price shock occurs.

While for oilseeds, once a short-run price shock happens, it takes 1.55 years for it to adjust itself towards long-run equilibrium. The short run coefficient for the world coffee price is positive and significant, which is compatible with the theory that if the long run co-integration coefficient is negative, the short run coefficient would be positive to show its upward movement to the long run equilibrium. With the same token, the short run coefficients for oilseeds prices are positive, but the first difference coefficient is statistically insignificant while the second difference coefficient is statistically significant; the domestic price moves upward towards long run

equilibrium after a one-time world price shock happens. Moreover, both the domestic and world prices of coffee are influenced by their own lagged prices. In the case of oilseed prices, the second-lagging world oilseed price influences the domestic oilseed price.

Table 3

VECM Short Run Estimated Results and Adjustments Coefficients

Coffee			Oilseeds		
Variables	Δlogdomc	Δlogworcoff_	Variables	Δlogdomss_p	Δlogwo
ECT_{t-1}	-0.205**	0.031	ECT_{t-1}	-1.55**	0.087
	(0.064)	(0.058)		(0.339)	(0.251)
$\Delta logdomcoff\_p_{t-1}$	0.228**	-0.134	$\Delta logdomss\_p_{t-1}$	0.262	-0.296
	(0.116)	(0.105)		(0.244)	(0.18)
			$\Delta logworss\_p_{t-2}$	0.24	-0.099
				(0.188)	(0.139)
$\Delta logworcoff\_p_{t-1}$	0.145	0.406**	$\Delta logdomss\_p_{t-1}$	0.44	0.46
	(0.143)	(0.131)		(0.32)	(0.237)
			$\Delta logworss\_p_{t-2}$	0.80**	-0.244
				(0.317)	(0.235)
Dummy (dd)	0.013	-0.016	dd1	-0.12	-0.08
	(0.015)	(0.014)		(0.065)	(0.048)
			dd2	-0.013	0.099
				(0.08)	(0.059)
Intercept	0.002	0.009	Intercept	0.006	0.105**
	(0.009)	(0.008)		(0.061)	(0.45)
No. of Obs.		88	No. of obs.	50	
R-squared	0.207	0.127	R-squared	0.5342	0.3493
F-statistics, P-value	0.0006	0.034	F-statistics, P-value	0.00	0.004

*** stands for statistically significant at 5% significance level and standard errors are in parenthesis.*

CGE Simulation Results

The Impact of Selected Cash Crops Price Variation on the Macro-economy:

The international price shock is transmitted to domestic prices of export commodities and has a significant impact on the macroeconomy of the domestic economy. In our case, when the domestic prices of selected cash crops (coffee and oilseeds) rose and fell by the same amount, it impacted differently on the Gross Domestic Product (GDP), government consumption demand, household consumption, investment demand, national savings, and trade balance. When the domestic price of coffee and oilseeds increases, all the macro-economic indicators are negatively affected. As the domestic price increases, demand for domestically produced commodities reduces, consumers tend to shift to relatively cheaper imported commodities, and supply for domestically produced commodities will fall so as to equilibrate demand and supply. The fall in supply and output has a direct impact on factors of production, demand, and factor income. Because of the slowdown in factor income and tax revenue from households' and enterprises, GDP growth was negatively affected. GDP is measured at factor cost and tax.

The government gets income from tax revenues and foreign transfers. Though tax revenue from sales tax (VAT) and the foreign transfer increases, its major source from households' income tax, enterprise income tax, and import tariffs reduces, which in turn hinders its consumption demand. Moreover, due to the domestic price increment, consumers spend more money in order to maintain their utility level, and their income left for savings will be reduced. The fall in demand for commodities, coupled with low savings, discourages investment demand.

Regarding the trade balance (export-import performance), when domestic prices rise, the domestic market will be more attractive than the export market, and thus producers tend to sell to domestic markets and exports fall. However, due to low demand for domestically produced commodities, consumers shift to relatively cheaper import commodities, resulting in an increase in imports. To maintain the Balance of Payments at equilibrium, the equilibrating variable, the exchange rate, depreciates. When the exchange rate depreciates, the imported commodities become relatively expensive, making them uncompetitive in the domestic market. Demand for imported commodities falls, and then imports are reduced.

Table 4

Selected Cash Crops Price Variation Impact on Selected Macro-Economic Indicators

Macro-economic Indicators	Price Variation	
	20% price increase	20% price fall
Nominal GDP (at factor cost)	-0.207	0.207
Government Consumption Demand	-0.042	0.042
Households Consumption	-0.251	0.251
Investment Demand	-0.038	0.038
National Savings	-0.042	0.042
Export	-0.064	0.064
Import	-0.110	0.110

Source: Own Computation Based on Simulation Results

The reverse is true when the domestic price of cash crops falls. When the domestic price for coffee and oilseeds falls, demand for commodities increases. Producers are incentivized to produce more so as to meet the growing demand, and they need more factors of production. Factors get more income, and this income is distributed to households. Thus, households consume more and save more since they can maintain their utility level with less income, and this attracts more investment demand and increases domestic output and GDP. Moreover, the domestic market is not attractive since domestic prices went down. Thus, producers prefer to sell to the export market, and exports increase while imports decrease due to low demand for imported commodities. This pushes the exchange rate to be appreciated to equilibrate the balance of payments.

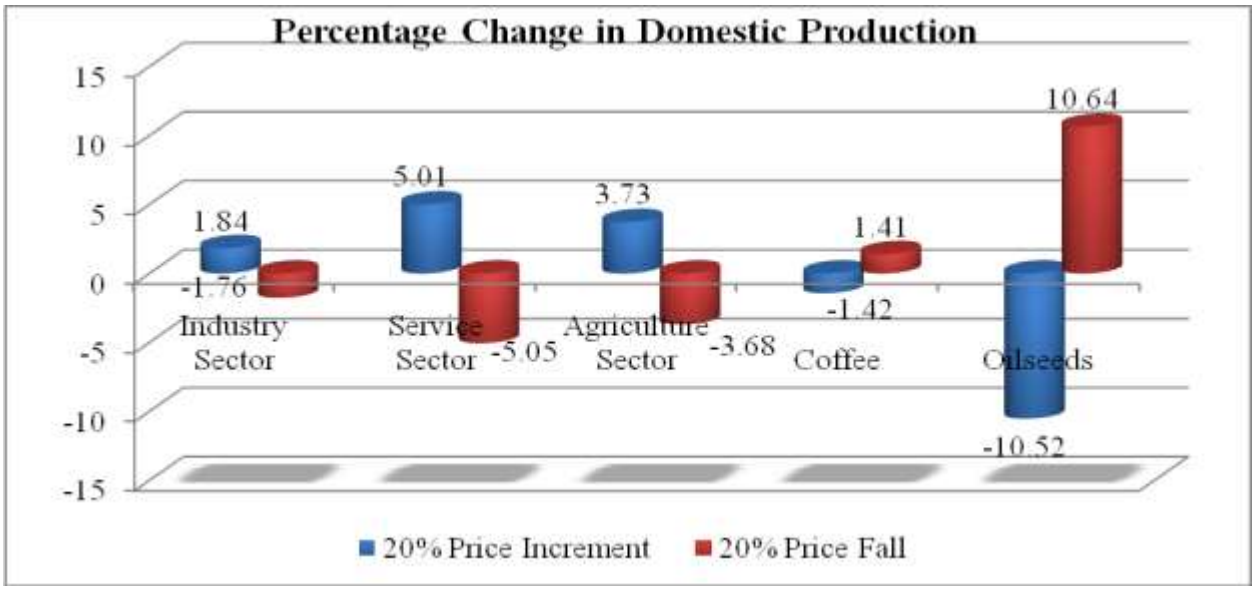
As the exchange rate appreciates, imported commodities become relatively cheaper, consumers shift their demand to imported commodities, and imports increase. However, the country faces a trade deficit because the increase in imports outweighs the increase in exports. Households' consumption is highly affected (both positively and negatively) by domestic price variation, followed by GDP growth and imports. Households are affected highly because they get income from different sources: factor income, transfer income from the rest of the world, and real transfer income from the government. Thus, price variation affects these sources of income at the same time and thus households' income and consumption.

The Impact of Selected Cash Crops Price Variation on Domestic Output:

The simulation result shows that when there is an increase in the domestic price of selected cash crops (coffee and oilseeds), the domestic output of coffee and oilseeds decreases by 1.42 and 10.52 percent, respectively, while the same amount of price fall has an inverse impact on coffee and oilseeds, resulting in a 1.41 and 10.64 percent increment in the output of coffee and oilseeds, respectively. This is because when the domestic price increases, demand for these commodities falls, households shift their consumption to other commodities, and the output of cash crops under consideration falls. In addition, the VEM result confirms that oilseeds are more price elastic than coffee, and as a result, price variation impacted more oilseeds output than coffee output. In terms of sectoral impact, the result is opposite to the coffee and oilseeds sub-sectors and different from expectations. Prices for selected cash crops and sectoral output (domestic production) have a positive correlation. However, the service sector is more influenced by price variation than agriculture and industry sectors, with a 5.014, 3.725, and 1.84 percent increment in output and a 5.051, 3.676, and 1.763 percent fall in output as prices increase and decrease, respectively. This is because of the role of exchange rates on the economy, as detailed in the above section 5.2.1: when domestic prices increase, the exchange rate depreciates and income earned from the service sector in terms of local currency increases.

Figure 4.1

Percentage Change in Domestic Production



Source: Own Computation of CGE Simulation Result

The reason for the greater responsiveness of the service sector to domestic price variation is that when domestic prices increase, producers prefer to sell to the domestic market rather than exporting their products, and then exports fall. This creates a foreign currency reserve shortage, and the exchange rate depreciates in order to equilibrate the current account balance by reducing imports, making imported commodities relatively expensive. Domestic products sold in foreign currency, on the other hand, benefit more from exchange rate depreciation. Service sector is the one that can benefit more from exchange rate depreciation since the major share of service sector activity comes from transport activity (from Ethiopian Airlines as shown from 2009/10 Ethiopian SAM). Therefore, the domestic price variation impact is seen significantly on the service sector because of the depreciation of the exchange rate.

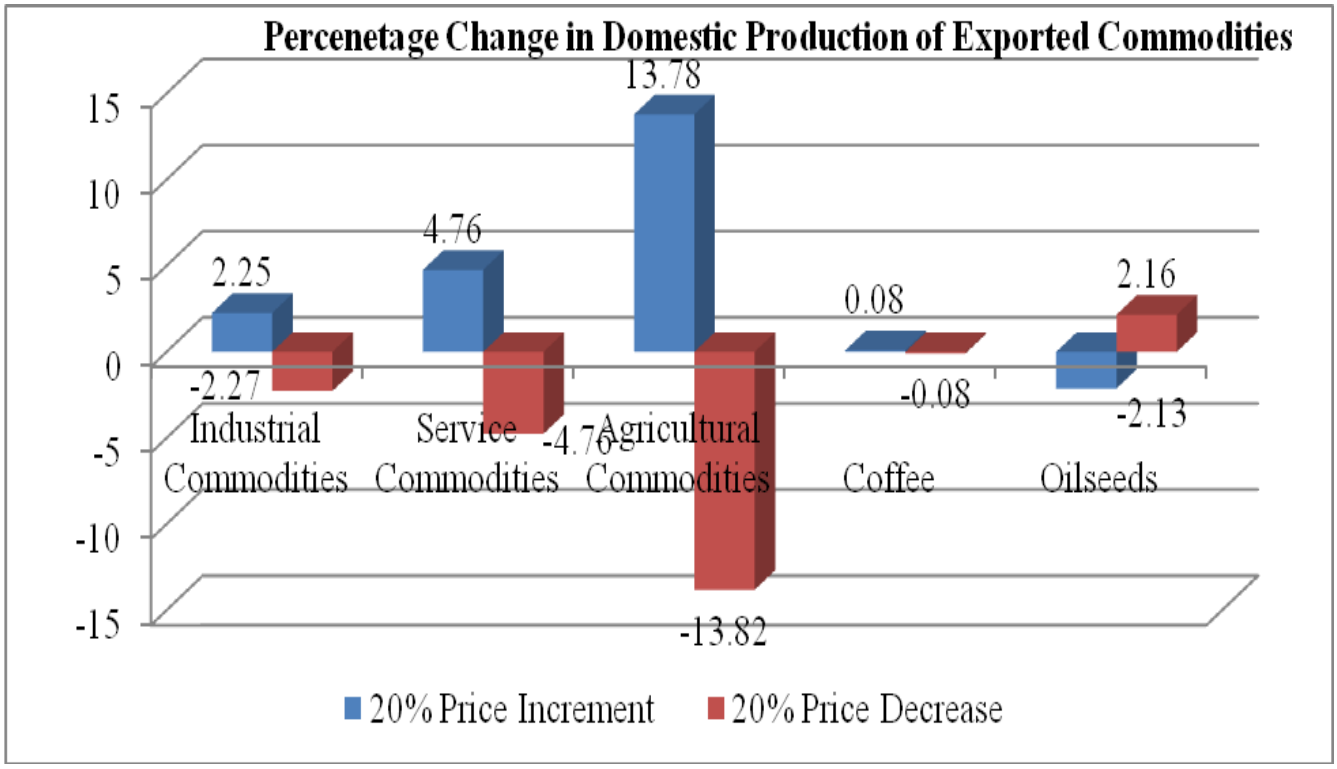
The Impact of Selected Cash Crops Price Variation on Exported Output

The domestic price variation has an opposite impact on coffee and oilseeds exports; the domestic price and coffee exports have a positive relationship, while there is a negative association between oilseeds export and the domestic price. For oilseeds export, it is obvious that when the

domestic price increases, producers tend to sell to domestic markets since it is more attractive than the export market, and then oilseeds export decreases. When it comes to coffee exports, this does not work because of the coffee export regulation set by the government of Ethiopia. The regulation mandates that any standard export coffee should be exported, whatever the price the international market pays. Therefore, in the long run, when the domestic price increases, producers are encouraged to produce more, and at the same time, coffee exports increase since standard export coffee goes only to the export market. On the other hand, when the domestic price falls, producers shift factors of production (since factors are mobile across activities) to other cash crops, and in the long run, coffee production decreases and coffee exports also fall.

Figure 2

Percentage Change in Domestic Production of Exported Commodities



Source: own computation based on CGE Simulation Results

As shown in figure above, the domestic price variation for coffee and oilseeds has a direct relation with domestic output of exported commodities (other than coffee and oilseeds). This can be justified as follows: as explained in the above sections, when the domestic price for coffee and oilseeds increases, exports fall, imports rise, and the exchange rate depreciates. When the exchange rate depreciates, export prices increase, and producers tend to export due to low domestic demand and high export prices. Then, domestic output for exported commodities increases, and vice versa when the domestic price for coffee and oilseeds decreases.

The Impact of Selected Cash Crops Price Variation on Households Welfare

Factors get income from sales of their services to activities. The simulation result shows that factors are worse off when domestic prices rise and better off when they fall. This is because when domestic prices increase, demand for commodities and domestic output fall. As shown above, the price increases impacted coffee and oilseeds production negatively, and this, complemented with low investment demand due to low savings, reduced the demand for factors of production. This pushes down the factor price and income for factors. Furthermore, when domestic prices rise, households spend the majority of their income to maintain the same level of satisfaction, reducing household savings. Since investment is driven by savings, when households' savings decrease, investment will fall, factor demand and factor price will reduce, and then factor income will be affected negatively. The opposite is true when the domestic price decreases. When prices fall, consumers demand more commodities, and there is a gap between demand and supply of commodities. Thus, producers produce more to narrow the supply gap, and demand and prices for factors increase. As a result, factor income increases. As seen in the Ethiopian 2009/10 SAM, the income for land and agricultural labor is heavily influenced by price fluctuations because agriculture is their sole source of income.

Table 5

Impact of Price Variation on Factor Income (Percentage Change)

Factor	20% Price Increment	20% Price Fall
Capital	-0.12	0.12
Agricultural Drought Prone Labor	-0.31	0.32
Agricultural Highland Cereal Labor	-0.30	0.30
Agricultural Humid Lowland Labor	-0.29	0.29
Agricultural Pastoralist Labor	-0.30	0.30
Skilled Labor	-0.10	0.10
Semi Skilled Labor	-0.13	0.13
Unskilled Labor	-0.25	0.25
Drought Prone Livestock	-0.18	0.18
Highland Cereal Livestock	-0.19	0.19
Humid Lowland Livestock	-0.19	0.19
Pastoralist Livestock	-0.18	0.18
Drought Prone Land	-0.46	0.46
Highland Cereal Land	-0.43	0.43
Humid Lowland	-0.45	0.45
Pastoralist Land	-0.39	0.39

Source: Own Computation Based on Simulation Results

The Impact of Selected Cash Crops Domestic Price Variation on Households' Income

In Ethiopia's case, households' get income from factors of production, transfers from the government, and transfers from the rest of the world. The simulation output portrays that price variation has the opposite impact on households' income. When the domestic price of coffee and oilseeds increases, households' income reduces, and the opposite happens when the domestic price falls. This is because when prices increase and demand for commodities decreases, demand and income for factors of production reduce, and in turn, households' income earned from factors of production falls. As indicated on the Ethiopian 2009/10 SAM, more than 85 percent of households' income comes from factors of production, and the fall in this source of income has a

great impact on households' income status. In addition, when domestic prices increase, transfers from the government decrease, and vice versa.

Table 6

Impact of Selected Cash Crops Domestic Price Variation on Households' Income

	Percentage Change in Income	
Households	20% Price Increment	20% Price Fall
Drought Prone Non-Poor Households	-0.211	0.211
Drought Prone Poor Households	-0.267	0.267
Highland Cereal Non-Poor Households	-0.219	0.219
Highland Cereal Poor Households	-0.284	0.285
Humid Lowland Non-Poor Households	-0.188	0.188
Humid Lowland Poor Households	-0.237	0.238
Non-farming Non-poor Households	-0.141	0.141
Non-farming Poor Households	-0.155	0.155
Pastoralist Non-poor Households	-0.221	0.221
Pastoralist Poor Households	-0.284	0.284
Large Urban Non-Poor Households	-0.134	0.134
Large Urban Poor Households	-0.154	0.154

Source: Own Computation Based on Simulation results

The other important reason for households' income changes is the exchange rate. When the domestic price increases, the exchange rate depreciates in order to keep the current account balance at equilibrium by discouraging imports. This exchange rate depreciation has a direct impact on income earned from the rest of the world. Since the exchange rate is depreciated, the income from the rest of the world in terms of local currency increases. That is why urban households' income reduction is smaller than rural households' income reduction because the fall in factor income is partially offset by the increment in income from the rest of the world (urban households are the major receiver of income from ROW). Rural households' income increases and decreases by 2.21 percent when the domestic price falls and rises, respectively. While urban households' income increases and decreases by the same 0.29 percent when the domestic price for cash crops falls and rises, respectively.

Table 7

Impact on Rural and Urban Households' Income

Household Category	Percentage Change in Income	
	20% Price Increase	20% Price Fall
Rural Households	-2.21	2.21
Urban Households	-0.29	0.29

When the domestic price falls, households get better income due to the increment in income from factors of production. Moreover, a fall in domestic prices encourages households' savings, which further initiates more investment to balance the savings-investment cycle. This expansion in investment needs more factors of production and, hence, a higher factor price and higher income. Thus, households that earn more from the sales of factor services will have more income.

Impact of Selected Cash Crops Price Shock on Consumer Prices of Selected Commodities

The prices of selected cash crops (oilseeds and coffee) have opposite impacts on the prices of other commodities. When the domestic price of coffee and oilseeds increases, aggregate demand for commodities falls, and consumers shift their consumption to other imported commodities. The fall in aggregate demand will push down the consumer price of commodities. Since consumers have two sources of supply for commodities: domestic production and imports, they shift consumption to the relatively cheaper commodities, and the price of composite commodities falls. When domestic prices for coffee and oilseeds fall, aggregate demand for commodities increases, and this pushes the consumer price of composite commodities' upwards.

Table 8

Impact of Selected Cash Crops Price Shock on Consumer Prices of Selected Commodities

	Commodity Price (Percentage Change)	
Selected Commodities	Positive Price Shock	Negative Price Shock
Milk	-0.21	0.21
Barley	-0.30	0.30
Food	-0.28	0.28
Fruits	-0.28	0.28
Grain Mill Products	-0.22	0.22
Maize	-0.32	0.32
Pulses	-0.30	0.30
Teff	-0.30	0.30
Vegetables	-0.32	0.32
Wheat	-0.25	0.25

Source: Own Computation Based on Simulation Results

Welfare Impact of Price Variation

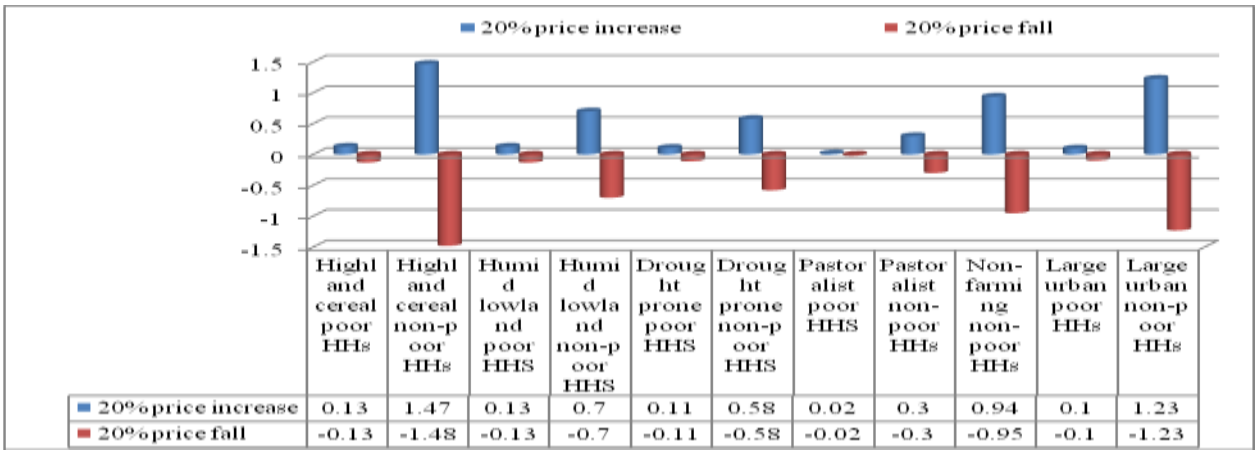
Welfare is measured considering the income level and price of commodities, and it is measured using equivalent variation (EV). EV can be thought of as the amount of money the consumer would accept as a result of the price change. It also measures the difference between attaining the initial utility level at initial and subsequent prices. EV is negative if the price and income change would make the consumer worse off and positive if the price and income change would make consumers better off.

Simulations under the two scenarios have different results on households' welfare. The Equivalent Variation (EV) simulation result confirms that households are better off when the domestic price of coffee and oilseeds increases and worse off when the prices of these commodities fall. This is because, as shown in the above table, both household income and the price of commodities fall when the price of coffee and oilseeds increase, and vice versa. EV increases when the domestic price of coffee and oilseeds increases because the reduction in

commodity prices outweighs the loss in households' income, and the opposite is true when the domestic price of coffee and oilseeds falls.

Figure 3

Impact of Selected Cash Crops Domestic Price Variation on Welfare



	Highland cereal poor HHs	Highland cereal non-poor HHs	Humid lowland poor HHS	Humid lowland non-poor HHS	Drought prone poor HHS	Drought prone non-poor HHS	Pastoralist poor HHS	Pastoralist non-poor HHs	Non-farming non-poor HHs	Large urban poor HHs	Large urban non-poor HHs
20% price increase	0.13	1.47	0.13	0.7	0.11	0.58	0.02	0.3	0.94	0.1	1.23
20% price fall	-0.13	-1.48	-0.13	-0.7	-0.11	-0.58	-0.02	-0.3	-0.95	-0.1	-1.23

Source: Own Computation Based on Simulation Results

Highland cereal non-poor households, large urban non-poor households, non-farming non-poor households, lowland humid non-poor households, and drought-prone non-poor households are the most affected household categories due to the fact that their main source of income is from factor of production; 71.68%, 87.01 percent (plus 12.99% from ROW), 95.46%, 80.49%, and 79.78%, respectively.

Conclusion and Policy Implications

This study tried to examine the impact of selected cash crops international price shock transmission on the overall economy of Ethiopia, production sectors, and households' welfare using a vector error correction model and a stage-computable general equilibrium (CGE) model. The VECM regression is done using international and domestic coffee and oilseeds price data (coffee price data from January 2009 to June 2016 and oilseeds data from 1970 to 2013) obtained from FOA Stat (for oilseeds price and world coffee price) and Ethiopian Commodity Exchange price data (for domestic coffee price), and the result confirms that the international and domestic prices for both coffee and oilseeds have a long-run relationship and the domestic price is more elastic than the international price.

The CGE simulation is done using the Stage CGE model developed by McDonald and Thierfelder (2009) with the simulation scenarios of a 20 percent domestic price shock for coffee and oilseeds. The simulation outcome shows that domestic price increment impedes macro-economic performance in general and GDP growth in particular and that domestic price fall enhances macro-economic performance and GDP growth. When it comes to domestic production and export, coffee and oilseeds price increases affect coffee and oilseeds production negatively, while the overall sectoral impact is positive as agricultural, industrial, and service outputs improved, with the service sector being more affected than other sectors. The price fall has had the opposite effect on coffee and oilseed production in particular and agriculture, industry, and service sector output in general. Regarding exported commodity output, price increment enhances coffee exports and discourages oilseed exports, but price fall slows down coffee exports and enhances oilseed exports. Agricultural commodity export performance is more heavily affected by domestic variation than other sectors. Though factor income and household income fall when the domestic price of coffee and oilseeds increases and increase when the price falls, the overall welfare of households is improved when the price falls when the price falls.

Formulating appropriate policy options is a challenging task for policymakers. In today's era of globalization, countries' economies are highly interdependent, and any policy change and/or macro-economic shock in one country has great implication for another country's economy. Price shock is one of the external shocks that can be transmitted to the domestic economies of trading nations, and policymakers need to be well informed to design policies that consider the positive and negative impacts of price shock transmission on the domestic economy and households' welfare.

Policy makers need to design appropriate policies that stabilize the macro economy in general and maintain households' welfare in particular. To minimize the impact of price shock transmission, the government needs to work on productivity enhancement among smallholder farmers. In addition, policies should be designed to target all categories of households and their income status so as to benefit all parts of the society fairly. It is also recommended to reduce reliance on primary commodity exports, which means diversifying export products is critical to reducing the burden of external price shock transmission on the domestic economy

(diversification in terms of primary commodities and shifting away from primary commodities toward more value-added commodities).

This paper is limited in scope and methodology, and it can be used as a springboard for further research on the magnitude of price shock transmission on selected cash crops domestic prices; it can widen the scope by including more cash crops and import commodities; and it can examine the impact of price shock transmission on the domestic economy and households' welfare.

References

Alam, M. J., Buysse, J., Begum, I. A., Nolte, S., Wailes, E. J., & Van Huylenbroeck, G. (2015). Impact of trade liberalization and world price changes in Bangladesh: a computable general equilibrium analysis. *Agricultural and Food Economics*, *4*, 1-22.

Deaton, A. (1980). Measurement of welfare: Theory and practical guidelines.

NBE (2014/15). National Bank of Ethiopia: Annual Reports

Von Arnim, R., Tröster, B., Staritz, C., & Raza, W. (2015). *Commodity dependence and price volatility in least developed countries: A structuralist computable general equilibrium model with applications to Burkina Faso, Ethiopia and Mozambique* (No. 52). ÖFSE Working Paper.

Ghoshray, A. (2011). Underlying trends and international price transmission of agricultural commodities. *Asian Development Bank economics working paper series*, (257).

Bellemare, M. F., Barrett, C. B., & Just, D. R. (2013). The welfare impacts of commodity price volatility: evidence from rural Ethiopia. *American Journal of Agricultural Economics*, *95*(4), 877-899.

Ricardo, D. (1817). *On the Principles of Political Economy and Taxation: London*.

Engle and Granger (1987). Co-integration and Error Correction: Presentation, Estimation and Testing, Econometrica, 55, 251-276.

EDRI (2009). Ethiopian Development Research Institute: Ethiopia: Input Output Table and Social Accounting Matrix.

FAO (2009). The State of Agricultural Commodity Markets; High Food Prices and the Food Crisis Experiences and Lessons Learned.

Gilbert and Morgan (2010): Food Price Volatility; Philosophical Transactions of the Royal Society, 365, 3023-3034.

Lofgren, H., Harris, R. L., & Robinson, S. (2002). *A standard computable general equilibrium (CGE) model in GAMS* (Vol. 5). Intl Food Policy Res Inst.

Johansen, S. (1991). Estimation and Hypothesis Testing of Co-integration Vectors in Guassian Vector Autoregressive Models, econometrica, 59, 1551-1580.

Kelbore, Z. G. (2013). Transmission of world food prices to domestic market: The Ethiopian case.

Haile, M. G., Kalkuhl, M., Algieri, B., & Gebreselassie, S. (2016). *Analysis of Price Shock Transmission: Case of the Wheat-Bread Market Value Chain in Ethiopia* (No. 2201-2019-1470).

McDonald, S., & Thierfelder, K. (2009). STAGE_LAB: An applied general equilibrium model with enhanced labour markets: technical documentation. *STAGE_LAB version*, *1*.

Selliah, S., Applanaidu, S. D., & Hassan, S. (2015). Transmission of global food prices to domestic prices: Evidence from Sri Lanka. *Asian Social Science*, *11*(12), 215.

Siddig, K., & Grethe, H. (2014). International price transmission in CGE models: how to reconcile econometric evidence and endogenous model response?. *Economic Modelling*, *38*, 12-22.

UNCTAD (2012). Excessive Commodity Price Volatility: Macroeconomic Effects on Growth and Policy Options; Contribution to UNCTAD Secretariat to the G20 Commodity Markets Working Groups.

UNDP (2015). United Nations Development Program: Towards Human Resilience: Sustaining MDG Progress in an Age of Economic Uncertainty

Worako, T. K., van Schalkwyk, H. D., Alemu, Z. G., & Ayele, G. (2008). Producer price and price transmission in a deregulated Ethiopian coffee market. *Agrekon*, *47*(4), 492-508.